THE EMERGING DIGITAL ECONOMY

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FIGURES AND TABLES

INTRODUCTION

During the past few years, the United States economy has performed beyond most expectations. A shrinking budget deficit, low interest rates, a stable macroeconomic environment, expanding international trade with fewer barriers, and effective private sector management are all credited with playing a role in this healthy economic performance.

Many observers believe advances in information technology (IT), driven by the growth of the Internet,*[1] have also contributed to creating this healthier-than-expected economy.

In recent testimony to Congress, Federal Reserve Board Chairman Alan Greenspan noted, "...our nation has been experiencing a higher growth rate of productivity—output per hour—worked in recent years. The dramatic improvements in computing power and communication and information technology appear to have been a major force behind this beneficial trend."[1]

Some have even suggested that these advances will create a "long boom"[2] which will take the economy to new heights over the next quarter century.

Other economists remain skeptical about the contribution of the IT industry to overall productivity. As yet, there is limited direct evidence in government data that investments in IT have substantially raised productivity in many non-IT industries.[3]

While the full economic impact of information technology cannot yet be precisely evaluated, its impact is significant. IT industries have been growing at more than double the rate of the overall economy— a trend that is likely to continue. Investments in IT now represent over 45 percent of all business equipment investment. Declining prices for IT products have lowered overall inflation.

This report also begins a discussion about the potential impact on the economy of the Internet and electronic commerce.

Recent rapid growth of the Internet is in part attributable to its strength as a medium of communication, education and entertainment, and, more recently, as a tool for electronic commerce.

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* The Internet is a global matrix of interconnected computer networks using the Internet Protocol (IP) to communicate with each other. For simplicity, the term "Internet" is used throughout this paper to encompass all such data networks and hundreds of applications such as the World Wide Web and e-mail that run on those networks, even though some electronic commerce activities may take place on proprietary or other networks that are not technically part of the Internet.

Businesses in virtually every sector of the economy are beginning to use the Internet to cut the cost of purchasing, manage supplier relationships, streamline logistics and inventory, plan production, and reach new and existing customers more effectively.

Cost savings, increased consumer choice and improved consumer convenience are driving growth in the sale of physical goods and in the digital delivery of goods and services via the Internet.

Because the Internet is new and its uses are developing very rapidly, reliable economy-wide statistics are hard to find. Further research is needed. This report therefore uses industry and company examples to illustrate the rapid pace at which Internet commerce is being deployed and the benefits being realized. Examples showing the growth of the Internet and electronic commerce this past year are numerous:

- Fewer than 40 million people around the world were connected to the Internet during 1996. By the end of 1997, more than 100 million people were using the Internet.[4]

- As of December 1996, about 627,000 Internet domain names had been registered. By the end of 1997, the number of domain names more than doubled to reach 1.5 million.[5]

- Traffic on the Internet has been doubling every 100 days.[6]

- Cisco Systems closed 1996 having booked just over $100 million in sales on the Internet. By the end of 1997, its Internet sales were running at a $3.2 billion annual rate.

- In 1996, Amazon.com, the first Internet bookstore, recorded sales of less than $16 million. In 1997, it sold $148 million worth of books to Internet customers. One of the nation's largest book retailers, Barnes and Noble, launched its own online bookstore in 1997 to compete with Amazon for this rapidly growing online market.

- In January 1997, Dell Computers was selling less than $1 million of computers per day on the Internet. The company reported reaching daily sales of $6 million several times during the December 1997 holiday period.

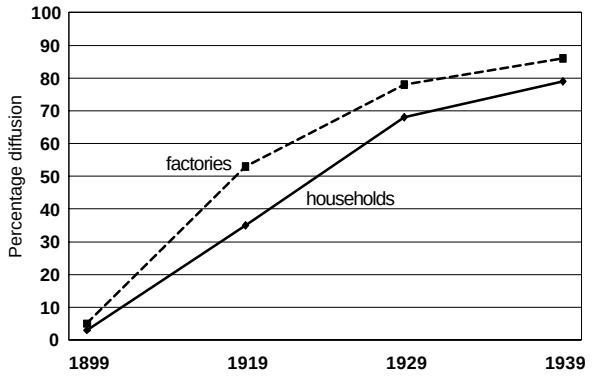
- Auto-by-Tel, a Web-based automotive marketplace, processed a total of 345,000 purchase requests for autos through its Web site in 1996, for $1.8 billion in auto sales. As of the end of November 1997, the Web site was generating $500 million a month in auto sales ($6 billion annualized) and processed over 100,000 purchase requests each month.

If the trends suggested by this preliminary analysis continue, IT and electronic commerce can be expected to drive economic growth for many years to come. To realize this potential, however, the private sector and governments must work together to create a predictable, market-driven legal framework to facilitate electronic commerce; to create non-bureaucratic means that ensure that the Internet is a safe environment; and to create human resource policies that endow students and workers with the skills necessary for jobs in the new digital economy.

CHAPTER ONE:
THE DIGITAL REVOLUTION

The Industrial Revolution was powered by the steam engine, invented in 1712,[7] and electricity, first harnessed in 1831.[8] Harnessing the power of steam meant less labor was needed for manual work; it also meant that factories could locate anywhere, not just in geographical areas with strong wind and water resources.

Figure 1. Diffusion of Electric Power in the U.S., 1899-1939



Factories - primary and secondary electric motor HP's as proportion of total mechanical drive in mfg.
Household - proportion of U.S. dwellings wired for electric lighting.
Source: David, Paul. "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox."

Because it required a network to contain and transmit its power, electricity's potential had to wait until 50 years after it was first harnessed before the first power station was built in 1882.[9] It took another 50 years before electricity powered 80 percent of factories and households across the country (Figure 1).[10]

Early uses of electricity were limited. While factories used generators for lighting, their primary power still came from line shafts and belt drives up to 1907. It was not until factories replaced the old power system for electric motors that fundamental changes in production occurred. Factory structures were streamlined, and key processes, such as materials handling and manufacturing flows, were made more efficient.[11]

The digital revolution is happening much more quickly. The harnessing of light for nearly instantaneous communications and the ability to use microscopic circuits to process and store huge amounts of information are enabling this current economic transformation.

In 1946, the world's first programmable computer, the Electronic Numerical Integrator and Computer (ENIAC), stood 10 feet tall, stretched 150 feet wide, cost millions of dollars, and could execute up to 5,000 operations per second. Twenty-five years later, in 1971, Intel packed 12 times ENIAC's processing power into a 12 mm^2 chip with a $200 price tag.[12] Today's personal computers (PCs) with Pentium processors perform in excess of 400 million instructions per second (MIPS). At the current pace of development, by 2012, PCs will be able to handle 100,000 million instructions per second.[13]

As late as 1980, phone conversations only traveled over copper wires which carried less than one page of information per second. Today, a strand of optical fiber as thin as a human hair can transmit in a single second the equivalent of over 90,000 volumes of an encyclopedia.[14] By 2002, a constellation of several hundred satellites orbiting hundreds of miles above the earth is expected to bring high-bandwidth[15] communications to businesses, schools and individuals everywhere on the planet.

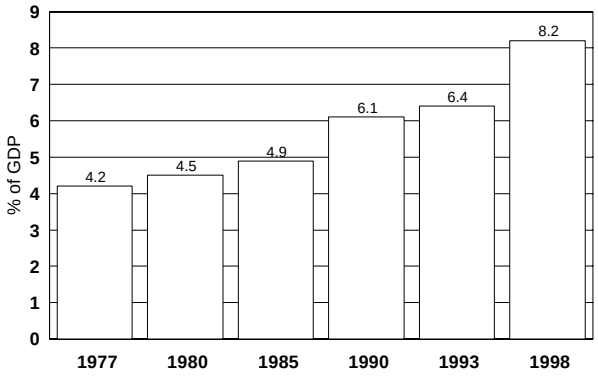
A global digital network using new packet switching technology[16] combines the power of these remarkable innovations in computing and communication. The Internet ties together the computing power on desks, in factories and in offices around the world through a high-speed communications infrastructure. More than 100 million people around the world, most of whom had never heard of the Internet four years ago, now use it to do research, send e-mail to friends, make requests for bids to suppliers, and shop for cars or books.

The Internet's pace of adoption eclipses all other technologies that preceded it. Radio was in existence 38 years before 50 million people tuned in; TV took 13 years to reach that benchmark. Sixteen years after the first PC kit came out, 50 million people were using one.[17] Once it was opened to the general public, the Internet crossed that line in four years.[18]

Growing Economic Importance of the IT Sector:

One of the most notable economic developments in recent years has been the rapid increase in the IT sector's (computing and communications) share of investment activity and of the gross domestic product (GDP). It grew from 4.9 percent of the economy in 1985 to 6.1 percent by 1990 as the PC began to penetrate homes and offices. The next spurt started in 1993, with the burst of commercial activity driven by the Internet. From 1993 to 1998, the IT share of the economy will have risen from 6.4 percent to an estimated 8.2 percent (Figure 2). With such rapid expansion, IT's share of total nominal GDP growth has been running almost double its share of the economy, at close to 15 percent.

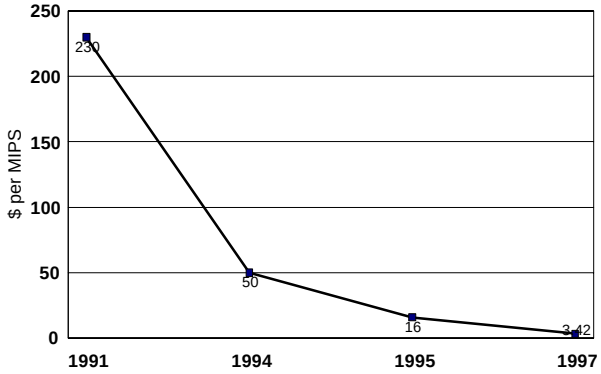
Figure 2. IT's Share of the Economy Grows



Source: U.S. Department of Commerce
Economics and Statistics Administration
Estimates based on Bureau of Economic Analysis and Census data

What makes this rise in IT's nominal share of the economy even more remarkable is the fact that IT prices, adjusted for quality and performance improvements, have been falling while prices in the rest of the economy have been rising.

Figure 3. Microprocessor Prices Plummet from $230 per MIPS to $3.42 per MIPS in 6 years

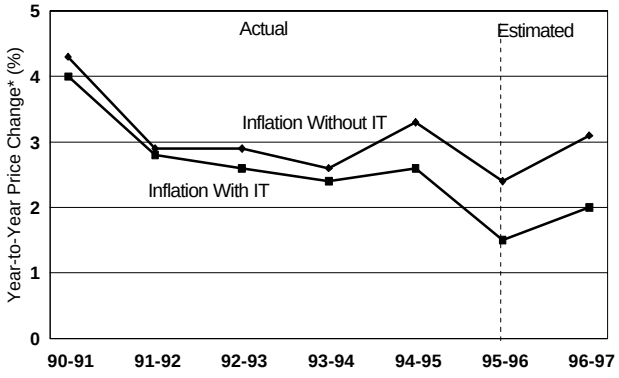


Source: Intel

Computing power has been doubling every 18 months for the past 30 years. At the same time, the average price of a transistor has fallen by six orders of magnitude, due to microprocessor development. In just six years' time, the cost of microprocessor computing power has decreased from $230 to $3.42 per MIPS (Figure 3). No other manufactured item has decreased in cost so far, so fast.[19]

In 1996 and 1997, declining prices in IT industries lowered overall inflation by one full percentage point (Figure 4). Without the contribution of the IT sector, overall inflation, at 2.0 percent, would have been 3.1 percent in 1997.

Figure 4. IT Industries Help to Keep Inflation Down

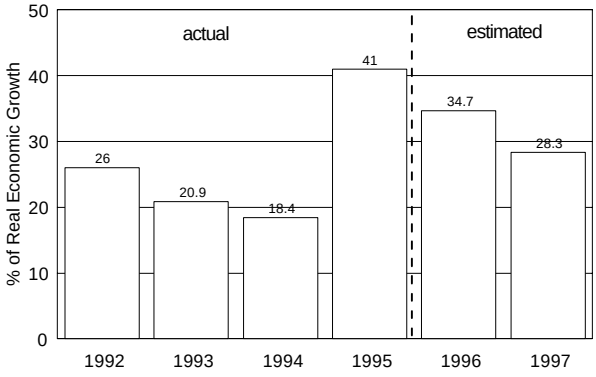


*As measured by the Gross Domestic Income Implicit Price Deflator

Source: U.S. Department of Commerce
Economics and Statistics Administration
Estimates based on Bureau of Economic Analysis and Census data

Thus, in real terms, the expansion of the IT sector accounts for an even larger share of overall economic growth in the mid-to late-1990s. In recent years, IT industries have been responsible for more than one-quarter of real economic growth (Figure 5).[20]

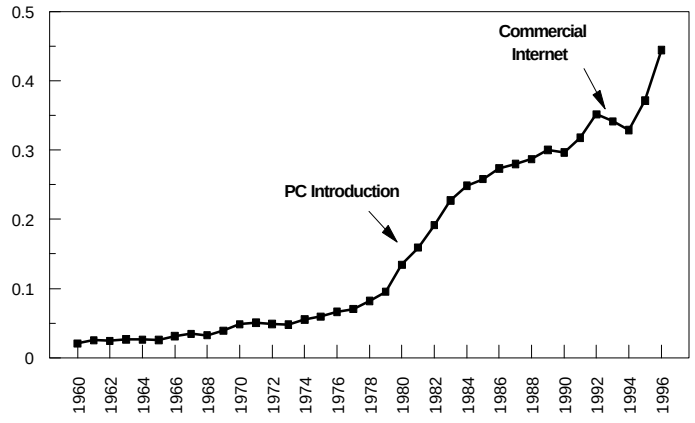
Figure 5. IT Contribution to Real Economic Growth



Source: U.S. Department of Commerce
Economics and Statistics Administration
Estimates based on Bureau of Economic Analysis and Census data

Companies throughout the economy are betting on IT to boost productivity and efficiency. In the 1960s, business spending on IT equipment represented only 3 percent of total business equipment investment. In 1996, IT's share rose to 45 percent (Figure 6). For some industries like communications, insurance and investment brokerages, IT equipment constitutes over three-quarters of all equipment investment.

Figure 6. IT's Share of Business Equipment Investment Grows Rapidly



Source: U.S. Department of Commerce
Bureau of Economic Analysis

* Inflation-adjusted investment in information processing equipment (office, computing, and accounting machinery, communications equipment, instruments, and photocopying equipment) as a share of total private equipment investment.

Information technology supports high-paying jobs. In 1996, 7.4 million people worked in IT industries and in IT-related occupations across the economy. They earned close to $46,000 per year, compared to an average of $28,000 for the private sector.

The impact of IT is also reflected in the capital IT firms currently represent. The collective market capitalizations of five major companies, Microsoft, Intel, Compaq, Dell and Cisco, has grown to over $588 billion in 1997 from under $12 billion in 1987,[21] close to a fifty-fold increase in the space of a decade.

Despite these impressive trends, the digital revolution is just beginning. Growth could accelerate in the coming years not only in the IT sector itself, but across all sectors of the economy as the number of people connected to the Internet multiplies and as its commercial use grows. The growth will be driven by four types of economic activity:

- ***Building out the Internet*:** In 1994, three million people, most of them in the United States, used the Internet.[22] In 1998, 100 million people around the world use the Internet.[23] Some experts believe that one billion people may be connected to the Internet by 2005.[24] This expansion is driving dramatic increases in computer, software, services and communications investments.

- ***Electronic commerce among businesses***: Businesses began using the Internet for commercial transactions with their business partners about two years ago. Early users already report significant productivity improvements from using electronic networks to create, buy, distribute, sell, and service products and services. By 2002, the Internet may be used for more than $300 billion worth of commerce between businesses.[25]

- ***Digital delivery of goods and services***: Software programs, newspapers, and music CDs no longer need to be packaged and delivered to stores, homes or news kiosks. They can be delivered electronically over the Internet. Airline tickets and securities transactions over the Internet already occur in large numbers. Other industries such as consulting services, entertainment, banking and insurance, education and health care face some hurdles but are also beginning to use the Internet to change the way they do business. Over time, the sale and transmission of goods and services electronically is likely to be the largest and most visible driver of the new digital economy.

- ***Retail sale of tangible goods***: The Internet can also be used to order tangible goods and services that are produced, stored and physically delivered. Though Internet sales are less than 1 percent of total retail sales today, sales of certain products such as computers, software, cars, books and flowers are growing rapidly.

CHAPTER TWO:
BUILDING OUT THE INTERNET

Where advances in telecommunications and computing largely occurred side-by-side in the past, today, they converge in the Internet. Soon, virtually all information technology investment will be part of interlinked communications systems, whether internal to a business, between businesses, between individuals and businesses, or individual to individual.

However measured, the Internet is expanding at a very rapid pace.

For instance, the number of Americans using the Internet has grown from fewer than 5 million in 1993 to as many as 62 million by 1997.[26]

UUNET, one of the largest Internet backbone providers, estimates that Internet traffic doubles every 100 days.[27]

The number of names registered in the domain name system grew from 26,000 in July 1993 to 1.3 million in four years. Over the same period, the number of hosts connected to the Internet expanded from under 1.8 million to over 19.5 million (Table 1).

Table 1. Growth of Internet Hosts and Domain Names*
(000s)

	# Hosts	# Domains
July 93	1,776	26
July 94	3,212	46
July 95	6,642	120
July 96	12,881	488
July 97	19,540	1,301

* Internet host refers to a computer that is connected to the Internet that has a unique Internet Protocol (IP) address. A domain name represents a record within the Domain Name System.

Source: Network Wizards http://www.nw.com

In January 1995, just over 27,000 top-level commercial (.com) domain names were assigned. Most businesses used them for little more than posting product and company descriptions, store locations, annual reports and information about how to contact corporate headquarters. Two and a half years later, commercial domain names number 764,000.[28] Static brochures and bulletin boards are giving way to full-fledged businesses offering financial services, news and information, manufactured goods, and travel and entertainment to individuals and businesses.

To meet this increased demand, consumer electronics companies, media giants, phone companies, computer companies, software firms, satellite builders, cell phone businesses, Internet service providers, television cable companies and, in a few cases, electric utilities, are aggressively investing to build out the Internet.

Hundreds of new firms are starting up around the country to help businesses use the World Wide Web effectively. They design Web sites and advertising banners, create Web-based catalogs, build security tools, create and track direct marketing campaigns, provide consulting services, and develop technology to speed the flow of data and information across the network. Venture capitalists gave just under $12 billion to hundreds of information technology start-ups in 1996 and 1997.[29]

Making the Internet Faster and More Accessible

Households typically connect to the Internet through a PC and a telephone line. This method of access means that most households without PCs (just under 60 percent of all U.S. households[30]) do not have Internet access. It also means that most Internet connections from the home are slow.[31] To illustrate the importance of speed, it takes 46 minutes to download a 3.5-minute video using a 28.8 kbps (thousand bits per second) modem, the modem most commonly used by households today (Table 2).

Table 2. Time to Download 3.5-Minute Video Clip Using Different Technologies

	Transfer Time
28.8 Kbps modem	46 minutes
128 Kbps ISDN	10 minutes
4 Mbps cable modem	20 seconds
8 Mbps ADSL	10 seconds
10 Mbps cable modem	8 seconds

Source: FCC, CS Docket No. 96-496, 1997; ADSL from Werbach 1997, p. 75.

Telephone companies, satellite companies, cable service providers and others are working to create faster Internet connections and expand the means by which users can access the Internet. New technologies such as ADSL (Asynchronous Digital Subscriber Line) enable copper telephone lines to send data at speeds up to 8 million bits per second (mbps). At this speed, that same 3.5 minute video takes 10 seconds to download.[32]

PC manufacturers and software developers are also taking steps to make home computers cheaper and easier to use.[33] Some PCs can now be purchased for less than $1,000 apiece. New network computers are expected to be introduced at prices of a few hundred dollars apiece. At the same time, new and enhanced software programs (for instance, better graphical user interfaces, search tools, and voice recognition technology) will make the PC and the Internet easier to use and thereby able to reach a broader community of consumers.

Soon, many Americans will be using their televisions to access the Internet. Present in nearly every household, TVs are easy to operate and require little or no maintenance. Digital broadcasting services (high-definition television, or HDTV) will be available in the top ten markets by November 1999, and broadcasters are expected to make the transition to digital

broadcasting by 2006.[34] With digital broadcasting, TV viewers will be able to interact with their televisions and surf the Web, pay bills, plan a weekend trip, or make dinner reservations. Already, satellite dishes and signals carried over cable television lines enable consumers to receive data from the Internet through their TVs and television programming through their personal computers. At speeds of 10 million bits per second, a household connected to the Internet via a cable modem can download a 3.5-minute video in 8 seconds.[35] In most cases today, however, the outgoing communication (the speed at which the Internet receives the commands by the user) is still limited to the fastest modem speeds that copper telephone wires will support.

Two-way cable traffic would be much faster, but only 9 percent of the 103 million cable subscribers in the U.S. and Canada (9 million homes) live in zones where two-way cable connectivity exists. And, only a small number of them—111,000—have actually subscribed to the service. By 2000, analysts estimate that two-way cable connectivity will be available to 34 million households, of which 1.6 million are expected to subscribe to the service.[36] Cable operators are planning to make significant investments in the next few years to upgrade their systems to carry two-way Internet traffic.

The wait for broadband Internet access to households is measured in years, not decades. Within the next five to ten years, the vast majority of Americans should be able to interact with the Internet from their television sets, watch television on their PCs, and make telephone calls from both devices. These combined services will be brought to homes by satellite, wireless, microwave, television cable and telephone lines, all interconnected in one overall system.

People will also access the Internet away from their homes or offices. Cellular telephones and portable digital assistants (PDAs) have become very sophisticated devices capable of sending faxes, receiving e-mail and electronic pages, and now, accessing the Internet. Industry experts predict that users of cellular phones and digital personal communications devices will more than triple from 77 million to 251 million by 1999.[37]

Technology already exists to enable many appliances and consumer electronics devices to transmit and receive data. The first products to link home appliances with PCs should become available this year. Entering a simple message into a computer on a desk will be able to turn off the television or pre-heat the oven for dinner. Automobiles with video monitors will receive data from overhead satellites to warn about traffic jams, give directions to the nearest gas station, and deliver the latest news and information.

The U.S. Government's FY 1999 budget calls for $850 million to be invested in high-performance computing and communications. As part of this effort, the budget provides $110 million for the Next Generation Internet Initiative, which will create a research network that is 100 to 1,000 times faster than today's Internet, and invests in R&D for smarter, faster networks that support new applications, such as telemedicine, distance learning and real-time collaboration.

Table 3. The Race to Build Out the Communications Infrastructure of the Internet

During the 19th and 20th centuries, governments played a key role in helping build or actively regulate much of the country's transportation, communication and energy infrastructure powering the Industrial Revolution. Although the Internet originated in U.S. Defense Department research, private sector investments will largely drive its future expansion.

Telecommunications: Manufacturers and software companies have been developing new technologies to allow higher-bandwidth communications across the existing copper network infrastructure, including DSL technologies, compression and faster electronic switches. Communications carriers around the world are building out fiber optic networks; technological advancements including optical amplification and new photonic switches make these high-speed networks more powerful and more efficient.

Satellite: Satellite, telecommunications, electronics and aerospace companies plan to spend close to $27 billion to build out a global broadband network in the sky between 1998-2002 to reach most of the two billion people that live in areas around the world where phone service is unavailable.

Cable: Thick cable wires pass more than 90 percent of U.S. households, piping in TV programming at speeds much faster than telephone copper carries voice traffic. Four years ago, many cable companies began to prepare the cable network for two-way Internet traffic, investing in fiber optic cable and set-top boxes to decipher voice, video and data sent in digital form.

Wireless: Over time, wireless networks will be integrated with the Internet. Investments in satellites and repeater stations are now being made at a rapid rate to accomplish this. Cellular phones, pagers and hand-held computers will be able to transmit and receive voice, data and Internet traffic.

Electric utilities: A number of utility companies around the country are beginning to lay thousands of miles of new fiber cable for Internet access at speeds ten times faster than today's high-speed phone connections.

As the number of Internet users grows, accessing the Internet becomes faster and easier to do, and as the number of Internet-enabled devices multiplies, the IT industry's share of the economy can be expected to continue to expand rapidly.

CHAPTER THREE:
ELECTRONIC COMMERCE BETWEEN BUSINESSES

Internet commerce is growing fastest among businesses. It is used for coordination between the purchasing operations of a company and its suppliers; the logistics planners in a company and the transportation companies that warehouse and move its products; the sales organizations and the wholesalers or retailers that sell its products; and the customer service and maintenance operations and the company's final customers.

Early computers were used for scientific and military purposes, not for commerce. They first made their way into commercial applications in the 1960s, with ERMA (the Electronic Recording Machine—Accounting). Banks were swamped with the growing volume of checks that needed to be processed (between 1943 and 1952, check use had doubled from 4 billion to 8 billion checks written each year). By automating the function with ERMA, the first bank to use the computer, Bank of America, reported that nine employees could do the job that previously took 50 people.[38]

The commercial use of computers quickly spread as companies in a variety of industries used them to keep accounting ledgers, administer payroll, create management reports, and schedule production.

In the 1970s and 1980s, businesses extended their computing power beyond the company's walls, sending and receiving purchase orders, invoices and shipping notifications electronically via EDI (Electronic Data Interchange). EDI is a standard for compiling and transmitting information between computers, often over private communications networks called value-added networks (VANs). The 1980s also brought the introduction of computer-aided design (CAD), computer-aided engineering (CAE) and computer-aided manufacturing (CAM) systems that enabled engineers, designers and technicians to access and work on design specifications, engineering drawings and technical documentation via internal corporate communications networks.

The cost of installation and maintenance of VANs put electronic communication out of the reach of many small and medium-sized businesses. For the most part, these businesses relied on the fax and telephone for their business communications. Even larger companies that used EDI often did not realize the full potential savings because many of their business partners did not use it.

The Internet makes electronic commerce affordable to even the smallest home office. Companies of all sizes can now communicate with each other electronically, through the public Internet, networks for company-use only (intranets) or for use by a company and its business partners (extranets), and private value-added networks.

Companies are quickly moving to utilize the expanded opportunities created by the Internet. For instance, Cisco Systems, Dell Computers and Boeing's spare parts business report almost

immediate benefits after putting their ordering and customer service operations on the Internet. They are so convinced of its benefit to their own companies and their customers that they believe most of their business will involve the Internet in the next three to five years.[39]

Although still in an embryonic stage, analysts predict businesses will trade as much as $300 billion annually over the Internet in the next five years.[40] Some believe the volume of Internet commerce will be much higher. As statistically valid sampling data are not yet available, determining the actual growth rate is very difficult to do. This report does not attempt to size the current market or predict the size of the future market. Instead, it describes the underlying drivers of growth of business-to-business electronic commerce, using specific company and industry examples as illustrations.

Growth of business-to-business electronic commerce is being driven by lower purchasing costs, reductions in inventories, lower cycle times, more efficient and effective customer service, lower sales and marketing costs and new sales opportunities.

LOWER PURCHASING COSTS

Buying materials or services for a corporation can be a complex, multi-step process. First, purchasers have to find suppliers who make the product and determine whether they meet volume, delivery, quality and price requirements. Once a potential supplier has been chosen, detailed drawings and information are transmitted to the supplier so that the product is built to exact customer specifications. Assuming the product sample has been approved and the supplier's manufacturing lines are ready for production, the buyer then transmits a purchase order (P.O.) for a specific quantity of goods. The buyer, meanwhile, receives notification from the supplier that the P.O. was received and confirmation that the order can be met. When the product ships from the supplier, the buyer again receives notification, along with an invoice for goods delivered. The buyer's accounting department matches the invoice with the P.O. and pays the invoice. When changes to the normal order happen—a frequent occurrence in most companies—the process can be much more complicated.

Companies lower procurement costs by consolidating purchases and developing relationships with key suppliers to benefit from volume discounts and tighter integration in the manufacturing process. They also cast a wide net for lower-cost sources of supply.

Large companies have been using EDI over private networks to reduce labor, printing and mailing costs in the procurement process. Automating routine procurement means the procurement staff has more time to focus on negotiating better prices and building supplier relationships. Analysts estimate that businesses already trade well over $150 billion in goods and services using EDI over VANs.[41] Companies using EDI commonly save 5-10 percent in procurement costs.[42]

The Internet has the potential to further reduce procurement costs. Large companies benefit from lower transmission costs versus private networks. The Internet also opens the door to doing

business electronically with new suppliers and with small and medium-sized suppliers who formerly communicated only via fax or phone. Small companies also benefit. The Internet reduces processing costs and opens up new sales opportunities from potential buyers that post requests for bids on the Internet.

Procurement via the Internet is new enough that projecting economy-wide savings or other benefits is difficult. Specific company examples suggest that its potential is large and growing. For instance, General Electric's lighting division reports significant gains in responsiveness, improved service, and reduced labor and material costs as a result of shifting purchasing from a largely manual system to an electronic one using Internet protocols.

Factories at General Electric's lighting division used to send hundreds of requisitions for quotes (RFQs) to the corporate sourcing department each day for low-value machine parts. For each requisition, the accompanying blueprints had to be requested from storage, retrieved from the vault, transported on site, photocopied, folded, attached to paper requisition forms with quote sheets, stuffed into envelopes and mailed out. The process took at least seven days and was so complex and time-intensive that the sourcing department normally only sent out bid packages to two to three suppliers at a time.

In 1996, GE Lighting piloted the company's first online procurement system, TPN Post, an extranet developed by GE Information Services. Now, the sourcing department receives the requisitions electronically from its internal customers and can send off a bid package to suppliers around the world via the Internet. The system automatically pulls the correct drawings and attaches them to the electronic requisition forms. Within two hours from the time the sourcing department starts the process, suppliers are notified of incoming RFQs by e-mail, fax or EDI. A bid can be evaluated and awarded the same day GE receives it.

Previously, more than one out of four invoices had to be investigated and "reworked" to reconcile them with purchase orders and receipts. With the transaction handled electronically from beginning to end, invoices are now automatically reconciled with purchase orders, reflecting any modifications that happen along the way.

According to GE, the division's labor costs for procurement have declined by 30 percent. Sixty percent of the procurement staff have been redeployed. The sourcing department has at least six to eight additional days a month to concentrate on strategic activities rather than the paperwork, photocopying and envelope stuffing it had to do when the process was manual.

Material costs have declined by up to 20 percent as the ability to reach a wider base of suppliers online created more competition and led to lower prices.

As of October 1997, eight divisions of General Electric use TPN for some of their procurement. The company bought more than $1 billion worth of goods and supplies via the Internet in 1997. By 2000, GE aims to have all 12 of its business units purchasing its non-production and maintenance, repair and operations materials (MRO) via the Internet, for a total of $5 billion. GE

estimates that streamlining these purchases alone could save the company $500-$700 million over the next three years.[43]

Other companies report plans to use the Internet for procurement. One out of four purchasing managers expects to use the Internet for MRO purchases, up from 10 percent who use it for that purpose today.[44]

REDUCED INVENTORY/THE RIGHT PRODUCTS IN STOCK

The longer it takes for production schedules to reach suppliers, the more inventory a company has to hold to account for delays and errors, and the less quickly it can react to changes in demand.

The more inventory a company holds, the higher its operating costs, and the lower its profits. Carrying more inventory does not ensure better customer service, either. Shelves weighed down with size-10 running shoes do not help the customer who wears a size 8. When a customer enters a furniture showroom looking for an armchair with green and white stripes and is told it's on back-order for 12 weeks, he may drive across town to a competitor rather than wait.

Managing inventory properly results in better service for the customer and lower operating costs for the company. Increasing the frequency of inventory "turns" (the number of times inventory in existing warehouse or store space is sold or used for production each year) reduces inventory-related interest, handling and storage costs. Reducing inventory levels also means that existing manufacturing capacity is more efficiently utilized. More efficient production can reduce or eliminate the need for additional investments in plant and equipment.

IBM's Personal Systems Group provides an illustration of how the Internet and private networks are helping companies keep stocks of inventory smaller, yet more targeted on likely consumer needs.

Each month, the group's marketing departments report information on how many PCs they think will be sold. The production planning departments identify manufacturing and materials capacity in each factory. Armed with inputs from across the company on demand and supply, production schedules are assigned to each factory. The procurement staff uses the same information to negotiate with suppliers. As new information comes in each week, the process is repeated and the production schedule fine-tuned.

Electronic communication between factories, marketing and purchasing departments have made this quick response possible. Problems are communicated as they arise and the appropriate adjustments are made. If demand suddenly rises or if one factory cannot meet its production schedule, IBM is aware of it in time to increase production at another factory.

The Personal Systems Group has been phasing in this Advanced Planning System (APS) since 1996 and already reports significant results. During the first year of APS, inventory turns

increased 40 percent over the previous year, and sales volumes increased by 30 percent. The group anticipates another 50 percent increase in turns and a 20 percent increase in sales volume in 1997. By better utilizing its existing manufacturing capacity, IBM has avoided having to make additional investments to meet the increased volume requirements. The lower investment and operating costs due to improved inventory turns have resulted in savings of $500 million.

IBM is not alone in its efforts to use networks to improve communication between the marketing and sales arm of a business and its production units. Manufacturers, wholesalers and retailers are working together to form standards and guidelines for better forecasting and restocking called Collaborative Planning Forecasting Replenishment (CPFR). These standards will allow companies to collaborate in determining future demand for products and to share information about the availability of products in stock.

With CPFR, a retailer and its supplier electronically post their latest sets of forecasts for a list of products. A server tied to the Internet compares the forecasts and flags differences in those that exceed a normal safety margin—say 5 percent. Differences are then reconciled by planners at both the retailer and the supplier. To keep that process from becoming too cumbersome, software companies are working to develop programs that automatically handle exception messages based on rules that apply to that business.[45] The accounting and consulting firm Ernst & Young believes that CPFR could yield an inventory reduction of $250 billion to $350 billion across the economy. By reducing inventory levels, businesses will realize substantial savings in materials handling, warehousing, and general administrative costs.[46]

LOWER CYCLE TIMES

Cycle time is the total time it takes to build a product. There are certain fixed costs associated with building any product that do not vary with the amount of production, but rather are time dependent. These "fixed" costs include depreciation of equipment, most utility and building costs, and most managerial and supervisory time. If the time to build a product can be reduced to seven days instead of ten, then the fixed costs per product are lower since less time was needed. Electronic commerce allows "cycle times" to be shortened, allowing more to be produced for the same or lower costs.

In the 1980s, the lower cycles times realized by Japanese companies presented American companies with a serious competitive challenge. They responded by breaking down organizational barriers that had grown up between design, manufacturing and sales divisions and improving communications with external partners.

Establishing electronic links with their large suppliers and customers enabled companies to transmit and receive purchase orders, invoices and shipping notifications with much shorter lead times than previously. Some also began to share product specifications and drawings over value-added networks to speed product design and development.

The Internet will permit even further reductions by broadening the network of businesses connected electronically and by facilitating collaboration on projects across work teams and geographical locations.

Few industries faced a greater challenge to reduce cycle times than the automotive industry in the early 1980s. While Japanese automakers could take a car from concept to mass production in approximately three years, American companies typically took four to six years.

First, a full-scale clay model was built to see how the vehicle would look in real life. Incorporating changes to the model could take months. Once approved, single- or multiple-prototype vehicles were built by hand to see whether parts fit together correctly and whether the car could be built economically. Engineers worked with the prototype builders to refine the engineering specifications. Once the prototype was ready, the engineers would design the individual components and the tooling needed to make the components. Then, purchasing agents would work with suppliers to produce prototype tooling and parts for assembly of pilot or pre-production vehicles. If everything went smoothly, the manufacturing-engineering team would then assemble the vehicle to discover any assembly problems. Finally, after additional modifications, the vehicle was mass produced.[47]

Today, all parties involved in designing a new platform or vehicle—designers, engineers, suppliers, and manufacturing and assembly personnel—work as part of a team, contributing to the process from beginning to end. As a result of computerization, steps that used to take weeks or months can now be done in a matter of days. Sharing information electronically allows the different members of the group to work on projects together, rather than having to wait for each member to finish his step before the next one can be taken. Through the use of computer-aided design (CAD), computer-aided manufacturing (CAM) and computer-aided engineering (CAE), the whole team can share computer files and use 3-D modeling techniques to design the vehicle and see how parts fit without building prototypes by hand. Changes to the components can be made without building sample tooling and parts.

When the final design is agreed on, CAM data is loaded into machines that build the tooling and prototype parts. The same techniques are being used to reconfigure and retool assembly plants. Working as a team and sharing information electronically has cut the time it takes to develop and build a new vehicle to about 30 months.[48]

Automotive companies now want to shorten the design cycle to less than 24 months by setting up platform teams in different parts of the world and linking them electronically. By using global communication links, engineers in Detroit can assign a problem to engineers on their team in India. With the time zone difference, the engineers in the Far East can work on the problem and get an answer back to their Detroit counterparts by the next business day.[49]

Cycle times are also being shortened for production. Before the use of EDI, automotive companies communicated production requirements and schedules to their suppliers by phone, fax or mail. This meant time-consuming manual data entry, photocopying and information hand-offs

from one supplier to another. It could take several weeks to get the manufacturing schedule and requirements to all component factories and vendors. To minimize the impact of delays and errors caused by miscommunication, the assembly plant kept a large inventory of parts on-hand.

Today, automobile manufacturers and their large suppliers communicate production and scheduling requirements via EDI. The assembly plant electronically sends the supplier an 8- to 12-week forecast or build plan. Daily production requirements detailing the number of parts needed at each plant at specific scheduled times are also communicated electronically. When the parts are ready and loaded in the trailer, the supplier notifies the assembly plant that the parts are on their way. The plant schedules its lines to coincide with the arrival of the trailers. By changing its assembly process to take advantage of the more accurate and timely information they receive electronically, most North American assembly locations turn inventory 130 times per year, up from 7 to 10 times per year in the past.[50]

In January 1994, Chrysler, Ford, GM, Johnson Controls and 12 of their suppliers began working together as part of the Manufacturing Assembly Pilot (MAP) to further improve material flow within a pilot four-tier seat assembly supply chain. At the project's outset, it took four to six weeks for material release information to reach the bottom of the supply chain. Along the way, information was distorted and truncated. The resulting late, inaccurate and untrusted information cost millions of dollars in the form of "just-in-case" inventories, premium freight, unplanned set-ups and changeovers, and other inefficiencies.

By electronically connecting the MAP participants, production schedules reached the bottom of the supply chain in less than two weeks. On-time shipments improved 6 percent. Error rates were reduced by 72 percent. Up to eight hours per week per customer was saved in labor costs.

Connecting all levels of suppliers through the entire industry via EDI could save nearly $1.1 billion annually—a cost savings of $71 or more per car—and decrease information lead-time to just one day between each tier of the supply chain.[51]

The automotive industry is now investing in a new venture, the Automotive Network Exchange (ANX), a managed "virtual private network" that runs over the Internet and links manufacturers and suppliers worldwide. ANX will electronically link those suppliers who still communicate to the automotive manufacturers by fax, phone and mail. And, it will replace the thousands of direct dial connections with a single network, considerably lowering the transmission costs borne by the manufacturers and the suppliers. Scheduled to be fully implemented by 2000, the network will electronically route product shipment schedules, CAD files for product designs, purchase orders, payments and other business information. Participating automobile manufacturers believe that ANX has the potential to reduce the product development and manufacturing cycles even further, as well as improve many other key business processes.

The results achieved by the auto industry through EDI can be, and are being, replicated in many other industries. Because of its low cost and ease of use, the Internet will help accelerate the pace at which businesses communicate with each other electronically and the benefits they can realize.

MORE EFFICIENT AND EFFECTIVE CUSTOMER SERVICE

Companies are beginning to use the Internet for customer service. Having product descriptions, technical support and order status information online not only saves money by freeing up a company's own customer service staff to handle more complicated questions and manage customer relations, it can also lead to more satisfied customers.

Companies have long gathered and stored information about customers and products in databases that only certain authorized employees can access. Innovative businesses are finding ways to tap the potential of that information, making it available to those who need it most—whether it's a customer service representative answering a phone call or a customer looking for account information or technical support online.

Few things are more frustrating to a customer than uncertainty about when an important purchase will arrive. Too often, phone calls to a supplier result in a series of transfers from one department to another and an eventual promise to check on the status of the order and to call the customer back. This pattern consumes time and money for the customer and the seller.

Delivery companies are helping their business partners solve this problem via the Internet. A customer can go to the company's Web site, enter his order number, and find out that the product is already on a FedEx or a UPS truck and is expected to arrive the next morning. This information can be retrieved from the company's Web site in less than a minute.

In addition to improved customer satisfaction, companies using the Internet for customer service report savings from putting order tracking, software downloads and technical support information online. For instance, Cisco reports that its customer service productivity has increased by 200 to 300 percent, resulting in savings of $125 million in customer service costs. Dell estimates that it saves several million dollars a year by having basic customer service and technical support functions available on the Internet.

LOWER SALES AND MARKETING COSTS

An individual sales person can support as many customer accounts as he can physically visit or contact by telephone. Therefore, as the number of accounts increases, so does the size of the sales force. Even direct marketing companies increase staffing as telephone order volume increases. By contrast, a Web business can add new customers with little or no additional cost. Because its sales function is housed in a computer server rather than physical store locations or sales people, its reach is bounded only by the capacity of the servers to respond to inquiries and orders.

The Internet can also make traditional sales organizations, layered distribution channels, catalog sales and advertising more efficient. With automated ordering capabilities, sales representatives no longer have to prepare time-consuming manual orders. Instead, they can spend time building

and maintaining customer relationships. Electronic catalogs present far more information and options than their paper counterparts. Direct marketing online can shorten repurchase cycles and increase the ability to sell additional items.

Some recent business examples suggest the potential of the Internet as an efficient sales tool.

Boeing's spare parts business debuted its PART Page on the Internet in November 1996, allowing its airline customers around the world to check parts availability and pricing, order parts, and track the status of their orders. Less than a year later, about 50 percent of Boeing's customers use the Internet for 9 percent of all parts orders and a much larger percentage of customer service inquiries. The Boeing spare parts business processes about 20 percent more shipments per month in 1997 than it did in 1996 with the same number of data entry people. And, because customers can satisfy many service requests online, as many as 600 phone calls to customer service representatives are avoided each day.

Cisco builds virtually all its products (routers, switches and other network interconnect devices) to order, so there are very few off-the-shelf products. Before the company established an Internet sales capability, ordering a product could be complicated. Generally, an engineer at the customer site knew what type of product was needed and how it should be configured. The engineer communicated this information to his procurement department who then created the purchase order and sent it to Cisco via fax, phone or e-mail. A Cisco customer service administrator entered the order into Cisco's system. If the order went through "clean", it would be booked and production scheduled within 24 hours. Nearly one out of four orders didn't get a "clean" bill of health, however. Instead, when Cisco's system tried to validate the order, it discovered an error in how the product was configured. The "dirty" order would be rejected, the customer contacted and the procurement cycle would begin again.

In July 1996, Cisco rolled out its Web-based ordering and configuring system. Today, that same engineer can sit down at a PC, configure the product online, know immediately if there are any errors, and route the order to the procurement department. Because the customer's pricing structure is already programmed into the Cisco site, the authorized purchaser can complete the order with a few keystrokes. And, rather than calling Cisco to find out the status of the order, invoice or account information, a customer with the proper authorization can access the information directly on the Web site. With the online pricing and configuration tools, about 98 percent of the orders go through the system the first time, saving time both at Cisco and the customer's site. Lead times have dropped two to three days, and customers' productivity has increased an average of 20 percent per order.

NEW SALES OPPORTUNITIES

The Internet operates around the clock and around the world. As a result, businesses on the Web can reach new markets they could not reach effectively with an in-person sales force or advertising campaigns.

For instance, a plastics commodity specialist at a large manufacturer can sit down at his PC, click on a Web browser and search for suppliers selling industrial plastics online. A small supplier with a limited sales force can now reach that buyer, getting its first introduction online. Similarly, a vendor's sales force may not be able to reach the millions of home offices and small offices around the country. By having an online presence and creating customized services for the small business market, that vendor may develop a new, lucrative market, both within the U.S. and globally.

Companies using the Internet to sell products find that they attract new customers. For example, eighty percent of the consumers and half of the small businesses who purchased from Dell's Web site had never purchased from Dell before. One out of four say that if not for the Web site, they would not have made the purchase. And, their average purchase value is higher than Dell's typical customer.

W.W. Grainger, the leading distributor of MRO supplies in North America, describes similar results. The company launched its Web business in the spring of 1995. Today, more than 30 percent of the company's online sales are to new customers or incremental sales to existing customers. Because the virtual store is open seven days a week, 24 hours a day, customers who wouldn't otherwise be able to order from a Grainger store are now able to do so. In fact, more than 50 percent of all orders are placed after 5 PM and before 7 AM when the local store is closed.

THE FUTURE

Businesses that use the Internet to buy, sell, distribute and maintain products and services are realizing significant cost savings and increased sales opportunities. And, the benefits only increase as the network of businesses conducting electronic commerce grows.

Investments are already taking place to realize the $300 billion in business-to-business Internet commerce analysts predict by 2002.[52] Three of the companies discussed in this chapter—Cisco, Dell and General Electric—were responsible for about $3 billion in Internet commerce in 1997. If their current projections prove accurate, these three companies alone will conduct more than $17 billion in Internet commerce within three to five years.[53] The experiences of these and other companies are quickly spreading through the rest of U.S. industry through conferences and consulting firms who assist companies to design and implement Internet-based business solutions. Even at $300 billion, Internet commerce will only represent 3 percent of total GDP.[54] This means that the greater efficiencies companies are experiencing from electronic commerce are likely to continue to diffuse through the U.S. economy for decades to come.

Meeting legal and technical hurdles

Businesses have raised three potential inhibitors to the widespread adoption of Internet commerce: the lack of a predictable legal environment, concerns that governments will overtax the Internet, and uncertainty about the Internet's performance, reliability and security.

For a business to feel comfortable about using the Internet in communications with its suppliers and customers, it needs to be sure of the identity of the party at the other end of the transaction and that any agreement made electronically is binding.

Today, a business verifies identities with passwords, electronic signatures and Internet Protocol (IP) addresses. Initiatives are currently underway to develop a more effective system of digital certification and authentication. The U.S. Government is promoting the development of an international convention to legally recognize digital authentication.

The U.S. government also supports the development of both a domestic and global uniform commercial legal framework that will recognize, facilitate and enforce electronic transactions worldwide. Internationally, the U.S. government is working with the United Nations Commission on International Trade Law (UNCITRAL) which has completed work on a model law that supports the commercial use of international contracts in electronic commerce. The government is also encouraging the work of the International Chamber of Commerce which has issued model commercial code guidelines.

Companies are also concerned about the potential for excessive taxation of the Internet. The U.S. Government believes that no new discriminatory taxes should be imposed on Internet commerce. It also believes that no customs duties should be imposed on electronic transmissions. The application of existing taxation on commerce conducted over the Internet should be consistent with the established principles of international taxation, should be neutral with respect to other forms of commerce, should avoid inconsistent national tax jurisdictions and double taxation, and should be simple to administer and easy to understand.

Some companies express concern about the Internet's current technical limitations. Those who conduct EDI transactions over VANs have the confidence and experience that important information will arrive at its destination, on schedule, intact. If any problems do arise, a single network service provider is accountable and responsible for resolving them.

Companies expecting this level of service worry that the Internet offers no such guarantees. Because it is a public network that connects many smaller, interconnected networks and service providers, there is no single entity responsible for ensuring that a message leaves one point and arrives, intact, at another. And, because companies have a need to transmit confidential information, they want assurance that it remains secure.

Companies are taking different approaches to address the current technical limitations. Some use the Internet to purchase lower-value, indirect materials while keeping their higher-value, direct material purchases over VANs. Some rely on extranets, or "virtual private networks," that limit access to a certain pre-qualified set of businesses and their partners.

Sophisticated encryption products and firewalls are being used by some companies to protect privacy and ensure the security of Internet transactions. Many others await a resolution of current export limitations on encryption software before they plan to increase their Internet business.

The automotive industry's ANX is an example of an extranet that will provide automotive trading partners with a single, secure network for electronic commerce and data transfer. The industry has created a management structure and business rules to ensure that the network meets the performance, reliability and security requirements the industry has put forward. The ANX Overseer, Bellcore, has direct operations and management responsibilities over the network. Participating Internet Service Providers and Network Exchange Points have been certified and will operate according to the terms of the ANX. A common set of business practices, including "acceptable use" policies and common network level security methods are additional conditions of participation in the ANX.

Businesses will pursue alternatives most suitable for their immediate business requirements. For some, standard off-the-shelf solutions running over the public Internet are satisfactory. For others, customized solutions—along with explicit rules and operating procedures—may be the answer.

As the Internet's performance and reliability improves over time, and as predictable legal frameworks emerge, the growth of business-to-business electronic commerce will accelerate.

CHAPTER FOUR:
DIGITAL DELIVERY OF GOODS AND SERVICES

Software, CDs, magazine articles, news broadcasts, stocks, airline tickets and insurance policies are all intangible goods whose value does not rely on a physical form. Much of today's intellectual property is produced, packaged, stored somewhere and then physically delivered to its final destination. The technology exists (or soon will exist) to transfer the content of these products in digital form over the Internet.

CONTENT

News from around the world is now available on the Internet, usually free of charge. More than 2,700 newspapers have online businesses, of which over 60 percent are U.S.-based.[55] All but three of the top 50 magazines in the country (as defined by paid circulation) had a Web presence as of January 1998.[56] More than 800 TV stations across the U.S. have Web sites.[57] UltimateTV.com lists 151 U.S. cable channels including CNN, fX, HBO, MTV, the Weather Channel and a host of others.[58] AudioNet calls itself the leader in Internet broadcasting, with live continuous broadcasts of over 175 radio and television stations, play-by-play of thousands of college and professional sporting events, live music, on-demand music from the CD Jukebox (over 1,600 full-length CDs), live and on-demand shows and Internet-only Webcasts and live and on-demand corporate and special events.

The rapid emergence of information services on the Internet is being driven by consumer demand, more effective distribution, and an expected shift in advertising revenues away from traditional media to the Internet.

Consumer Demand

Nearly 90 percent of Web users go online to get news and information.[59] There, they can find obscure or limited circulation journals online as well as the top sellers. Articles limited to text and perhaps a picture in a print edition may be supplemented in the online version with video or audio clips, maps or in-depth background research.

Still somewhat difficult to navigate, the Internet's wide selection of content sites save individuals time when conducting research, and yield much more complete and up-to-date information than offline alternatives. As technology advances and search tools become easier to use, individuals can be expected to increasingly turn to the Internet's content sites to do research, to learn about the day's news, and to be entertained.

How quickly individuals change their behavior in favor of the Internet, and away from other media, is difficult to determine. Recent studies indicate that as use of the Internet increases, television viewing declines.[60] However, some of today's Web businesses point out that circulation for their existing newspapers and magazines has not dropped, even while their Web audiences increase. They state that some in the online audience are also found among their most loyal print readers, but look to each medium to satisfy different purposes. For instance, *Business Week* reports that visitors to its Web site read the front page article and then use the site to research the magazine's archives and special report sections, features they do not have in the print version.

It may take a number of years before the impact is felt. For instance, McGraw-Hill's financial information services division began to distribute its products electronically over ten years ago. Up until three years ago, print revenues made up 85 percent of the division's sales. Today, digital products account for more than 50 percent of sales.

Lower Capital and Distribution Costs

The New York Times invested $350 million in its new printing press. Readers can now see front-page photos in color instead of black and white. Readers accessing the *New York Times* on the Web not only see color photos from the print version's front page, they get radio clips, color spreads on special feature sections for the Web only, and the chance to interact with other *New York Times* readers interested in the day's or week's hot topics.

Web content businesses require a much lower capital investment than their print counterparts, lowering the barrier to entry in this online industry. With the Internet, the content of a newspaper or a magazine does not have to be printed and delivered to news stands or doorsteps across the city in order to be consumed—steps that add 30 to 40 percent to the cost of the product.

Instead, content delivered via the Internet can be entered directly into a computer, stored digitally on a server and appear directly on a reader's computer screen with a few simple commands the reader enters on the Web site. The consumer can then read the information on the screen or print it out. The publisher's distribution costs include paying off the investment in the Web servers and other technology that ensures that when someone enters the site, it responds quickly. Unlike newspaper or magazine content that gets used once, digitally-stored content offers the potential for repeated repackaging and reuse. Once the content has been created and stored, there is little or no extra cost to send it to one reader or 1,000 readers. That increases the efficiency of the newspaper and magazine businesses dramatically.

However, simply establishing a presence on the Internet does not guarantee that a business will succeed. Building brand awareness through advertising and marketing is critical to success in a new and rapidly evolving market, particularly on the Internet where consumers have the choice of spending their time and money at thousands of different sites. If the Internet evolves in such a way that a limited number of sites become the "funnel" that guides a viewer through its vast content, businesses looking to appeal to mass audiences may have to pay large fees to secure "shelf space" on those sites. Or, they may be excluded altogether. In this scenario, advertising

and marketing costs may become too expensive for some to bear. If, on the other hand, technology and consumer preference evolves so that consumers access and navigate the Internet using a variety of devices and tools (perhaps personal software "agents"), then high rents might be avoided.

Statistics on Web traffic indicate that the "funnel" model is winning out today. Over time, as people begin to access the Web via their TVs, telephones and personal digital assistants, and as the Web becomes easier to navigate, this may change and lower advertising and marketing costs may result.

Shift of revenue sources to the Internet

Even with their lower costs of operation, content businesses on the Web do not yet generate adequate revenues. Unlike newspapers and magazines that rely on subscriptions for some of their revenue, most Web businesses currently shy away from charging subscriptions in favor of building an audience and attracting advertising and direct marketing/transactions revenues. Though growing, these revenue sources are still small.

At this early stage of development, it is unclear how quickly Internet content businesses will draw readers or viewers away from traditional media sources such as newspapers, magazines and television. As it happens, advertising and subscription revenues flowing to the Internet are likely to increase. Even if the total audience for a newspaper or a TV sitcom does not decline, advertisers may shift spending to the Internet if they feel that it provides a more effective means to reach their audiences.

Current trends in classified and local advertising spending indicate a shift already taking place. Newspapers have been watching their share of classified advertising dollars shrink as real estate agents, car dealers and owners, and businesses looking to hire employees increase their advertising in niche publications, direct mail and online services. A 1996 Newspaper Association of America study points out that newspaper publishers could lose as much as 50 percent of their classified ad dollars in the next five years if current trends continue. If that happens, the average newspaper's operating margin, now 14 percent, would drop to 3 percent.[61] To maintain revenues from classifieds and to attract local advertising dollars, newspapers have been quick to establish Web sites featuring classified ads and city guides.

Other industries are also seeking a share of classified and local advertising revenues. Software companies, telephone companies, Internet service providers, television networks and newspapers are gearing up to compete for a share of this potentially large market. A New York-based research firm, Find/SVP, reported that more than 60 corporations ranging from Warner Brothers and PacTel to NBC and U.S. West have launched, or are in the process of organizing, Web sites with a strong emphasis on local content.[62]

Software companies and search engines feature city guides listing movies and restaurants, arts and music, current events, places to go, local sports, weather and news. Some broadcast and cable networks combine coverage of national news and entertainment with local news from affiliates and searchable databases of online classified ads. Directory listings and mapping services partner with newspapers, software companies and others to offer their own city guides. Telephone companies have their own directory listings and mapping services and are partnering with others for real estate listings, restaurant guides, and other local information and services.

Analysts project significant growth in revenues available for online content businesses. Forrester Research predicts that revenues from advertising, subscriptions and transactions fees will grow to $8.5 billion within five years,[63] or almost 5 percent of the $175 billion advertisers spent in newspapers, TV, radio, direct mail, billboards, and other traditional media in 1996.[64]

TRAVEL

Vacationers and business travelers can now find information on the Internet about cities they plan to visit, from driving directions and recommended itineraries to weather patterns and business telephone numbers and addresses. Many hotels have detailed property descriptions, along with photos of the property's grounds, public rooms and bedrooms. Rental cars can be reserved online. Top travel magazines offer online suggestions for the best week-end getaways.

The largest initial online travel business is the sale of airline tickets. Web-based travel services offer the reservations engines that airline customer service representatives and travel agents use directly to leisure and business travelers. Customers enter point-to-point destinations, desired travel times and dates, preferred airlines, and other preferences into the reservation system. The system processes the information and delivers a choice of options, along with a secure transactions environment for customers who wish to purchase the ticket online.

In 1996, Web users booked $276 million worth of travel this way. For 1997, online travel sales are estimated to have reached $816 million. By the year 2000, online travel sales could reach $5 billion,[65] or close to 7 percent of U.S. airlines' revenues for passenger air travel.[66]

According to a survey released in November 1997 by the Travel Industry Association of America, 13.8 million Americans used the Internet to plan their trips and 6.3 million made reservations on the Internet. And, consumer acceptance is growing. In 1996, 10 percent of Internet users used the Internet to make travel plans and purchases. When polled in 1997, nearly 70 percent of Internet users said they planned to use the Internet for travel in the upcoming year. Acceptance is high among the general population, as well. Thirty-eight percent of all adults said they would consider using the Internet for their travel in 1998.

Lower sales and marketing costs, and increased consumer choice and convenience are driving the Internet's increased use in travel planning and reservations.

Lower sales and marketing costs

It is cheaper for an airline to process a ticket sale online than to use a travel agent or a reservations center. Not only are transaction fees reduced, but savings are also realized when cheaper electronic tickets can be substituted for more expensive paper tickets. Through the use of the Internet and other information technology, airlines expect to be able to significantly cut distribution costs.

At $12 billion, distribution—travel agent commissions, marketing and advertising expenses, labor and other expenses for airline central reservations services—is the airline industry's second largest operating expense.[67]

Figure 7. Cost to Process Airline Tickets

$8.00: Travel agent books, using computer reservation system
$6.00: Travel agent books direct with airline
$1.00: Customer books "electronic ticket" direct with airline

Source: Air Transport Association of America, 11/20/97

How a ticket is sold, through an agent or by the airline directly, and whether the ticket is paper or electronic, can mean the difference between paying $8.00 or $1.00 to process a ticket (Figure 7).[68]

Airlines are pursuing various strategies to drive their distribution costs down: lowering travel agent commissions, selling through the Internet and promoting electronic ticketing.

Southwest Airlines was the first major U.S. airline to let passengers buy tickets directly on their Internet site in 1996, bypassing the agent and the commission. New Web travel services quickly emerged: online travel sites sponsored by airlines themselves, "virtual" travel agents like Microsoft's Expedia.com and The SABRE Group's Travelocity.com, and travel agents' own sites. Whether customers purchase tickets on an airline's site or through online travel agents, the airlines save money since their own travel reservations centers do not have to be involved in the purchase. In addition, the commissions they pay to online agents are about half what they pay to traditional agents.[69]

While the airlines' ability to move customers away from paper tickets to lower-cost electronic tickets does not depend on the Internet, it is proving to be a useful vehicle for accelerating the shift. Some airlines encourage their Internet customers to use electronic tickets by offering frequent flyer miles for travel booked online with an electronic ticket. Because Internet customers reserve their tickets, select seats and give credit card information online, getting an electronic ticket rather than a paper one seems natural.

Airlines also use the Web to generate additional revenues. No matter how precise an airline's forecasting, seats still go unsold on some flights. Auctioning airline seats to the highest bidder and offering special "cyberfares" for leisure travel are two techniques made possible by the Internet.

Every Monday or Tuesday, American Airlines looks at its yield management results and picks out low-performing markets. Midweek, more than one million "NetSAAver" subscribers receive an e-mail from American Airlines listing special discounted fares for travel in selected markets during the upcoming weekend. The NetSAAver program has generated tens of millions of incremental dollars for the airline since its launch in March 1996.

RETAIL BANKING

Internet banking is still in its infancy. Although most of the top 100 banks in the U.S. have a Web site, the Online Banking Report classifies 24 of them as "True Internet Banks"—banks that let their customers review balances, transfer funds and pay bills on their Web sites. Smaller banks also have Web presences. In Online Banking's list of 133 "True Internet Banks," 109 do not make the list of the top 100 U.S. banks ranked by assets.[70]

Before the decade is out, customers are likely to be able to do most of their banking transactions on the Web. According to a 1996 Booz-Allen & Hamilton survey of North American financial institutions with Web sites, 80 percent of respondents planned to allow their customers to conduct most traditional banking transactions over the Internet within three years.[71]

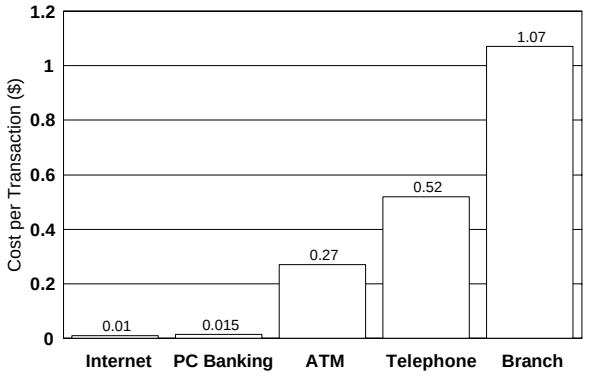
Online retail banking is being driven by lower operating costs, the ability to offer new services, and the ability to do one-to-one marketing.

Lower operating costs

Online banking services are less expensive to offer to customers than other forms of banking. Checking an account balance or transferring funds from a checking account to a savings account can be done in person at a branch bank, over the telephone, with an Automatic Teller Machine (ATM), at home using a PC, or, in some cases, on a bank's Web site.

A branch bank can serve as many customers as it has staff to handle. Once the investment is made to create a fully functioning Internet site (for a

Figure 8. Internet Banking is Cheaper for Banks



Source: Booz-Allen & Hamilton

large bank, the initial investment could be millions of dollars; a more limited solution for a small bank might cost tens of thousands of dollars), the bank's Web site can handle one customer inquiry or tens of thousands a day.

Booz-Allen & Hamilton estimates that it costs about a penny to conduct a banking transaction using the Internet and more than one dollar if handled by a teller at a branch bank (Figure 8).[72]

New Services

Today's online banking allows customers to check account balances, transfer funds, and update customer information—transactions that can already be performed through traditional banking channels. For some customers, the convenience of banking from home or the office is preferable to calling the bank's automated phone service or going to a branch bank. Others do not find the services offered online today reason enough to change their banking habits.

In the future, analysts expect that Internet banking will be enhanced with new services that make online banking easier and more convenient than banking by ATM, by phone, or visiting the branch bank. Paying bills electronically is one such example.

Checks are the preferred method of bill payment in the United States.[73] For a business, preparing and sending paper bills can be costly. For a consumer, paying bills by check can take a great deal of time. Billers print out and mail the bills to a consumer's home. The consumer writes a check, records the check number and amount paid, balances the checkbook, finds a stamp and mails the check back to the biller. The biller receives the check, updates his accounts and sends the check to the bank to credit to his account. Handling paper bills and checks can cost a biller between $1.65 and $2.70 each time he sends out a bill.[74] It costs the customer time and the price of a stamp to pay each bill.

Today's Internet-based bill payment services take some of the paperwork out of the process. Rather than writing a paper check and mailing it to the vendor, a customer authorizes his bank to pay bills on his behalf. This saves the customer some time, and may save the vendor some money, if all steps are completed electronically. However, vendors still incur the costs of mailing the bill to the customer. And, smaller vendors without an electronic connection still have a series of manual and paper-based steps to complete.

Some banks believe that future Web-based bill payment services can make the entire process paperless. The vendor will send an electronic image of the bill to the customer's bank. The customer will electronically authorize the bank to pay the bill, the bank will debit the customer's account, and the vendor will receive payment electronically. The vendor's printing and mailing costs are eliminated, and processing costs are greatly reduced. The customer enjoys the convenience of paying bills without having to keep stamps and envelopes on hand. With services that automatically update account balances, the customer also saves time he formerly spent balancing his checkbook.

One-to-one Marketing

Today, most banks are still equipping their Web sites with basic transactions processing and do little with tailored or one-to-one marketing. However, some now realize that through the Internet, a bank can get to know a customer's banking priorities and preferences even better than it could when banking was done in small neighborhood branches.

Bank of America's "Build Your Own Bank" provides an example of how one-to-one marketing could work. Internet customers using this service provide the bank with basic information about their place of residence, occupation, age, income and gender, whether they own or rent a home, and what types of accounts they have with the bank. They then indicate their financial interests and priorities—whether saving and investing, home buying/improvement, building a business, retirement, economic and financial markets, electronic commerce, or simply better financial organization and budgeting. Based on these inputs, the bank responds with Money Tips and news items geared to the customer's interests, and special offers for the services the customer has prioritized.

These and similar mechanisms give banks the opportunity to cross-sell products and services. Ideally, the customer benefits from these tailored offerings, as well. At a minimum, he should benefit from greater convenience. Because his account profile automatically gets called up when the customer logs into a personalized site, he wastes no time entering account information. Having up-to-date information about balances in each account gives the customer a snapshot of his holdings with the bank without having to do the math himself. The personalized tips and special offers may help the customer to make important financial decisions.

The Future

Over the next few years, a growing number of American households are expected to do their banking online—whether through a dial-up connection to their bank or through the Internet. Roughly 4.5 million households were banking online in 1997. By the year 2000, as many as 16 million households are expected to bank online.[75]

INSURANCE

Insurance carriers' Web sites typically provide customers with basic corporate and policy information, but refer customers to offline agents or customer service phone representatives in order to make a purchase. A more limited number of carriers' sites, and other sites, including banks, securities brokerages, real estate companies and automobile marketplaces, allow Internet customers to purchase term life, automobile and homeowners' insurance online.

Table 4. Internet Sales of Personal Insurance Projected to Grow

	1997	2001
Auto	$21 M	$850 M
Term life	$17 M	$108 M
Homeowner	$1.1 M	$152 M
Total	$39.1 M	$1.1 B

Source: Forrester Research

By 2001, analysts project that more than $1 billion in premiums will be generated via the Internet (Table 4).[76] The rapid increase in sales will be driven by cost savings, increased competition and growing consumer acceptance.

Cost savings

Distribution costs for life and property and casualty policies can be as high as 33 percent or more of the product's price.[77]

Selling policies and providing customer service over the Internet is much less expensive than via an agent or a telephone representative—as much as 58-71 percent lower over the lifetime of a customer.[78] In a direct online sale by the carrier, the agent commission is avoided. If the sale is completed by an online agent such as Quicken InsureMarket, it can be more than cut in half. Even if a traditional agent completes the transaction started on the Internet, the transaction is less expensive. The Internet prequalifies the customer for the agent, saving sales time and expense. The Internet can also be used for electronic communication between agents and carriers, reducing time spent on routine tasks such as applications processing, updating customer account information, and reporting on the status of claims.

In addition to saving money, the Internet can generate new sales opportunities. Carriers that traditionally sell through agents may pick up new customers on the Internet that agents cannot effectively reach. Because of the time needed to acquire a new customer, agents tend to focus on clients they believe will buy larger policies. One insurer, Lincoln Benefit Life, reports differences in the face value of the policies it sells via the Internet and through independent agents. The majority of policies sold by an agent have face values of $500,000 or greater. Online, Lincoln reaches customers who wish to purchase policies with face values of $500,000 and under.

Increased competition

Banks and securities brokerages have begun to sell insurance in their aim to be the one-stop shop for consumers' financial services needs. Whether through alliances with insurers or in direct competition with them, these new entrants will affect how insurers go to market. At the moment, both banks and securities brokerages are embracing the Internet more rapidly than insurers.

Growing consumer demand

Surveys indicate that people would like to be able to get quotes, pay premiums and update their policies online—functions that are not yet provided on most insurance carriers' sites today.

Insurance executives believe that within five years, their customers will prefer to purchase and receive auto and term life policies online to purchasing from an agent. They will use the Web to get product information and quotes, pay premiums, compare prices, access their claims status, access and update their policy information, and get advice from financial service experts.[79]

THE FUTURE

Most industry watchers predict that the market for the digital delivery of products and services will evolve quickly. The rate varies considerably by industry, however.

Selling travel online appears to have the fewest constraints, perhaps because computer reservations systems have been in place for years. Analysts predict rapid growth in travel services, from less than $1 billion in 1997 to close to $8 billion within three to five years.[80]

Similarly, the financial services area is poised for quick growth. Nearly 5 million people actively trade stocks online and pay $8 - $30 per trade (traditional brokerages charge an average of $80 per trade).[81] Investment bank Piper Jaffrey estimates that $614 million in broker commissions were generated online in 1997. This represents more than 4 percent of total retail brokerage commissions and 29 percent of the $2.1 billion in commissions attributable to the discount brokerage sector.[82] Analysts predict that 10-16 million households will bank online by 2000, more than double the number in 1997.[83] Internet-generated premiums for insurance are expected to grow from $39 million in 1997 to $1.1 billion by 2001.[84]

Other digital products and services have significant growth potential, but their long-term success is tied to solutions for protecting copyrights and to improvements in the Internet infrastructure. Intellectual property holders—software developers, recording artists and record companies, movie studios, authors and publishers—worry that digital copies sold or transmitted over the Internet may be prone to copyright infringement and piracy. The Internet is a natural, low-cost distribution channel for these digital products, but the uncertainty of whether their products can be protected impedes growth. Companies are working with technological solutions such as "watermarks" and "digital object identifiers" so that they can keep track of their products online. In December 1996, governments negotiated treaties at the World Intellectual Property Organization (WIPO) to address the question of how copyright should be recognized and protected in global Internet commerce. The U.S. government is working to have these treaties ratified in the U.S. and around the world.

For the multimedia industry, the question of bandwidth is crucial. Until Web users can download a video in a matter or seconds, Web sites will not create many video products to sell online and Web users will prefer to read text, watch television or use their VCR.

Increased bandwidth will also benefit education and health care services. Educational services will be able to use more video programming to supplement other online resources. The Web can also be a very useful tool in medical education and for the delivery of health care diagnostic services. Today's Web users can access some information from their health plans and physicians about medical conditions, symptoms and suggested treatments. Increasingly, they will be able to schedule appointments, pay bills, and check the status of their claims online. As new equipment is developed for remote diagnosis, doctors will be able to diagnose some medical conditions and recommend treatments to patients via the Internet (state laws and regulations regarding telemedicine and licensure may limit how widely remote diagnosis is used). However, because some medical diagnostics require very high-quality images (poor resolution could give the impression of a tumor or a fracture where none exists, for instance), improvements in bandwidth, image quality and reliability will need to occur before telemedicine and remote medical diagnostics emerge as viable industries on the Internet.

CHAPTER FIVE:
RETAIL SALE OF TANGIBLE GOODS

In addition to goods and services that can be delivered electronically, the Internet is also used to sell physical goods. Increasing demands on leisure time and the improvement of overnight and second-day delivery services that spurred the growth of catalog shopping in the 1980s and 1990s are now leading people to shop over the Internet.

A fall/winter 1997 CommerceNet/Nielsen study found that 10 million Web users in the U.S. and Canada (about 16 percent of all Internet users in North America) have actually purchased something on the Web, up from 7.4 million six months earlier. A much larger number use the Web to shop, but they still close the transaction over the telephone or at a store.[85]

Internet consumers report that they shop on the Web because of convenience, ease of research and good prices.[86] Where most Internet shoppers bought computer software and hardware a year ago, today's shoppers buy more mainstream items. America Online (AOL), the largest Internet Service Provider with 11 million customers, reported a shift in online buying patterns during the 1997 holiday season. Apparel climbed to the top spot, and books, to third place this year. Also popular were food, flowers, music and toys.[87]

Internet retailers pursue a variety of strategies to attract customers. Just as one would find in traditional retailing, specialty retailers, large discounters and malls/marketplaces have their places online. Internet consumers may also visit online auction houses or use a "personal agent" to help with their shopping.

Most Internet stores try to make online shopping as familiar and as easy as possible. Physical products arranged on store shelves are replaced with electronic catalogs that include photographs, detailed product descriptions, pricing and size information. Third-party reviews may be available to assist the buyer in choosing between different brands or models. When ready to make a purchase, the customer clicks on the product and puts it into a virtual "shopping cart," and may continue shopping or proceed directly to check out. First-time customers enter basic name and address information, along with a credit card, hit the enter key on the computer, and the transaction is completed. Recognizing that customers may want to speak with a company representative directly in some instances, many Internet retail sites offer toll-free customer service numbers.

Just as traditional bookstores feature tables of bestsellers and gift books, and organize racks of books by subject area, Internet bookstores also provide guides through their vast virtual selection. For those who know the title or the author of the book, a keyword search scans the entire inventory in a matter of moments, retrieves the title, along with a brief description and review of the book, and a button to add it to the customer's shopping cart. Visitors may also browse for a

book according to topic. The topic can be as broadly defined as “history” or as narrowly defined as “Civil War.”

At the same time they borrow from concepts familiar to traditional retail, Internet merchants do not think that merely duplicating what can be found offline is enough to convince customers to shop online. Early pioneers of Internet retail talk about attracting customers with additional value, selection and entertainment.

The Cendant Corporation, a $5.3 billion consumer goods and services company, sells over one million products and services on its Web site, from cars to electronics and cameras, books, appliances, luggage, perfume, flowers and gifts, computer hardware and software, video games and a variety of other goods and services. For an annual membership fee of $69, Cendant claims that its netMarket Web site satisfies 20 percent of the average family’s shopping needs. Because the company’s business model relies almost entirely on membership fees, Cendant reports that it sells products to retail customers at, or near, wholesale prices. In 1997, Cendant facilitated the sale of more than $1.2 billion worth of products and services over the Internet. Before the decade comes to a close, the company plans to offer a product selection which will cover 95 percent of the products a typical household would buy.

Internet Shopping Network’s First Auction site aims to attract Internet users looking for adventure, entertainment, and seeking a bargain. People from all over the country bid against each other in real-time to “win” products. First Auction starts many of its bids at $1.00, well below a product’s cost. Bidders quickly bid up the price, competing with each other to take possession of golf clubs, CD players, television sets, jewelry and a range of other items. Launched in July 1997, First Auction’s membership roster approached 100,000 people by the end of 1997, and 30,00 people visited the site each day.

An Internet shopper need not go to a “store” in order to buy something. In fact, the concept of retail is blurring. Some media sites, online service providers and search engines prominently feature retailers and provide direct links to their sites. Some give customers the ability to buy goods directly from their own sites. Time Warner, the media and entertainment company, has a marketplace on its Web site featuring retailers selling books, music, travel, computers and electronics, vitamins and more. Visitors using Yahoo!’s search engine can buy products from The Visa Shopping Guide by Yahoo!. A shopper who wants to buy a pair of ladies’ shoes, but does not want to go from Web store to Web store to shop, can use the “one search” option and a software agent scans the offerings of participating retailers for selection and price information in one trip. An interested buyer can click on the “buy” button and be transported to the Web page featuring a picture and a more detailed description of the shoes at the retailer’s site to finish the transaction.

Even buying a car, more of an investment than a typical retail purchase, is possible to do through a number of auto marketplaces, online classified sites, and manufacturers’ own sites. JD Power & Associates, a marketing information firm specializing in the automotive industry, estimates that roughly 16 percent of all new car and truck buyers used the Internet as part of their shopping

process in 1997, up from 10 percent in 1996. By 2000, they project that the Internet will be used in at least 21 percent of all new car and truck purchases.[88]

As in other areas, the growth of online retailing is being driven by cost savings, the ability to customize marketing, and increased consumer convenience.

Virtual stores report lower operating costs than their physical counterparts. Costs of supporting a store infrastructure—rent and depreciation, labor, utilities and other expenses - - are almost entirely avoided online. 1-800-FLOWERS sells flowers through its own flower shops, affiliated flower shops in major cities across the country, by telephone sales and online. Although its online business generates only 10 percent of its total revenues, its profit contribution to the overall business is nearly that of its store-based business which generates 20 percent of total revenues.[89]

Direct marketing in traditional retail is already quite sophisticated: retailers can access and manipulate extensive databases made up of warranty information for cars, appliances and consumer electronics. Retailers can use this information to attract new customers by sending mailings to consumers living in certain zip codes that fit given demographic or other specialized profiles. Databases of existing customers may be even more detailed, allowing retailers to send more targeted offers. In either case, these direct mailings often take time and significant expense to compile, mail and then review their effectiveness.

Though not really in practice yet, the Internet offers the opportunity to take direct marketing to the next level: to market directly to narrow bands of customers—even to individuals—and to do so profitably. When a customer visits a site, for example, the site may say "hello" and state the visitor's name. It knows who is there because of a technology that records the Internet address of the visitor and matches it to a name if the visitor has already registered or purchased something at the site.

Web businesses also keep track of what an individual customer purchases. Increasingly, Web businesses will send a message to the buyer of a 28.8 kbps modem that the company now offers the latest 56 kbps modem; the person who buys a certain style and size of pants and sweaters will receive notices of new merchandise in that style or size, along with suggestions for accessories to match; the adventure traveler whose last trip was to Nepal at the height of trekking season may receive information about the newest hiking boots and multi-day packs to hit the market or an invitation to join a team traveling to Patagonia. Right now, many consumers are wary of this type of marketing, fearing a loss of personal privacy. If Web users become convinced that they can protect their privacy online at the same time they make these offers, targeted marketing will likely become commonplace.

Amazon.com has taken some first steps in this direction. It greets site visitors by name, informs customers by e-mail when a particular book has arrived or sends them reviews of "best new books" in areas where the customer has indicated an interest. An "instant recommendations" feature proposes books to customers based on purchases they have made at Amazon. Customers can also get an accounting of their purchases at Amazon or see the status of their orders.

THE FUTURE

Analysts believe that Internet retailing (where sales are actually completed on the Internet) will grow quickly, but they vary widely on just how quickly. On the conservative end, it is expected to reach $7 billion by the year 2000.[90] If mail order sales are used to determine the potential for Web retail sales, as some suggest, the figure could reach $115 billion in five to eight years.[91] If online shopping provides customers with a larger assortment, better prices, and greater choice than mail order companies, the figure may even exceed that projection.

To make the most of the potential of the Internet, retailers will have to overcome a number of challenges. Among others, they will need to increase consumer confidence in relying on computer images and information to determine the quality and fit of a product, and simplify the process of returning defective or unwanted merchandise. They will also need to address the question of credit card security and consumer privacy.

Making Virtual Purchases More "Real"

How can virtual images on the Internet replicate the sensation of picking up a product, feeling the material and its texture or sturdiness, trying it on (in the case of clothing) or sitting down on it (in the case of a sofa) before making the decision to buy?

As described earlier, Internet retailers offer very detailed product descriptions online. Many provide toll-free numbers for customers who prefer to speak with a sales representative before making a purchase. As video and voice become more widely used, some Internet sites can be expected to give customers the choice to click on a button and speak directly with a customer service or sales representative via the Internet. As bandwidth increases, three-dimensional images that show the product from a variety of angles will supplement or replace the flat photos on most sites today. Customers visiting Internet furniture stores will be able to furnish their own homes and apartments by "dragging and dropping" furniture and accessory icons into rooms the customer has made to resemble those in his home. This feature will enable customers to gauge how well different pieces of furniture fit into a room of a given size, and which furniture styles or colors work best together.

How well will Internet retailers satisfy demands, particularly in the U.S., for immediate gratification, no-fuss returns, and a strong customer service policy?

Customers are generally interested in speed of delivery and ease of return. The emergence of extensive overnight shipping in many parts of the world already allows retailers—including those on the Internet—to provide quick, reliable service. As Web retailing increases, overnight delivery and "drop shipping" services from manufacturers to the customer's home are likely to grow as well. Customers who worry that they will have to make an extra trip to the post office or parcel delivery company if a product they order via the Internet is not what they had in mind may be surprised to learn that some companies will actually send packaging overnight, free of charge,

to a customer's home, along with instructions to return the product, free of charge, to the company.

Making transactions secure

Most Internet purchases are currently made by entering credit card and delivery information on a computerized form and transmitting it electronically to the retailer. Even though consumers are accustomed to giving credit card information over the telephone, many are reluctant to give it online for fear that it will be stolen or misused. This reluctance is often cited as the largest barrier to the growth of retail sales on the Internet.

Web retailers believe that concerns about credit card security will lessen, particularly as more people shop online, have trouble-free experiences, and tell their friends and relatives about them. In fact, some already detect greater comfort among their consumers this year as compared to one year ago. (1-800-FLOWERS recently reported that fewer than one-third of its customers worry about credit card security, compared to almost 75 percent in 1996.[92]) Word of mouth, combined with technology and standards for safeguarding sensitive information, should help to alleviate these concerns.

Smart cards and digital cash will also be used for electronic commerce. Instead of reentering name, address and credit card information each time a purchase is made at a different Web site, information already stored on the smart card will be transmitted to the merchant electronically, saving steps for the consumer and reducing fraud by automatically validating the consumer's identity. For those consumers who wish to purchase goods or services anonymously, digital cash and stored value cards (cards worth a set amount of money) will also be available at banks and other companies for use over the network.

Ensuring Privacy of Personal Information

Consumers worry about protecting the privacy of their personal information, as well. A majority of respondents to a recent *Business Week/Harris* poll mentioned privacy as the main reason they do not use the Internet. More than three-quarters of current users say they would use the Web more if privacy were guaranteed.[93]

Some sites request that new visitors volunteer personal information upon entering the site. In exchange for that information, they may offer "membership" services such as birthday reminder e-mails, new product announcements or newsletters. A purchase may trigger the gathering and creation of a customer profile, as Internet retailers need basic personal information in order to deliver a physical good to a customer. Or, an Internet user may leave an electronic "footprint" of visits to different Web sites and purchases he has made and not even be aware of doing so.

Often today, consumers are not given the opportunity to block the gathering of information or, when they freely give it, to indicate how they would like that information to be used (for instance, whether the company should restrict its use to internal purposes, whether it can be disseminated to external companies if specific conditions are met, or whether it can be widely disseminated). Some realize that their information has been sold without their knowledge or consent when they receive unwanted e-mail. Some may see the positive side to data collection and direct marketing the next time they go to buy a book and are presented with suggestions of new releases in keeping with their interests and past purchases. Nevertheless, they want some control over when and how their data are collected and used.

In order to empower consumers to have control of their own personal information, the U.S. government is encouraging the private sector to establish codes of conduct and self-regulation. To be meaningful, the government believes that self-regulation must do more than articulate broad policies or guidelines. Effective self-regulation involves substantive rules, as well as the means to ensure that consumers know the rules, that companies comply with them, and that consumers have appropriate recourse when there is noncompliance. Consumers need to know the identity of the collector of their personal information, the intended uses of the information, and the means by which they may limit its disclosure. They should be given the opportunity to exercise choice with respect to whether and how their personal information is used. Companies creating, maintaining, using or disseminating records of identifiable personal information must take reasonable measures to assure its reliability for its intended use and must take reasonable precautions to protect it from loss, misuse, alteration, or destruction. In addition, consumers should have the opportunity for reasonable, appropriate access to information about them that a company holds, and be able to correct or amend that information when necessary.

Consumer retail on the Internet is already showing signs of rapid growth. As retailers address the challenges outlined above and as consumers become more familiar and comfortable with buying goods online, the Internet could emerge as an important retail channel.

CHAPTER SIX:
CONSUMERS IN THE DIGITAL AGE

Businesses invest in information technology and electronic commerce to increase productivity, cut costs and enhance customer service. Consumers shop on the Internet because they find their choices dramatically increased. They have access to much more information when making purchasing decisions. Busy consumers can save time and find shopping more convenient as merchants serve their needs individually. Better information and greater selection, combined with lower operating costs for many Internet business may, in turn, drive reductions in prices or improvements in quality.

CHOICE

The sheer number of stores that can be "visited" online far exceeds even the most densely populated retail areas in the country. No longer do customers find their shopping limited to the stores within a reasonable driving or walking distance or to the catalogues they receive in the mail. Online, customers can shop at stores in other states, in other countries, and at stores that do not exist in traditional formats.

News and newspapers provide a vivid example. Residents of large cities already benefit by being able to buy a number of different national and regional newspapers from coin-operated machines and specialty news outlets. Outside large cities, however, the selection is much more limited. Online, readers can access news from thousands of newspapers around the world. An online reader interested in news about the 1998 winter Olympics in Nagano can access coverage in Japan's Asahi Shimbun as well as turning to coverage in the American media.

The vast selection is not limited to products and services that can be delivered digitally. Web sites selling consumer electronics, gardening supplies, office supplies and other hard goods also offer larger selections than do their counterparts in traditional retail.

The largest chain bookstores carry about 150,000 different books. On the Web, readers can choose from 2.5 million titles under one roof, covering both in-print and out-of-print books. In addition to general purpose bookstores, specialty stores carry books on antiques, books written in foreign languages, rare editions, and other books that would require extensive phone calls and physical trips to obtain. On the Web, readers can enter the keywords identifying the types of books they want, choose some promising sites, search their inventories, and often have the book delivered within a few days or a week.

CONVENIENCE

Consumers cite convenience as the number one reason for making a purchase online. Shopping on the Internet can save time. A consumer does not have to travel to a store site or adjust his schedule around the store's hours. No longer does a consumer have to wait on hold for a customer service representative to answer the phone. Recognizing that customers may want products delivered as soon as possible, many sites offer next day or second-day delivery. Online support tools—order status, product availability and pricing, technical support and troubleshooting tips—are generally supplemented with toll-free numbers that customers may call for further information.

The example of Garden Escape, an Internet-based gardening company, shows how combining products and services in a virtual "store" can save consumers a great deal of time and effort. The founders of Garden Escape wanted to create a one-stop shop for gardening needs. They began by taking an inventory of all the resources a gardener uses today: nurseries and seed catalogs for plants and tools, other retailers for specialty outdoor products; books and magazines for tips on the plants and flowers that flourish or perish in certain soil and climate conditions; gardening clubs where hobbyist gardeners share suggestions with other enthusiasts; and the extensive array of catalogs, books and CD-ROMs that help gardeners in designing a garden.

By offering a virtual, rather than real, inventory, Garden Escape offers a selection of products that even the largest nursery could not possibly stock—a selection of 10,000 seeds, perennials, roses, bulbs, greenhouses, tools and other gardening products from around the world. Serious gardeners can use online software tools to design their ideal garden. For suggestions and tips, there's an online magazine, a chat room and new daily tips from the magazine's editors. A consumer with a question about a horticultural term can check out the glossary, or call Garden Escape's toll-free number.

BETTER AND MORE COMPLETE INFORMATION

Web consumers are often better informed than their offline counterparts. Two examples—shopping for a car and shopping for an insurance policy—illustrate the differences between purchasing via the Internet and purchasing through traditional means.

Shopping for a car can be a very complex process. It involves choosing a particular make and model of car, outfitting it with different accessories and performance options, choosing financing options (whether to lease or buy and how to obtain the best rates), purchasing or updating an auto insurance policy, and negotiating a fair price. Prior to the Internet, gathering that information could take a lot of time, and many consumers went to dealer showrooms ill-prepared. The Web changes the dynamic.

Web shoppers can view pictures of different car models and read extensive information on the car's features and performance. Financing and insurance options are also available online.

At Auto-by-Tel, a leading Web-based auto marketplace, shoppers can access model and pricing information, including dealer invoice pricing and manufacturer rebate information on all new and used cars from 2,700 accredited dealers from across the country. Along with a picture of the car and brief descriptions, the customer can access new-car and used-car pricing from third party sources like AutoSite, Edmund's, CarCenter and the Kelley Blue Book.

After deciding which car to buy, the customer enters the zip code where he or she lives and the make and model of the car desired. A screen pops up requesting that the customer indicate what color exterior and interior he wants, the type of transmission, the number of cylinders, and when they prefer a 2-door or 4-door model. Then the customer completes a new car purchase request, selecting the manufacturer options to include on the car (radio, power windows, anti-lock brakes, sunroof, etc.) After making these selections and providing contact information, the customer's request is transmitted to the Auto-by-Tel dealer closest to the customer's home. Within 24 hours, the dealer contacts the customer with a firm price.

Internet businesses selling life insurance products arm consumers with software tools that help them determine what types of insurance they might need, as well as information to enable them make educated choices between one insurer's policy and another's. Quicken InsureMarket, an Internet-based insurance marketplace, provides one illustration. Visitors maneuver through the InsureMarket site, accessing only the information they want; for example, an explanation of a term they do not understand, information about the carrier's rating, or how much and which type of insurance is suitable for them, given their family's financial profile. A consumer can comparison shop for term life policies by clicking on a button and answering some basic questions about residence, age, health, income, family situation, and the amount of insurance desired. In a matter of moments, the customer receives personalized quotes from up to seven carriers and up to four agent contact options. The system randomly generates the order of the insurance carriers providing quotes and referrals the visitor sees so as not to give an advantage to any single carrier. At a glance, the customer can compare the policies and the prices of several different carriers. Another few clicks of the mouse, and the customer has more information about each carrier and policy to determine whether a price difference between apparently similar policies is really justified.

LOWER PRICES

Commerce, and therefore competition, on the Internet is still undeveloped. A good deal of Internet retail is being driven by convenience, the search for a broader selection, or the opportunity to find items not readily available in ordinary retail outlets.

Despite its infancy, some Internet retailers offer discounts from traditional channels. For instance, online booksellers discount some books by 40 percent over typical bookstore prices.[94] (Depending on the cost of delivery, the total cost of an item may be higher on the Internet than at a store.) Consumers buying and selling stocks through the Internet commonly pay $8- $30 per trade, while traditional brokerages charge approximately $80 per trade on average.[95] Internet users can access most online news and information free of charge.

This pattern of lower prices is not universal. Some retailers have determined that their current Internet customers buy products from them primarily because of convenience, selection or quality. In the short term, they do not feel that lowering prices would lead to additional sales. Some traditional store-based retailers set their prices for products they sell through the Internet at the level found in their stores in order not to adversely impact their store-based business.

If retailing continues to grow on the Internet, competition and the favorable economics of the Internet are likely to translate into lower prices for the average consumer.

CUSTOMIZATION

The Internet offers the potential for increased customization**.** Some Web businesses, particularly media businesses, already customize the product to an audience of one. Readers can select only the news they want to read, and it gets "delivered" to their personalized Web page on the site, to an e-mail box, or as a service that the computer defaults to when at rest.

Music and computers are other products where the combination of innovation and economics is encouraging increased customization. Customers at online music stores have the choice of purchasing CDs available at record stores. Or, if they desire, they can create their own CDs from a growing number of digital recordings. Buying a laptop computer is no longer limited to what a store or a manufacturer has in stock. Instead, consumers can choose from a variety of base models, and purchase the standard configuration or customize the machine according to price and performance requirements. (For instance, the customer can decide whether to pay extra for a speedy 266MHz processor or save some money with a somewhat slower 166MHz processor. Similarly, the base model may have 48 MB of memory (RAM), but additional memory is available for those who need it. Different modems, network adaptors, extra batteries and software packages can be installed by the factory at the customer's request. Even the service package can be tailored to the customer's needs. Traditional retail and mail order outlets, in addition to Web businesses, offer customers the opportunity to customize their computers; the Internet and private networks speed the flow of information and thereby improve the economics of customization.

Web-based clothing stores may soon incorporate technology that allows customers to "try on" clothing. Deciding between a Large or Extra-Large sweater may be as simple using the computer mouse to "drag" the virtual sweater over a 3-D image of oneself to see whether it is too snug or a perfect fit. For retailers and manufacturers who continue to produce standard sizes for their customers, this technology will simulate the physical act of trying on clothing in a store's dressing room. Other businesses may decide to build a business around tailored clothing, using the 3-D image to customize the size and fit of the sweater to that individual customer.

The Internet and other new technologies may encourage businesses to explore the feasibility of mass customization; whether and how extensively retailers and manufacturers start to customize clothing, furniture, and other products based on individual customer specifications will ultimately depend on market demand.

THE FUTURE

Today's Web consumers benefit from a selection of products and services unparalleled in traditional channels. Without leaving home or an office, consumers can access thousands of Web sites to become informed about breaking news and events, research products, and purchase everything from groceries to books to insurance policies.

Whether they complete the transaction online or make the purchase at a store after using the Web to help narrow the search for a particular product, the Web arms the consumer with much more knowledge about choices and prices available to them.

Despite these advantages, many consumers today still remain wary of the Internet. They are concerned about protecting their privacy and the security of their credit card information. Many do not have computers, or find them too difficult to use. Or, they prefer the experience of shopping and selecting products they can see, feel, or try on in person. For these reasons, shopping in stores will likely be the main way that consumers purchase goods for many years to come.

However, the barriers to Internet shopping are likely to be lower for younger consumers. Children today are growing up with the Internet. Over the next decade, as today's children become adults, shopping on the Internet will be easy and natural to them.

The growth in the numbers of individuals using the Internet provides strong evidence that consumers perceive its benefits. As more individuals come online, as the Internet becomes easier to access, as Internet commerce increases, and as today's children become adults, the combined effect will be to further enhance the already-present benefits the Internet has to offer.

CHAPTER SEVEN:
WORKERS IN THE DIGITAL AGE

The rapid growth of the computing and telecommunications industries has already created a large and growing demand for programmers, systems analysts, computer scientists and engineers. If electronic commerce begins to substitute for more conventional sales and services, it will shift employment from traditional occupations to those requiring IT skills and, in many instances, other higher-level cognitive reasoning abilities. Electronic commerce is very much part of a broader national trend that requires more skills in the work place and an improved basic education in mathematics and science.

The digital age will also create greater opportunities for telecommuting, and already strong trends towards globalization will accelerate.

CHANGING SKILL REQUIREMENTS

Demand for workers in IT industries and workers with occupations focused on the design, programming, maintenance and repair of the computing and communications infrastructure will continue to grow. In 1996, more than 7 million people worked in these jobs and they earned an average annual wage of just under $46,000. Over the next ten years, the Bureau of Labor Statistics (BLS) projects that an additional 2 million workers will be needed to fill these jobs. Companies already report difficulties in filling these positions today.

Workers with information technology skills are needed across the economy. An analysis of IT occupations shows that the demand for workers to fill higher-skilled IT jobs (computer engineers, scientists, and systems analysts) is expected to grow from 874,000 in 1996 to 1.8 million by 2006.[96] These positions typically require a four-year undergraduate degree, often in a field of science, mathematics or engineering, and in many cases, advanced training or a graduate degree. Employment in lesser-skilled jobs like computer operators and duplicating machine operators is expected to decline from 481,000 in 1996 to 342,000 by 2006.

As electronic commerce becomes more widespread, it, too, will likely drive changes in the labor market. In most cases, the share of sales generated by a company's Web business is still only a small fraction of the company's total business. As it increases, however, the composition of the workforce required to produce and deliver a product or service may shift.

For instance, if online delivery of news services replaces some portion of the conventionally delivered news, workers may gradually shift away from the printing or delivery of newspapers to the creation of content or managing of computers. Workers manning printing presses, driving trucks, and staffing news stands have no role in online news distribution. Their function is

performed by new workers responsible for programming, operating and maintaining the computer servers that "distribute" the news to Web readers.

The same could be true for retail as online sales begin to substitute for in-store sales. Today, a super store might be staffed by a few hundred employees. Warehouse personnel receive new merchandise into the store and keep the shelves and bins filled. Salespeople advise customers on product features, check availability of merchandise not found on the shop floor, and book special orders. Cashiers ring up the sale and bag the goods. Back-office staff keep track of inventory and sales patterns, pay vendors and payroll, deposit sales receipts, and manage the day-to-day store operations. Other workers keep the store and its grounds clean and well-maintained.

A retail sale via the Internet does not require the presence of a physical store or the same intensity of staff in order to generate the sale. Virtual retailers will hire people with IT skills to develop and program software, and operate and maintain computer servers and networks. They will also need marketing staff, accounting departments, customer service representatives and people skilled in graphic design to keep their Web site, or "storefront," attractive and user friendly.

Whether a retailer handles the physical distribution of its own products or contracts with another company to perform that function, warehouse and distribution personnel will continue to be necessary to transport products from the manufacturer's site to the customer's home. Retailers with an existing store infrastructure are likely to position the online business as complementary to their traditional store business, at least in the near term. Until online sales are of a size to warrant a dedicated distribution strategy, traditional retailers may choose to deliver goods to Web customers from the nearest store location, adding to the workload of existing warehouse personnel. Other retailers may choose to have manufacturers package and mail or "drop ship" goods directly to customers without going through any intermediate steps. Or, they may outsource the entire logistics process for the online business to a third party. In any of these scenarios, few store personnel would be involved in an online sale.

Jobs characterized by a transfer of information from one party to another—travel agents, insurance agents, stock brokers, customer service representatives—will likely see routine tasks like order taking disappear, and more complicated tasks replacing them. For instance, a leisure traveler making plans to go home for the holidays usually knows all the carriers flying that route and simply needs to make the reservation and pay for the flight. That would be a case of order taking, a function as easily performed online as by calling the airline or a travel agent. On the other hand, a couple planning a trip to South Africa might seek the advice of someone who has been to the region, who can recommend hotels in the wine country near Cape Town and safaris in Kruger. Similarly, someone purchasing a term life policy with a face value of $400,000 may feel comfortable enough researching and purchasing that policy online. To help make the decision of whether to buy a whole or variable life insurance policy or put the money into an Individual Retirement Account or other investment vehicle, however, he might prefer to consult an expert in person.

WORKFORCE FLEXIBILITY

Workforce flexibility refers to a company's ability to produce products and services with less rigid organizational structures. It also refers to a worker's ability to work without being tied to a desk or an office. The growth in information technology has played an important role in both driving the need for a new work force and in enabling greater flexibility in the work place.

In the old model of industrial organization, production workers performed tasks by rote, over and over again throughout a shift. A car frame rolled down an assembly line, a worker attached a part, it proceeded to the next worker who performed the next process, and on it continued until a completed car emerged at the other end. A bank teller opened accounts, accepted deposits and provided account balance information. Someone else handled transactions involving Certificates of Deposit, Money Market Accounts and safety deposit boxes.

Bureaucratic work organizations are giving way to flexible "cells" and teams that cross the once-rigid lines of job description, management reporting structures, and business units. This transformation often results from a corporate objective to implement total quality management (TQM) and Six Sigma (a benchmark of nearly zero defects) systems throughout their organizations. Reducing errors and return rates, lowering cycle times and reducing costs means getting it done right the first time. People on the "front lines" - - the factory floor, the sales department, the customer service organization - - need to have the education and information to make decisions and solve problems. Companies with successful TQM and Six Sigma initiatives invest heavily in training and education. They also give employees the tools they need: clearly-stated objectives and real-time feedback on how well those objectives are being met. A robust computer network with online training and support tools can reinforce (or substitute for) in-classroom training sessions. It also keeps workers up-to-date with the latest forecasts, the current day's production or sales requirements, materials shortages, and other information in order to better perform the day's tasks and anticipate future needs.

As more companies move to this method of work organization, the need to share information and knowledge across the enterprise will increase. Internal corporate networks and the Internet will play an important role in enabling this transition.

Thanks to personal computers, fax machines, modems and cellular phones, as many as seven million workers in the United States work at home in "virtual offices."[97] The Department of Transportation estimates that up to 15 million workers may be telecommuting in the next decade.

Organizations with telecommuting programs report an increase in productivity, faster completion of assignments, fewer sick or absent days, better time management and increased morale and commitment to the company. They also benefit from reduced office space needs and associated costs, an enhanced ability to attract and retain quality employees, and improved customer service.[98]

Telecommuting benefits employees, as well. For those who need to balance work commitments with family commitments, telecommuting provides the means for working and communicating with coworkers and clients from home. Employees working part-time can manage their time more effectively, spending less time driving to one or more offices, and instead focusing on completing work assignments.

GLOBALIZATION

Information technology has opened up new opportunities for global commerce. The signals transmitted over the Internet do not recognize national borders. Work on the same project can be done in several places or several countries without workers having to physically relocate.

Organizations can now deploy resources and operations around the world. Information about new product introductions, corporate earnings, forecasted sales patterns, and materials requirements can be shared almost instantaneously via corporate e-mail systems and value-added networks, and now, over the Internet.

Developing software, designing a car, providing consulting services to a client, can be done collaboratively by teams of employees from different parts of the world. For instance, an engineer in California can send an e-mail at the close of her business day to a colleague in Singapore, asking him to look over the attached design specifications for a new product. By the time she arrives for work the next morning, a reply could be sitting in her "in-box" with a marked-up set of specifications.

With the opportunities come serious challenges. Countries that have an insufficient supply of skilled workers will see high-skilled, high-paying jobs migrate to countries that can supply the needed talent. Those that have a surplus will find job opportunities opening for their workers in overseas organizations. Even though the United States has led the world into the digital age, we face these same realities. Without a concerted effort to develop students and workers to meet the new challenges of the digital economy, the United States could face a migration of high-skilled, high-wage jobs to other countries.

CHAPTER EIGHT:
CHALLENGES AHEAD

This report has focused on the emergence of the digital economy—the promise it contains and some of the challenges it poses. Some of the challenges are technical, others involve the development of standards, and still others require significant capital investments.

The digital revolution is also changing the respective roles of government and the private sector. In the 19th and for much of the 20th centuries, governments played a key role in helping build or actively regulate much of the country's infrastructure. The federal government made extensive land grants to encourage private capital to expand the nation's rail network. Government subsidies were used to stimulate the development of an airline industry. Federal and state dollars combined to build and maintain the interstate highway system. In communications, the government granted a virtual monopoly to a single company and regulated the industry after its breakup. Most power companies have been regulated monopolies at the state or federal level.

The federal government funded and developed early versions of the Internet for national security and research purposes. It will continue to provide funding for research and development on future Internet and high-performance computing technologies. However, most of the capital to build the computing and telecommunications infrastructure is being provided by the private sector.

The pace of technological development and the borderless environment created by the Internet drives a new paradigm for government and private sector responsibilities. Creating the optimal conditions for the new digital economy to flourish requires a new, much less restrictive approach to the setting of rules.

- Governments must allow electronic commerce to grow up in an environment driven by markets, not burdened with extensive regulation, taxation or censorship. While government actions will not stop the growth of electronic commerce, if they are too intrusive, progress can be substantially impeded.

- Where possible, rules for the Internet and electronic commerce should result from private collection action, not government regulation.

- Governments do have a role to play in supporting the creation of a predictable legal environment globally for doing business on the Internet, but must exercise this role in a non-bureaucratic fashion.

- Greater competition in telecommunications and broadcast industries should be encouraged so that high-bandwidth services are brought to homes and offices around the world and so

that the new converged market place of broadcast, telephony and the Internet operate based on laws of competition and consumer choice rather than those of government regulation.

- There should be no discriminatory taxation against Internet commerce.

- The Internet should function as a seamless global marketplace with no artificial barriers erected by governments.

As with any major societal transformation, the digital economy will foster change and some upheaval. The Industrial Revolution brought great economic and social benefit, but it also brought about massive dislocations of people, increased industrial pollution, unhealthy child labor and unsafe work environments. Societies were often slow in responding to these negative side effects.

Similarly, the digital economy may bring potential invasions of privacy, easier access by children to pornographic and violent materials and hate speech, more sophisticated and far-reaching criminal activity and a host of other as-yet unknown problems.

The private sector and government, working together, must address these problems in ways that make the Internet a safe environment while not impeding its commercial development.

The U.S. Government's "Global Framework for Electronic Commerce," posted on the Internet at http://www.ecommerce.gov, describes a market-driven framework that will stimulate the growth of the digital economy while offering flexible, industry-driven solutions that will effectively address problems that may arise. Steps are now being taken in the United States and around the world to meet these public policy goals.

Perhaps the greatest challenge the U.S. faces, however, is to put in place the human resource policies necessary for the digital economy. If the trends described in this study continue, millions of jobs will likely be created, while millions of others will be lost.

The good news is that the net economic growth anticipated by this digital revolution will likely create more jobs than those that are lost. Further, the jobs created are likely to be higher-skilled and higher-paying than those that will be displaced. However, it is clear that we will face great challenges in preparing the current workforce and future workers to fill the new jobs that will be created. If we do not have a sufficient number of well-educated and trained people to fill these jobs, then the good news can turn to bad.

If these public policy issues can be resolved, and electronic commerce is allowed to flourish, the digital economy could accelerate world economic growth well into the next century.

ENDNOTES

1. "Monetary Policy Testimony and Report to the Congress." Testimony of Alan Greenspan, Chairman, Federal Reserve Board. February 24, 1998. Http://www.bog.frb.fed.us/boarddocs/HH/

2. Schwartz, Peter and Leyden, Peter. "The Long Boom: A History of the Future, 1980-2020." *Wired*. Issue 5.07. July 1997. Http://www.wired.com/wired/5.07/longboom.html

3. There is an ongoing debate on IT's contribution to productivity. Some believe that IT has had a positive impact on productivity, yet it does not show up in government data because of inadequate measurement techniques. Others believe that IT has not had a measurable impact on productivity because businesses have not yet reorganized their operations in order to take advantage of information technology. They note that the lag between investments and their full payoff generally takes many years.

4. NUA Internet Surveys estimate that there were between 23-33 million Internet users in the U.S. in 1996, representing 83 percent of all Internet users. Using that calculation, between 28-40 million people around the world were using the Internet in 1996. By the end of 1997, NUA estimates that 101 million people were using the Internet. Http://www.nua.ie/surveys

5. Network Solutions, Inc. Private communication received February 1998.

6. Inktomi Corporation White Paper. 1997. Paper cites data from UUNET, one of the largest Internet backbone providers. Traffic is measured as the total amount of information - - bits - - going across the network. http://www.inktomi.com/Tech/EconOfLargeScaleCache.html

7. Gordon, John Steele. "What has Watt wrought?" *Forbes*. July 7, 1997. pp.144-171. Thomas Newcomen developed the first practical steam engine in 1712, used primarily for pumping water out of mines. This engine was only practical near a source of wood or coals. James Watt's steam engine of 1769 added a separate condenser which increased the fuel efficiency by a factor of four. Due to this addition, a steam engine could be put anywhere and the fuel hauled to it. In 1782, Watt modified the engine by introducing a rotary motion that could turn a shaft.

8. Michael Faraday first harnessed electricity in 1831 by means of motion in a magnetic field. Forty years later, Thomas Edison and Joseph Swan invented the incandescent filament lamp.

9. Thomas Edison's Pearl Street Station in New York City began generating electricity on September 4, 1882. Smithsonian Institution, National Museum of American History.

10. David, Paul, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox." *The American Economic Review*. Vol. 80, No. 2, 1990. pp. 355-361.

11. Ibid.

12. Gwennap, Linley. "Birth of a Chip." *BYTE*. December 1996.

13. Moore, Gordon. "The Continuing Silicon Technology Evolution inside the PC Platform." Intel archives. http://developer.intel.com/solutions/archive/issue2/feature.htm

14. Lucent Technologies. http://www.lucent.com/netsys

15. Bandwidth determines the speed at which data can flow through computer and communications systems without interference. In the early days of the Internet, most messages were simple text that did not require large amounts of bandwidth. Bandwidth requirements have increased as people began to send images, sound, software, video and voice over the Internet.

16. In a packet-switched system, a message is broken into chunks and each chunk or "packet" is individually addressed and individually routed across the network to its destination. At the destination, the message is reassembled. Packets that do not arrive at the destination are retransmitted. As Vint Cerf, one of the inventors of the Internet, describes it: Packet switching is conceptually similar to the way the postal service works. That is, each letter or postcard is individually addressed and moves geographically from point-to-point as it travels towards its destination. Two postcards mailed from a post office in San Francisco may take different routes to New York, but once they arrive at the New York City post office, they are assembled with the other mail going to the destination address and delivered. Each "packet" is like a postcard and network routers are like the mail stops along the way.

17. Meeker, Mary and Pearson, Sharon. *Morgan Stanley U.S. Investment Research: Internet Retail.* Morgan Stanley. May 28, 1997. pp.2-2, 2-6. Notes: Data for TV and other media are U.S. figures. PC figures reflect worldwide users. Morgan Stanley uses the launch of HBO in 1976 as their estimate for the beginning of cable. "Though cable technology was developed in the late 1940's, its initial use was primarily for the improvement of reception in remote areas. It was not until HBO began to distribute its pay-TV movie service via satellite in 1976 that the medium became a distinct content and advertising alternative to broadcast television."

18. In 1989, the World Wide Web (WWW) protocols for transferring hypertext via the Internet were first used in experimental form at the European Center for Particle Research

(CERN) in Switzerland. In 1991, the National Science Foundation lifted the restrictions on the commercial use of the Internet. That same year, the World Wide Web (WWW) was released by CERN. In 1993, the alpha version of Mosaic, the graphical user interface to the WWW, was released, giving non-technical users the ability to navigate the Internet. This report uses 1993 as the date when the Internet became truly open to the public. See: Cerf, Vint. "The Internet Phenomenon." National Science Foundation Web page. Http://www.cise.nsf.gov/general/compsci/net/cerf.html

No exact figures exist on Internet usage worldwide, but different sources point to 1997 as the year when Internet usage approaches/crosses the 50 million mark. For instance, NUA, an Internet consultancy and developer, compiles figures from different research analysts and finds the following ranges of Internet usage: 1995: 8-30 million, 1996: 28-40 million, 1997: >100 million. (Note: some research groups report U.S. figures only. Global figures for 1995 and 1996 were derived from NUA estimates on U.S. Internet usage as a percent of global Internet usage.) http://www.nua.com/surveys/how_many_online/index.html

19. Intel. "Moore's Law: Changing the PC Platform for another 20 years." http://developer.intel.com/solutions/archive/issue2/focus.htm

20. Making adjustments for price and performance, the IT sector contributed 28 percent of real GDP growth between 1996 and 1997. Measured in nominal terms, the IT sector contributes 15.7 percent of GDP growth over the same time period. (See IT chapter for more detailed explanation and charts.)

21. Parekh, Michael et al. *Goldman Sachs U.S. Research: Cyber Commerce: Internet Tsunami*. Goldman Sachs. August 4, 1997.

22. Meeker, Mary and Pearson, Sharon. *Morgan Stanley U.S. Investment Research: Internet Retail.* Morgan Stanley. May 28, 1997.

23. Ibid.

24. Nicholas Negroponte, founder and director of the MIT Media Lab, estimates that 1 billion people will use the Internet as early as 2000. See: "The Third Shall Be First: The Net leverages latecomers in the developing world." *Wired.* January 1998. In his book, *Digital Economy*, Don Tapscott cites the New Paradigm Learning Corporation when he estimates that there should be well over 1 billion Internet users by 2000. Others feel that 2000 may be too optimistic, as much of the developing world does not even have a basic telecommunications infrastructure. As new investments in fiber, satellite, wireless and cable are made, more of the world will be connected to the Internet. One billion people on the Internet by 2005 could therefore be possible.

25. Forrester Research, numerous business executives.

26. Morgan Stanley estimates 46 million U.S. Internet users in 1997. See: Meeker, Mary and Pearson, Sharon. *Morgan Stanley U.S. Investment Research: Internet Retail.* Morgan Stanley, May 1997.

    CommerceNet Nielsen estimates 62.8 million Web users in the United States and Canada for the six months ending September 1997. Statistics provided by CommerceNet/Nielsen representatives.

    IntelliQuest estimates 62 million online in the United States in the 4th quarter 1997. See: IntelliQuest. "Latest IntelliQuest Survey Reports 62 Million American Adults Access the Internet/Online Services." IntelliQuest Press Release. February 4, 1998. http://www.intelliquest.com/about/release41.htm

27. Inktomi Corporation White Paper. 1997. http://www.inktomi.com/Tech/EconOfLargeScaleCache.html

28. Network Wizards. "Internet Domain Survey." http://www.nw.com/

29. Price Waterhouse LLP. "Price Waterhouse National Venture Capital Survey: National Edition Top Line Results." Full Years 1995, 1996, Quarterly Results 1997. For purposes of this report, "IT startups" include communications, computers and peripherals, electronics and instrumentation, semiconductors, and software and information firms. http://www.pw.com/vc

30. Consumer Electronics Manufacturers Association (CEMA). "U.S. Consumer Electronics Industry Today." June 1997. pp. 50-52. CEMA reports that 40 percent of U.S. households own PCs. A more recent analysis by IDC/Link estimates that the penetration rate has now reached 43 percent.

31. While high-speed optical fiber lines are used for long-distance communications, most U.S. homes connect to these lines via lower-bandwidth copper wire. Integrated Services Digital Network (ISDN) connections have become widely available to households and businesses, but a very small percentage of Internet subscribers use them.

32. Federal Communications Commission (FCC). "Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming." CS Docket No. 96-496. January 2, 1997. pp.58-59. Http://www.fcc.gov/Bureaus/Cable/Reports/fcc97423.html

33. From January 1997 to January 1998, the average selling price of a home PC dropped 30 percent, to $1,169. By Christmas 1998, analysts expect top PC makers to offer $600 machines. At this price, analysts predict that PCs could find their way into 60 percent of U.S. homes by 2002. Source: Burrows, Peter et al. "Cheap PC's." *Business Week*, March 23, 1998.

34. Shankar, Bhawani. “Digital TV on home run.” *Telecommunications*. December 1997.

35. FCC, CS Docket No. 96-496, 1997, p.58. Because access to the cable network is shared, speeds may be overstated.

36. Estimates provided by Michael Harris, President of Kinetic Strategies, Inc., February 1998. Figures represent latest available projections for year-end 1997 and the year 2000 as of February 1998.

37. Bellcore, Mobile Solutions. http://www.bellcore.com/BC.dynjava?MobileSolutionsCCGeneralCustomerCenter

38. Allison, David. “Using the Computer: Episodes across 50 Years.” Smithsonian Institution. February 14, 1996. http://www.si.edu/resource/tours/comphist/eniac.pdf

39. Boeing currently receives 50 percent of its orders via EDI over the private airline network. Boeing believes that the Internet could automate up to 60 percent of the spare parts orders that come to them via phone, fax and mail by 2000. Between the private network and the Internet, 80- 90 percent of their orders will be transmitted electronically.

40. Forrester Research estimates that U.S. businesses will buy and sell $327 billion worth of goods over the Internet by 2002. Source: Erwin, Blane et al. “Sizing Intercompany Commerce.” Forrester Research. July 1997.
The International Data Corporation (IDC) predicts that it will be $208.5 billion by 2002. Source: Phone conversation with IDC, February 1998. U.S. business-to-business figures were drawn from IDC’s global Internet Commerce Market Model.

41. Input, a firm specializing in electronic business market research and consulting services, estimates that the worldwide value of goods and services traded between businesses via EDI over private networks was $162 billion in 1997. Torrey Byles, President of Granada Research, an electronic commerce research and consulting firm, estimates that U.S. businesses traded $500 billion via EDI in 1996. Input’s figure counts only those transactions where the entire transaction from purchase order to payment, was completed electronically. Byles’ figure includes transactions that are initially electronically. Payments may have been received via other means.

42. Lundstrom, Scott. “Internet Enabled Indirect Procurement: A Low Risk/High Return Project?” *The Report on Supply Chain Management*. Advanced Manufacturing Research, Inc. July 1997.

43. “Sales are Clicking on Manufacturing’s Internet Mart.” GE Information Services. Excerpts from *Fortune*. July 7, 1997. http://www.tpn.geis.com

44. 1997 survey of purchasing managers by Porter Novelli for W.W. Grainger.

45. Verity, John. “Vision Quest.” *Computer World*. December 15, 1997.

46. Phone conversations with Chuck Harrison and Bill Antoskiewicz, Ernst & Young. January 1998. According to Ernst & Young, CPFR could lead to reductions of 25-35 percent in finished goods inventory across the supply chain.

47. Pittman, Lee. “Electronic Commerce in Manufacturing: A Vision of the Future.” *EDI Forum*. The EDI Group. Vol. 10, No. 1. Lee Pittman is Vice President of Industry Relations for Future Three Software, a company specializing in EDI and other software for automotive suppliers and a member of the AIAG faculty for EDI.

48. Ibid.

49. Ibid.

50. Ibid.

51. Hoy, Tom and Margolin, David. “Charting the Course.” *ActionLine*. September 1996**.** Tom Hoy is a loaned executive to the Automotive Industry Action Group, a consortium of OEMs (original equipment manufacturers) and 1,300 suppliers. David Margolin is formerly of Wizdom Systems, a software and consulting company specializing in business process reengineering solutions.

52. Erwin, Blane, et al. “Sizing Intercompany Commerce.” Forrester Research. July 1997. Forrester Research predicts that business-to-business electronic commerce will reach $327 billion by 2002.

53. A conservative estimate for the combined online transactions for Cisco, Dell and GE in 1997 would be $3 billion. During the first 10 months of 1997, Cisco booked more than $1 billion in sales via the Internet. Although Dell did not report its 1997 sales via the Internet, a rough estimate would place them between $750 million - $1 billion for the year. GE reports having purchased over $1 billion online in 1997.

    In three to five years’ time, Internet commerce for the three companies will, by their own estimates, reach or exceed $17 billion. Cisco expects online sales to grow to 60 percent of total volume over the next year. If analyst projections for Cisco to grow to a $10.5 billion company by July of 1999 are correct, Cisco’s online sales will reach $5-6 billion by then. Dell expects to conduct half its total business online shortly after the year 2000. Even taking 50 percent of its current volume ($12 billion in 1997 and growing rapidly) would lead to $6 billion in online sales shortly after the year 2000. By 2000, GE aims to have all 12 of its business units purchasing via the Internet, for a total of $5 billion.

54. Forrester estimates that business-to-business electronic commerce will reach $327 billion by 2002. By 2002, the U.S. economy is projected to reach $9.993 trillion.

55. Number of Online Newspapers on the World Wide Web as of March 17, 1998. http://www.mediainfo.com/ephome/npaper/nphtm/stats.htm

56. "Top magazines by paid circulation: six month averages ended June 30, 1997." Advertising Age. Figures compiled by the Audit Bureau of Circulations and BPA International figures. http://www.adage.com/dataplace/archivers/dp169.html The three magazines that could not be located on the Web were: the Cable Guide, Home & Away and American Rifleman (although they may exist under a different name).

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60. Hu, Jim. "Study: Net use eclipsing TV." news.com. March 30, 1998. http://www.news.com/News/Item/0%2C4%2C20597%2c00.html?dd.ne.tx.wr

61. "Classified in Crisis." Newspaper Association of America. Newspaper Association of America Market & Business Analysis estimates; Presentation to NAA's Classified Advertising Project Team. "The Classified Imperative." Booz-Allen & Hamilton. January 19, 1996.

62. Noack, David. "The City Guide Wars: Free For-All Over Local Advertising." mediainfo.com. September 1997. http://www.mediainfo.com/ephome/news/newshtm/minfocom/0997c.htm

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64. Total advertising spending figures from McCann-Erickson.

65. Jupiter Communications Press Release. "Top End of Online Travel Market Closing as Bottom Tier Opens to New Players - - Online Travel Sites Must Differentiate or Die." April 16, 1997.

66. According to the Air Transport Association of America, domestic and international passenger revenues for U.S. Scheduled airlines in 1996 was $75 billion.

67. DOT Form 41 data, "Total Operating Revenues and Total Operating Expenses by Objective and Functional Groupings for U.S. Airlines with Annual Operating Revenues over $100 Million." U.S. Department of Transportation.

68. Phone conversation with Dave Swierenga, Air Transport Association of America. November 20, 1997.

69. Airlines pay commissions of 8 percent to traditional travel agents for each domestic ticket, with a cap of $25 for one-way travel and $50 for round-trip travel. Though there is no industry standard for commissions or fees paid to online travel agents, the major airlines pay significantly less for travel booked this way: American Airlines pays $15/ticket, United pays $10/ticket, Continental and Northwest pay 5 percent with a maximum of $25 for domestic trips.

70. "True Internet Banks." *Online Banking Report*. Last update April 7, 1998. See: http://www.onlinebankingreport.com/top100banks2.shtml and http://www.onlinebankingreport.com/fullserv2.shtml

71. "Internet Banking: A Survey of Current and Future Development." Booz-Allen & Hamilton, Inc. February 1996. Survey was limited to North American banks who currently had a Web site, among which were 34 commercial banks, 19 credit unions and 3 thrifts/FSBs.

72. Ibid.

73. "Lessons from the Payments War: The Battle Banks Must Win." Booz-Allen & Hamilton. November 1997. The check is the preferred method of payment 70 percent of the time for paying monthly bills in the U.S.

74. IBM Analysis

75. Jupiter Communications estimates that 4.5 million households were banking online in 1997, growing to 13.1 million by the year 2000. See: "1997 Home Banking Report." Jupiter Communications. Faulkner & Gray expects that 10 million households will be banking online by 2000. Source: Faulkner & Gray's *1998 Directory of Home Banking & Online Financial Services*. Booz-Allen & Hamilton projects that by 2000, more than 16 million households will do their banking using the Internet. See: "Internet Banking: Letting Customers Have It Their Way." *Financial Services ONLINE*. November 1997. pp. S3-S8. Find/SVP projects that upwards of 16 million households will bank online by the year 2001, "provided banks do a better job of marketing." See: "Online Banking: User Profiles, Market Segments and Forecasts." Find/SVP. March 1997.

76. Forrester Research

77. "The Long Uphill Climb." *Insurance Executive*. Winter 96/97. Ernst & Young.

78. "Internet Insurance: A Study of Current Use and Future Trends." Booz-Allen & Hamilton, Inc. February 1997. p. V-4.

79. "Global Insurance to the 21st Century." Economist Intelligence Unit Ltd. and IBM. 1996. Survey of insurance executives.

80. Jupiter Communications predicts that online travel will reach $8.5 billion by 2002, Forrester Research anticipates it will reach $7.4 billion by 2001.

81. Lipton, Beth. "Online trading up 150 percent." News.com. January 14, 1998. http://www.news.com/News/Item/Textonly/0,25,18101,00.html?pfv

82. "Ramping up for volume sales." *U.S. Banker*. New York. November 1997. According to the article, retail brokerage commissions across all channels should total $13.9 billion in 1997, of which $2.9 billion is attributable to the discount brokerage sector.

83. Jupiter Communications, Faulkner & Gray, Booz,Allen & Hamilton, and Find/SVP all predict that at least 10 million households will do their banking online by 2000. The most conservative estimate given is 10 million; the most optimistic is 16 million.

84. Forrester Research.

85. CommerceNet/Nielsen. *Internet Demographic Study*. CommerceNet/Nielsen. Vol. 1 & 2. Spring 1997. The Fall 1997 statistics were provided by CommerceNet/Nielsen representatives. See also: CommerceNet. "Electronic Commerce on the Rise According to CommerceNet/Nielsen Media Research Survey" Press Release. December 11, 1997. http://www.commerce.net/news/press/121197.html

86. Forrester Research.

87. Clark, Tim, "Xmas sales up for Net merchants," news.com, December 31, 1997.

88. Armstrong, Larry and Kerwin, Kathleen. "Downloading their Dream Cars." *Business Week*. March 9, 1998. Year 2000 projection is based on December 1997 phone interview with John Osborn, JD Power and Associates.

89. Goth, Nikki C. "Sweet Smell of Success." *H!TS supplement*. Red Herring online. Spring 1997. http://www.herring.com/hits/03/800.html

90. Forrester Research and Robertson Stephens 1997 estimates. Note: for purposes of this report, retail does not include travel or auto.

91. Meeker, Mary and Pearson, Sharon. *Morgan Stanley U.S. Investment Research: Internet Retail*. Morgan Stanley. May 28, 1997. pp.4-2+. The report estimates that mail order spending in the U.S. ranged from $71 - $155 B in 1996. It posits that Internet retailing's growth may occur three to five times faster than mail order did, given the growth in the

number of Internet users and the ease and efficiency of ordering from the Internet. Based on these assumptions, Morgan Stanley estimates that Internet retailing could reach $115 billion in five to eight years.

92. "1-800-FLOWERS announces key findings in on-line purchase habits..." 1-800-FLOWERS. Press Release. December 23, 1997.

93. Green, Heather. "A Little Net Privacy, Please." *Business Week*. March 16, 1998.

94. Discounts typically do not include the cost of delivery. When added to the cost of a single item, delivery charges may result in a higher price than can be found in some stores. Combining multiple items in a single delivery lowers the total cost and consumers may save money versus store prices.

95. Lipton, Beth. "Online trading up 150 percent." News.com. January 14, 1998. http://www.news.com/News/Item/Textonly/0,25,18101,00.html?pfv

96. These numbers represent wage and salary employment only, not self-employed and unpaid family workers. Total employment figures which include wage and salary, self-employed, and unpaid family workers are slightly higher.

97. The U.S. Department of Transportation reports that 2-7 million people telecommute. See: "Successful Telecommuting Programs in the Public and Private Sectors: A Report to Congress." U.S. Department of Transportation, August 1997, pp.3-5.

    A recent survey of 2,000 U.S. households by Find/SVP suggests that the figure might even be higher. Their results find that the number of telecommuters in the U.S. jumped to 11.1 million in 1997, up from 9.7 million in 1996. Three out of four telecommuters owned home computers and 43 percent have multiple phone lines. Thirty-five percent of today's telecommuters use the Internet and e-mail. Http://etrg.findsvp.com:80/prls/pr97/telecomm.html

98. "Successful Telecommuting Programs in the Public and Private Sectors: A Report to Congress." U.S. Department of Transportation, August 1997, pp.3-5.

APPENDIX 1

INFORMATION TECHNOLOGY INDUSTRIES–

OF GROWING IMPORTANCE TO THE ECONOMY AND JOBS

APPENDIX 1

INFORMATION TECHNOLOGY INDUSTRIES- OF GROWING IMPORTANCE TO THE ECONOMY AND JOBS

FIGURES

TABLES

INFORMATION TECHNOLOGY INDUSTRIES- OF GROWING IMPORTANCE TO THE ECONOMY AND JOBS

In the 1990s, information technology (IT) has altered the way businesses and consumers interact. Domestic and worldwide use of computer hardware and software products and communications equipment and services is converging into a single market. This market supports the global information infrastructure (GII), which is dominated by the Internet. Although IT is used by all industries to some degree, industries that support the GII are, for the purpose of this report, considered to be IT industries (Table 1). The criteria for the selection of IT industries and the methodology used to derive the charts below are described in the "Data and Methodology" section.

IT industries enable electronic commerce (e-commerce), thus their health and/or performance give some indication of the potential size and likely growth of e-commerce. This analysis presents an estimate of the size and growth of IT industries and their importance to overall U.S. economic and employment growth. Growth of IT industries provides us with some idea of the past and probable future success of e-commerce, but should not be interpreted as a direct measure of it.

IT Industries and Recent Economic Performance

The economy has been performing well lately, in terms of growth, employment, inflation, and productivity. Between 1996 and 1997, the economy grew 3.8 percent in inflation adjusted or real dollars, about 3 million new civilian employees were added, inflation remained low, 2.3 percent,[1] and business productivity increased by 1.9 percent. Some analysts believe that growth of the IT sector helps account for a large part of this good performance and the findings in this paper lend support to their assessments. In recent testimony to Congress, Federal Reserve Board Chairman, Alan Greenspan noted that

> "... our nation has been experiencing a higher growth rate of productivity -- output per hour worked -- in recent years. The dramatic improvements in computing power and communication and information technology appear to have been a major force behind this beneficial trend."[2]

Other analysts believe, however, that other factors may account for recent good performance and that the data do not yet confirm whether the recent burst of activity in the IT sector has had large positive effects on the rest of the economy. Because of the lags between bursts of investment and their economic effects taking hold, we are not yet able to assess the full economic effects of the recent dramatic growth in IT investment.

One of the most notable developments in recent years has been the rapid increase in the IT sector's (computing and communications) share of investment activity and the overall economy. IT grew from 4.9 percent of the economy in 1985 to 6.1 percent in 1990. In 1990, the IT share of the economy was proportional to its contribution to overall economic growth. Beginning in 1994, however, the IT sectors contributed twice its share of the economy to overall nominal economic growth.

In 1996, IT industries accounted for an estimated 7.5 percent share of the economy[3] and an estimated 15.8 percent of the rise in Gross Domestic Product (GDP), in current dollar terms as measured by its earned income. By 1997, IT industries accounted for an estimated 7.8 percent of GDP and 12.4 percent of its nominal growth, while in 1998, IT industries may account for as much as 8.2 percent of the economy and an estimated 14.7 percent of its nominal growth.

What makes this rise in IT's nominal share of the economy even more remarkable is the fact that IT prices, adjusted for quality improvements, have been falling while prices in the rest of the economy have been rising. In 1996 and 1997, declining prices in IT industries (as measured by their overall implicit deflator) lowered the annual change in prices in the overall economy by an estimated one full percentage point. Thus, the estimated real contribution of this sector to economic expansion was greater than what the nominal shares indicate. In recent years, an average of over one-quarter of total real economic growth can be attributed to IT industries.

In 1996, the IT workforce, as defined by employment in IT industries (Table 1) and employees with IT-related occupations (Table 2), across the economy, was 7.4 million workers (6.2 percent

Table 1. Information Technology Industries

SIC	Industry	SIC	Industry
Hardware		**Software and Services**	
3571,2,5,7	Computers and equipment	7371	Computer programming services
5045 pt.	Wholesale trade of computers and equipment	7372	Prepackaged software
5734 pt.	Retail trade of computers and equipment 5045 pt.		Wholesale trade of software
3578,9	Calculating and office machines, nec	5734 pt.	Retail trade of software
3695	Magnetic and optical recording media	7373	Computer integrated systems design
3671	Electron tubes	7374	Computer processing, data preparation
3672	Printed circuit boards	7375	Information retrieval services
3674	Semiconductors	7376	Computer services management
3675-9	Passive electronic components	7377	Computer rental and leasing
3823	Industrial instruments for measurement	7378	Computer maintenance and repair
3825	Instruments for measuring electricity	7379	Computer related services, nec
3826	Laboratory analytical instruments		
Communications Equipment		**Communications Services**	
3651	Household audio and video equipment	481, 22, 99	Telephone and telegraph Communications
3661	Telephone and telegraph equipment		
3663	Radio and TV and communications equipment	4832	Radio broadcasting
		4833	Television broadcasting
		4841	Cable and other pay TV services

of total employment) with an average annual wage of $45,737,[4] compared with a total employment of 119.6 million and an annual average wage of $28,000 (for all private employees). The Bureau of Labor Statistics (BLS) projects that the demand for these workers will increase to 9.5 million by 2006.

The fastest growing segment of IT workers is in the software and services industries. Between 1985 and 1996, employment in these industries more than doubled from just over one-half million workers to 1.2 million with an average annual wage of about $56,000. By 2006, BLS projects the demand for these workers to double again to 2.5 million.

The debate over the relation of IT industries to the health of the economy will continue for some time. Although the results of this paper suggest a healthy relationship, more data and analysis, especially in the area of IT-generated productivity improvements throughout the economy and the contribution to non-inflationary growth, are needed.

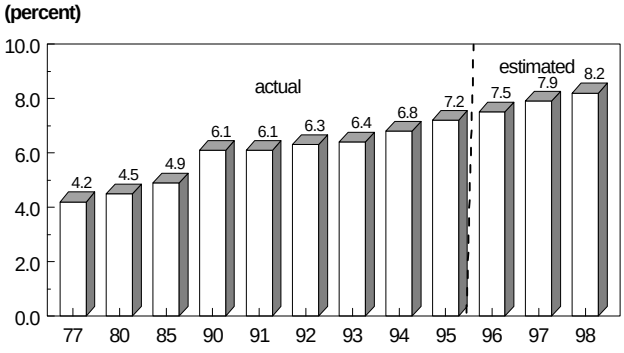
IMPACT ON ECONOMIC GROWTH, INFLATION, AND BUSINESS INVESTMENT

Share of the Economy and Contribution to Growth

The IT share of the economy, in current dollars, hovered between 4- and 5-percent from the late 1970s through the mid-1980s (Figure 1). Then, as the personal computer became more common in business and in the home, the IT share of the economy jumped by 1.2 percentage points between 1985 and 1990 to reach 6.1 percent. With the commercialization of the Internet, it started its upward climb again, growing from 6.4 percent in 1993 to an expected 8.2 percent by 1998.

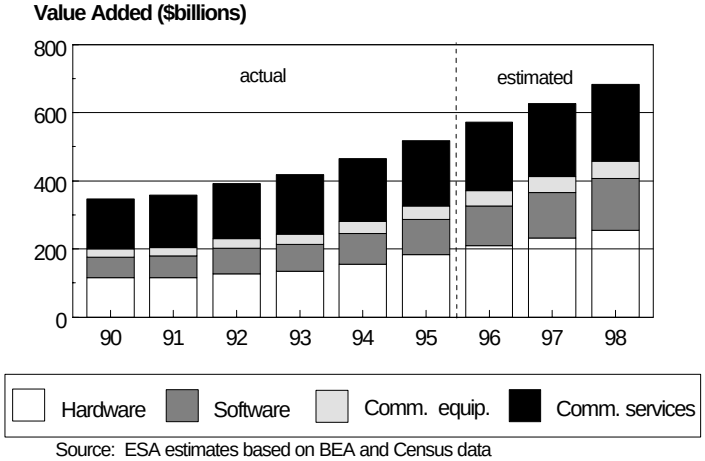
Between 1990 and 1998, value added of IT industries are expected to roughly double, growing from $347 billion to $680 billion (Figure 2). Hardware sales, comprised of computer hardware, electronic components, and some instruments, are expected to grow from $116 billion in 1990 to $254 billion by 1998—more than doubling over the period. Software sales are expected to increase by two and one-half times from $60 billion to $152 billion. Value added of the communications industries, by comparison, is expected to increase by about 60 percent, from $171.2 billion in 1990 to $276.5 billion in 1998.

Figure 1. Information Technology Industries: Share of the Economy Rises Slowly in the 1980s, Accelerates in the 1990s



Source: DOC's Economics and Statistics Administration (ESA) estimates based on Bureau of Economic Analysis (BEA) and Census data

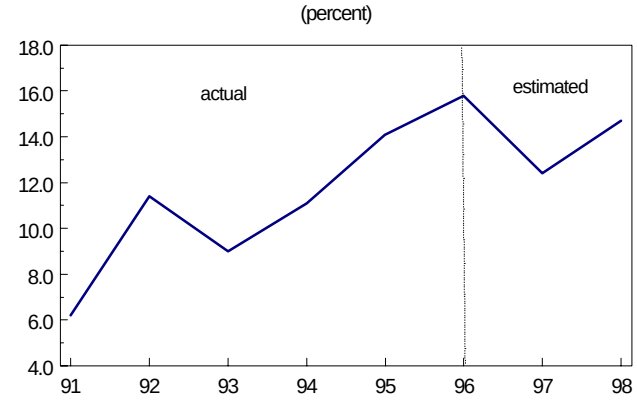
Figure 2. While Communications Revenues Increase By Half Computer Hardware and Software Sales More Than Double



Source: ESA estimates based on BEA and Census data

IT industries contributed a proportional share to the nominal growth of GDP in the early 1990s. For instance, in 1991, IT industries accounted for 6.1 percent of the economy and 6.2 percent of overall economic growth (Figure 3A). Since the commercialization of the Internet in the mid-1990s, IT's contribution to nominal GDP growth has expanded rapidly. Between 1994 and 1998, IT is responsible for 11-16 percent of overall economic growth, while its share of the economy ranges between 6.8-8.2 percent.

Figure 3A. IT Industries: Contribution to Economic Growth Rises from 6% in 1991 to Around 14% between 1995 and 1998

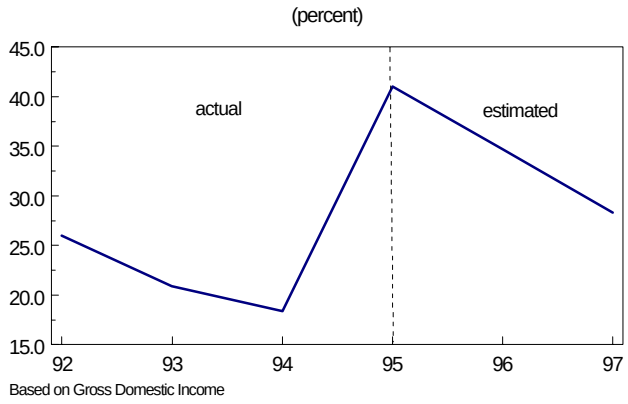


Source: ESA estimates based on BEA and Census data

The contribution of IT industries to nominal growth in the economy understates its full impact. The difference between the nominal and real contributions to growth results from significant productivity growth in some of these industries. Large gains in the quality of IT products, particularly computers and semiconductors, have been achieved without comparable increases in costs.[5]

Between 1992 and 1997, IT industries contributed over one-quarter of the real growth in the economy.[6] (Figure 3B) The IT contribution to real economic growth fluctuates considerably from year to year. From 1992 to 1994, IT growth was only slightly higher than overall economic growth.[7] In 1995, a spurt of investment in IT products in combination with a rather lackluster economy resulted in a dramatic increase in the IT contribution to real economic growth. By 1997, the IT contribution to real economic growth dropped back down to just over one-quarter, primarily

Figure 3B. IT Industries Average Over One-Quarter of Total Real Economic Growth, 1992-1997



Source: ESA estimates based on BEA and Census data

because the rest of the economy was doing well.

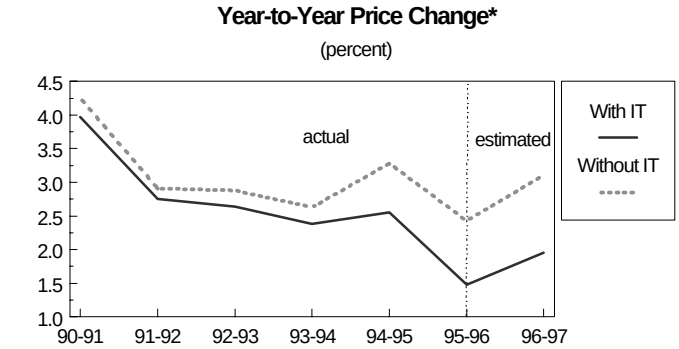
The inflation adjusted measure of the IT sector may overstate its practical contribution to overall economic growth, as businesses may not yet taking full advantage of the quality improvements in the IT products.

Inflation and IT Industries

Since 1996, the Bureau of Economic Analysis (BEA) has adopted quality-adjusted price indexes for computers and semiconductors for use in their real GDP calculations. The need to incorporate quality-adjusted deflators (sometimes called hedonic deflators) arose because of the increasing performance and declining prices of these products. Since the 1960s, the performance of microprocessors has followed Moore's Law--transistor (or microprocessor) density doubling about every 18 months. And during this time of phenomenal growth in performance, the average price of the transistor has fallen by an unprecedented six orders of magnitude. A doubling of microprocessor performance every 18 months is projected to continue for the next 20 years.[8]

With prices of computers and semiconductors falling, overall prices within IT industries have helped keep overall inflation down (Figure 4). Inflation in 1997, as measured by average prices in the overall economy,[9] was 2.0 percent. Without IT industries keeping prices down, inflation would have been 3.1 percent. In 1996, overall price inflation would have been 0.9 percentage points higher without declining prices in IT industries.

Figure 4. IT Industries Helped to Keep Overall Inflation Down



*As measured by the Gross Domestic Income implicit price deflator

Source: ESA estimates based on BEA and Census data

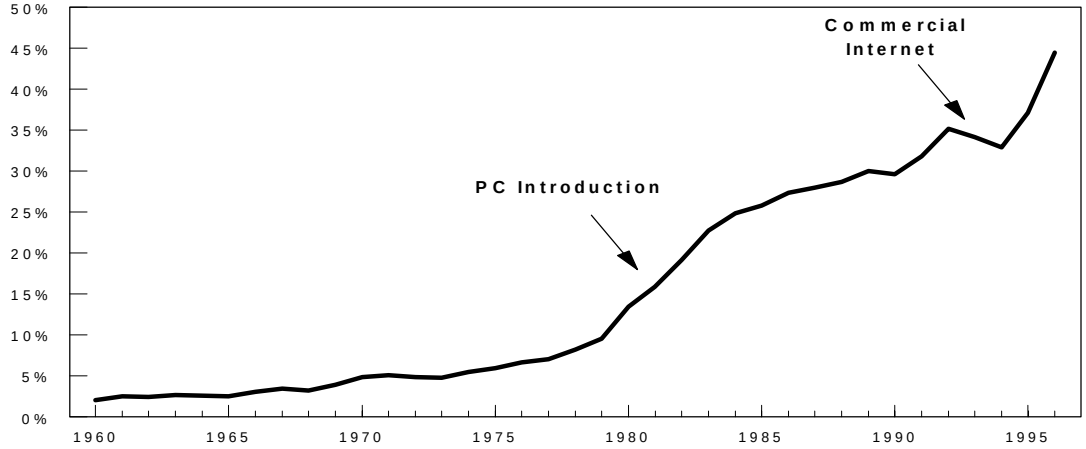
Industry Use of IT Equipment

IT industries not only directly have more than proportional impact on the growth of the economy, but the use of IT products has been an important and growing part of capital investments across all industries. In 1994, of the 53 aggregate industry sectors (across the economy), 40 percent or more of the total capital stock of 15 industries was comprised of IT equipment, 13 between 25 and 39 percent, 20 between 10 to 24 percent, and only 5 had a less than 10 percent share. IT spending, in inflation adjusted dollars,[10] as a share of total business equipment spending, grew

from negligible to 45 percent in a little over 30 years (Figure 5). In 1965, business spending for IT equipment was less than 5 percent of total business spending. By the early 1980s, IT spending jumped to about 15 percent. In the early 1990s, IT spending represented about one-third of all business equipment spending, and by 1996, almost half. The slope of the curve suggests that by 2000, business spending for IT equipment should exceed half of all spending on capital equipment.

A parallel can be drawn between the proliferation of computers (and other IT equipment) in the last three decades and the spread of electricity in the mid 1800s and early 1900s.[11] First harnessed

Figure 5. Information Technology Spending as a Share of Business Equipment Spending



Source: Bureau of Economic Analysis

* Inflation-adjusted investment in information processing equipment (office, computing, and accounting machinery, communications equipment, instruments, and photocopying equipment) as a share of total private equipment investment.

in 1831, electricity's potential had to wait 50 years until the first power station was built in 1882.[12] Industry then began a 50-year transition from using mechanical power to using power generated by electricity. In 1899, less than 5 percent of the power used by industry was from electric power generation. Fifty years later, electricity powered 80 percent of factories and households across the country.

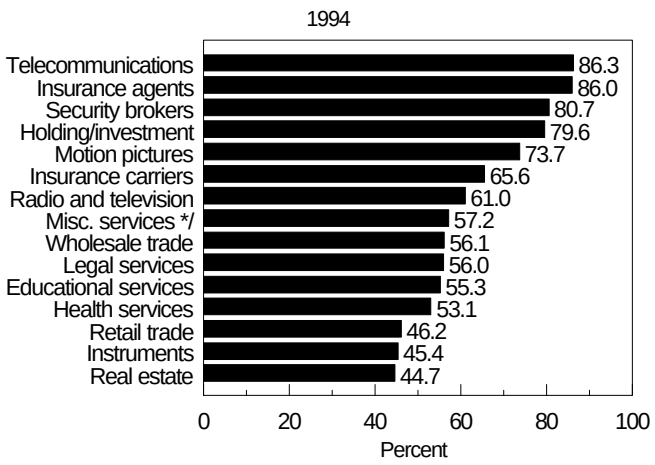
The increase in the share of IT-related capital by industries corresponds to a decline in the share of the other categories of business equipment and can be viewed as evidence of basic structural change among and within industries. Between 1977 and 1996, the share of business spending for the major categories of capital equipment (with the exception of IT) declined—the share of business spending for industrial equipment such as engines and machinery dropped by 5 percentage points over this period (year-end estimates); transportation equipment, such as trucks and autos, dropped by 2 percentage points; and other capital equipment, such as office furniture,

dropped 3 percentage points. At the same time, the share of business spending for IT-related equipment increased by 10 percentage points.

In some industries such as telecommunications, insurance, and securities brokerages, IT equipment constitutes over eighty percent of all the equipment used (Figure 6).

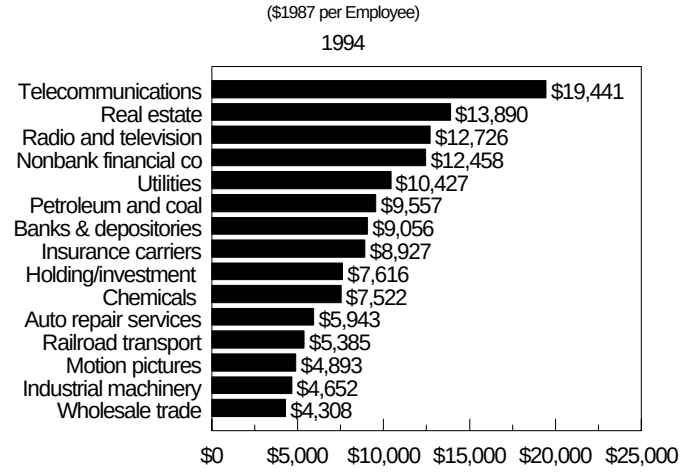
IT equipment used per employee is another measure of IT intensity (Figure 7). The top 15 industries, ranked by this criterion, include telecommunications, real estate, radio and television, nonbank financial companies and utilities. They spend over $10,000 (1987 dollars) per employee compared with an economy-wide average of $2,500. By this measure, while telecommunications remains at the top, other industries such as banks, petroleum, chemicals, and railroad transportation make it to the top tiers as major users of IT equipment.

Figure 6. IT Net Capital Stock - Top 15 Industries



Source: Bureau of Economic Analysis
*/ Includes social, management, engineering, and services n.e.c.

Figure 7. IT Capital Investment Intensity - Top 15 Industries



Source: Bureau of Economic Analysis

Industries that are major users of IT equipment, as shown in Figures 6 and 7, constitute about half of the economy and employ about half the workforce.

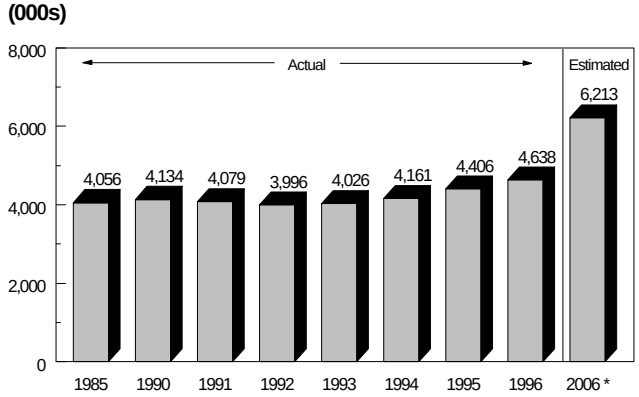
THE IT WORKFORCE

Total employment in IT-related jobs is defined as all employees in IT industries and all employees in IT-related occupations in non-IT industries.[13] In 1996, 7.4 million people worked in the IT workforce. Approximately two-thirds of these jobs were in IT industries, the other one-third were spread across the rest of the economy. The sections that follow include a separate analysis of employment in IT industries followed by a discussion of employment in IT-related occupations. Note that workers in IT industries and workers with IT-related occupations are not additive since approximately one-third of the workers with IT-related occupations are in IT industries.

Employment in IT Industries

Employment in IT industries has remained relatively stable even as its share of the economy has grown (Figure 8). From 1985 to 1990, employment in IT industries grew at only 0.4 percent annually, much slower than the 2.4 percent annual rate of growth for all private industries.

Figure 8. Information Technology Industries: Employment Accelerates after Remaining Flat for Several Years



Source: Bureau of Labor Statistics

* ESA projections of employment demand based on BLS projections.

IT industries have made a small but positive contribution to overall private employment growth, especially since 1993. IT industries contributed very little to the decline in employment from 1990 to 1991, with a loss of only 56,000 of the 1.2 million jobs lost. They supplied over 230,000 of the 2.2 million increase in jobs from 1995 to 1996, or 10.5 percent (Figure 9).

Employment in IT industries is projected to increase 3.0 percent annually from 1996 to 2006, more than twice as fast as the U.S. average of 1.4 percent.

Although historical employment data suggest little change in aggregate IT employment, there has been a fundamental shift in employment among industries. IT industries that produce computer

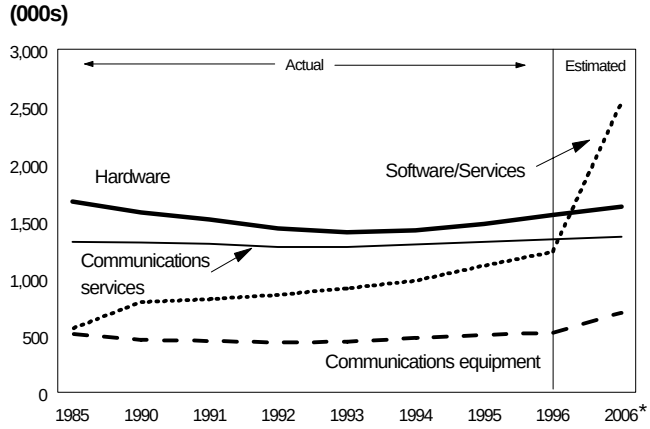
hardware and communications equipment have lost jobs as technological changes have made some processes routine, thus eliminating jobs or reducing the need for in-house staff to perform some jobs.[14] Increased outsourcing is reflected in increased employment in IT industries that provide maintenance and other support services. Also, more computer assembly is being done at the wholesale level.

Among the four IT industry groups, providers of software and services have experienced the most rapid employment growth. From 1985 to 1996, employment in these industries more than doubled from 557,000 to 1.2 million workers, with the fastest growth occurring in the computer programming and prepackaged software industries (Figure 10). By 2006, software and services employment will more than double again to 2.5 million workers, still driven by computer programming and prepackaged software industries. Communications equipment and communications services have seen slow employment growth, despite above average growth in sub-industries such as household audio and video equipment retail stores and cable television. In 1996 there were 116,000 fewer workers in industries that produce computer and related hardware than in 1985. However, employment in several sub-industries such as computer retail sellers and manufacturers of laboratory analytical instruments has grown faster than average.

Figure 9. Information Technology Industries: Contribution to Private Employment Growth is Small but Growing

Source: ESA estimates based on Bureau of Labor Statistics data.

Figure 10. Software/Services Industries Lead IT Industries in Employment Growth

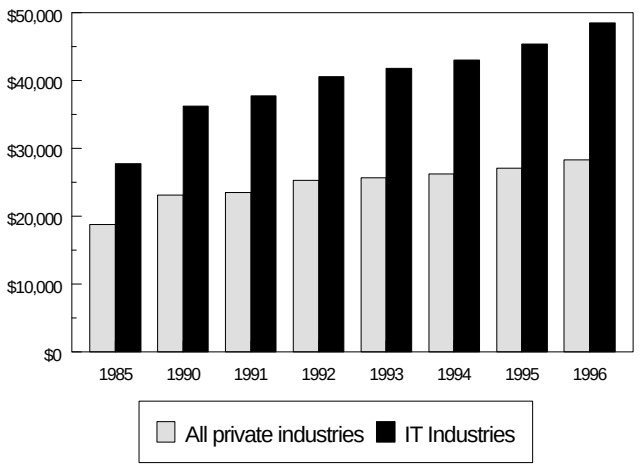


Source: Bureau of Labor Statistics

* ESA projections of employment demand based on BLS projections.

Earnings of Workers in IT Industries

Figure 11. IT Industries Pay Above Average Wages

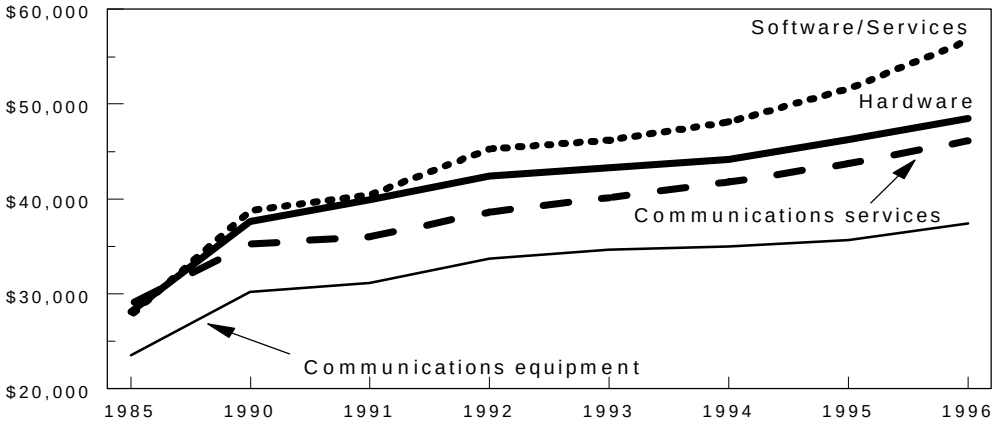


Source: ESA estimates based on Bureau of Labor Statistics data.

IT industries represent a small, but growing share of the total annual wage bill, accounting for 7.9 percent of all wages paid in 1996 compared with 7.4 percent in 1985. Strong growth in value added of the IT industries in the 1990s and rapid growth in productivity (as measured by value added per employee) resulted in a corresponding increase in wages (Figure 11). Wages of IT workers have been growing at 5.2 percent annually since 1985 compared with 3.8 percent for all private workers. In 1996, the average annual wages paid to workers in IT industries was almost $48,000 compared with $28,000 for all private employees.

Among the IT industries, workers in the software and services industries earned the highest annual wages, almost $56,000 in 1996 (Figure 12). This group also had the fastest increase in annual wages)growing at 6.6 percent annually since 1985. Average earnings of workers in the

Figure 12. Workers in the Software/Services Industries Have Seen Fastest Wage Growth



Source: ESA estimates based on Bureau of Labor Statistics data.

hardware-related and communications services industries were similar at around $46,000 to $48,000 per year. Communications equipment workers earned about $37,000 annually.

Employment in IT Occupations

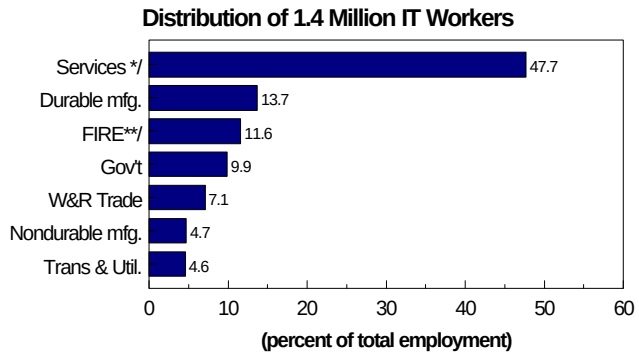
In addition to the IT industries themselves, IT workers are needed across the economy to install, operate, program, repair, maintain, design and develop IT equipment and services (Table 2).

Table 2. IT-Related Occupations

Engineering, science, and computer systems managers	Computer engineers, scientists, and systems analysts
Electrical and electronic engineers	Computer programmers
Electrical technicians	Computer and peripheral equipment operators
Electrical power line installers and repairers	Data entry keyers
Electronics repairers	Electronic equipment assemblers
Communications equipment operators	Data processing equipment repairers
Central office and PBX installers and repairers	Broadcast technicians
Calculating machine operators	Duplicating machine operators
Electronic semiconductor assemblers	Electromechanical equipment assemblers
Telephone and Cable TV installers and repairers	Electrical and electronic assemblers

In 1996, 4.2 million people worked in IT-related occupations. About one-third of these workers (1.4 million) were employed by IT industries and 2.8 million worked in non-IT industries. As an example, in 1996 there were 1.4 million computer scientists, systems analysts, computer engineers, and computer programmers. The services sector employed 47.7 percent of these workers—primarily in business services, health services, education, and engineering services. Durable goods manufacturing industries, financial services, and government were other large employers (Figure 13).

Figure 13. Employment of Computer Engineers, Scientists, Systems Analysts, and Computer Programmers, 1996



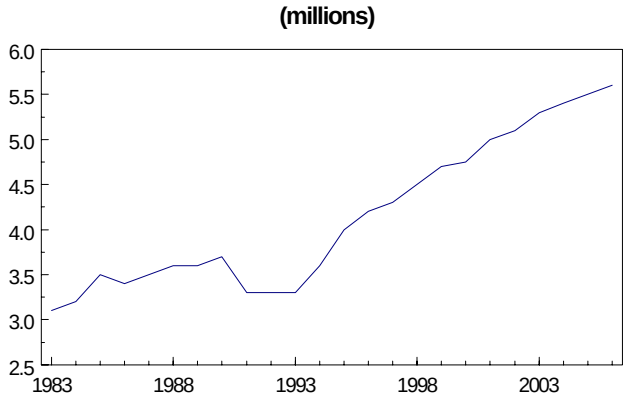
*/ including business, health, legal, education, social, & engineering services

**/Finance, Insurance, and Real Estate

Source: ESA estimates based on BLS data

The number of IT workers increased from 3.1 million in 1983 to 3.7 million in 1990 (Figure 14). After the slight decline in the early 1990s, IT jobs grew to 4.2 million by 1996. (Table 3 briefly describes some of these occupations.[15])

Figure 14. Employment in IT Occupations Across All Industries, 1983-2006



Source: ESA estimates based on BLS data

Table 3. Some IT-Related Occupations

Engineering, Science, and Computer Systems Managers plan, coordinate, and direct research, development, design, production, and computer-related activities. Many have a bachelor's or master's degree in computer or information science. In 1996, the mean annual wage of these managers was almost $66,000.

Computer engineers, scientists, and systems analysts--Computer engineers work with the hardware and software aspects of systems design and development. Computer scientists generally design computers and the software that runs them, and conduct research. Systems analysts use their skill in computers to develop business specific applications. Ph.D.'s or, at least master's degrees, are preferable for scientists and engineers in research labs or academic institutions. In 1996, the mean annual wage of computer engineers was almost $55,000. The mean annual wage of systems analysts and computer programmers, combined, was $48,000.

Electrical and Electronics Engineers design, develop, test, and supervise the manufacture of electrical and electronic equipment, including computer hardware, and communications and video equipment. A bachelor's degree is required for beginning engineers. In 1996, their mean annual wage was about $53,000.

Computer programmers write and maintain the detailed instructions that computers must execute to perform their functions. There are no universal training requirements for programmers, although the majority hold a four-year degree. In 1996, the mean annual wage of these workers (combined with systems analysts) was $48,000.

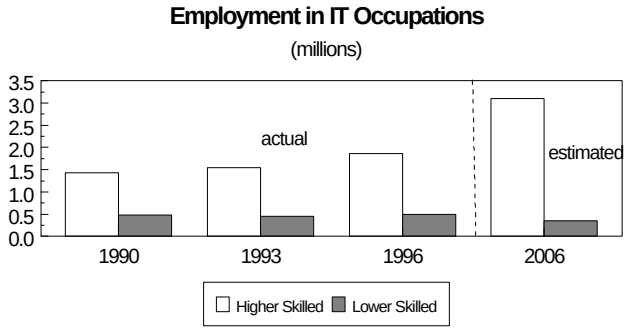
Communications Equipment Mechanics install, repair, and maintain complex and sophisticated communications equipment. Most employers prefer one to two years of training in electronics. In 1996, the mean annual wage for central office and PBX installers and repairers was about $40,000.

Broadcast Technicians install, test, repair, set up, and operate electronic equipment used to record and transmit radio and television programs. Employers prefer workers with training in broadcast technology or in engineering or electronics. A four-year college degree is not a prerequisite. In 1996, their mean annual wage was about $31,000.

Computer and Office Machine Repairers install, maintain, and repair computer and office equipment. Most employers prefer applicants with formal one- to two-year training in electronics specializing in computers. In 1996, their mean annual wage was $29,000.

BLS projects that 5.6 million workers will be needed to fill IT-related jobs by 2006. The demand for higher skilled IT jobs is expected to grow dramatically while the demand for lesser-skilled IT jobs is expected to decline (Figure 15). For instance, jobs for computer engineers, scientists, and systems analysts which typically require at least a four-year college degree, grew from 474,000 in 1990 to 874,000 in 1996. By 2006, BLS projects that 1.8 million people will be needed to fill these jobs. The demand for computer programmers, jobs requiring two to four years of college or advanced training, is expected to increase, rising from 548,000 in 1996 to 665,000 in 2006. On the other hand, lesser-skilled jobs like computer operators and duplicating machine operators, which only require a high school diploma, are expected to decline from 481,000 in 1996 to 342,000 in 2006.

Figure 15. Demand Should Grow for Highly Skilled IT Workers, Lower Skilled Jobs Decline



Higher skilled IT workers include elect. and comp. engineers, scientists, programmers, and systems analysts.
Lower skilled IT workers include computer and office machine operators.

Source: ESA estimates based on BLS data

The Internet is
also driving demand for workers with IT skills. Workers are needed to design Web pages, create graphics, code documents in Hypertext Markup Language (HTML) and program in Internet languages such as Java and C++. Webmasters responsible for the design, development, operation, and maintenance of Web sites earn starting salaries between $35,000 and $50,000; highly experienced webmasters earn $100,000 or more. Web developers, responsible for the actual creation of the Web site, are reported to earn a median salary of $55,000. On the lower end of the skill level in Internet jobs, customer service representatives that work for Internet Service Providers earn from $14,000 to $17,000 per year and up to $35,000 depending on experience.[16]

The demand for computer engineers, scientists, systems analysts, and computer programmers is expected to continue to increase through 2006. Despite this growth and anticipated demand, the number of U.S. graduates with a bachelor's degree in computer science declined by 40 percent

between 1986 and 1994. However, a bachelor's degree in computer science is not the only path of entry into an IT occupation. Other related academic fields, such as computer engineering and business information systems, can supply workers in these categories and even graduates in many non-science and engineering fields are employed in IT-related occupations.

At the same time demand for workers to fill IT-specific jobs is increasing, workers in a variety of non-IT occupations find themselves using computers and computerized devices–PCs, CAD, and CAM machines, computerized measuring and analytical instruments, testing and diagnostic equipment–to perform their jobs. Somewhat dated statistics (1993) show that nearly half of all workers regularly use a computer in their jobs, with even higher usage among more highly-skilled and educated workers.[17] Preparing students and workers to meet current and future labor market demand will require a new and determined commitment to education and training in mathematics and science.

DATA AND METHODOLOGY

DEFINING INFORMATION TECHNOLOGY INDUSTRIES

The first task in analyzing the IT sector was to choose a set of industries upon which to base the analysis. In this definition, IT industries produce, process, or transmit information goods and services as either intermediate demand (inputs to production to other industries) or as final products to consumption, investment, government purchases, or exports.[18] Other industries were considered to be IT industries since they provide the necessary infrastructure (communications) for the Internet to operate (Table 4).

IT industries are classified (and defined) according to the 1987 SIC manual, published by the Office of Management and Budget. IT industries are further separated into categories of Hardware, Software and Services, and Communications.

Hardware industries include computers and equipment, including their wholesale and retail sales, office machines, semiconductors, some other electronic component industries, and industries that produce measurement and laboratory analytical instruments. Wholesale sales of computers and equipment was included to capture the sales by manufacturers through their branch offices, accounted for by the Census as a wholesale sale. These sales were considered to be closely aligned with a manufacturer's sale; excluding their sale would result in a serious undercount. Retail sales were included in order to capture all other sales of computers.

Software and services industries include those that provide prepackaged software and services associated with computers. There is some concern that direct sales of software are underestimated because government data only detail the sales of prepackaged software for microcomputers. The cost of software loaded onto a mainframe computer for business or government use, therefore, may not be captured. A much greater problem exists with respect to international trade of software. In this case, the software cost reported to the Customs Bureau as an import might include only the cost of the cassette or CD-ROM. Once in the U.S., the software could be copied and resold any number of times. The same might be true for a U.S. manufacturer with foreign affiliates. In this case, the software could be developed in the U.S. and a single copy sent to their foreign affiliate and copied overseas to be used in their computer production. Accounting for these transactions is difficult to do, if not impossible.

Communications equipment and services industries were selected as IT industries since they provide the "infrastructure" that allows the connections between computers and servers that enable electronic commerce and provide the highways for access and movement.

Despite the attempt to cleanly designate the IT sector, there will always be some subjectivity with the data that are used to measure it. As IT goods and services are increasingly incorporated into non-IT goods and services, it is difficult to draw hard-and-fast boundaries. For instance, semiconductors are used in computers, but they are also used in automobiles, home appliances, and a variety of other goods. Because they provide computing power and intelligence to all of these products, we have included the entire semiconductor industry as IT. Similarly, the majority

of revenue by the telecommunications industry is still generated by traditional telephone service. Over time, however, virtually all IT investment will be part of interlinked communication systems.

Table 4. Information Technology Industries

Hardware Industries	SIC	NAICS
Computers and equipment	3571, 2, 5, 7	334111, 2, 3, 9
Wholesale trade of computers and equipment	5045 pt.	42143 pt.
Retail trade of computers and equipment 5734 pt.		44312 pt.
Calculating and office machines, nec	3578, 9	334119, 333313, 339942, 334518
Magnetic and optical recording media	3695	334613
Electron tubes	3671	334411
Printed circuit boards	3672	334412
Semiconductors	3674	334413
Passive electronic components	3675-9	334414, 334415, 334416, 334417, 334418, 336322, 334419
Industrial instruments for measurement	3823	334513
Instruments for measuring electricity	3825	334416, 334515
Laboratory analytical instruments	3826	334516
Software/Services Industries		
Computer Programming Services	7371	541513
Prepackaged software	7372	51121, 334611
Wholesale trade of software	5045 pt.	42143 pt.
Retail trade of software	5734 pt.	44312 pt.
Computer integrated systems design	7373	541512
Computer processing, data preparation	7374	51421
Information retrieval services	7375	514191
Computer services management	7376	541513
Computer rental and leasing	7377	53242
Computer maintenance and repair	7378	44312, 811212
Computer related services, nec.	7379	541512, 541519
Communications Equipment Industries		
Household audio and video equipment	3651	33431
Telephone and telegraph equipment	3661	33421, 334416, 334418
Radio and TV and communications equipment	3663	33422
Communications Services Industries		
Telephone and telegraph communications	481, 22, 99	513321, 513322, 51333, 51331, 513322, 51334, 51339
Radio broadcasting	4832	513111, 513112
Television broadcasting	4833	51312
Cable and other pay TV services	4841	51321, 51322

Note: Since the government is in the process of converting data collected under the SIC code to data collected under the NAICS code, both are provided here.

Due to the difficulty in isolating IT, no standard definition exists. Different governmental and private sector bodies propose their own definitions, sometimes breaking out IT as a separate sector, sometimes including it as part of a set of industries that they consider to be high-tech.

For example, BEA assesses high-technology industries. In addition to computer equipment and communications industries, their high-tech list includes those that produce an array of hardware for the national defense (military aircraft, aircraft engines, and electronics). The Bureau of the Census has just launched the use of the new industry classification system, called the North American Industry Classification (NAICS)–replacing the current SIC system–in their 1997 Economic Census. The NAICS provides for a new Information Sector, but its focus is primarily on industries that produce information and not hardware items such as computers or communications equipment.

The Organization for Economic Co-operation and Development (OECD) Statistical Panel of the Committee on Information, Computers, and Communications Policy, in August 1997, proposed a draft definition of the Information and Communications Technologies (ICT) sector.[19]

Industry associations have also produced varying definitions of IT and high-tech industries, but their selection was in part driven by their membership. For example, the American Electronics Association (AEA) provides an extensive list of industries that they consider as High Technology, inclusive of industries considered to be IT.[20] The Information Technology Institute's (ITI) list of IT industries includes a number of those that are also considered IT by the AEA, except for electronic component industries. Many of the industries included in these various definitions of IT are common. A number are not (Table 5).

Table 5. Comparison of Industries Selected as IT (or High Tech) by Different Organizations

SIC	Industry	This Study	ITI	AEA	NAICS
3571	Electronic computers	yes	yes	yes	no
3572	Computer storage devices	yes	yes	yes	no
3575	Computer terminals	yes	yes	yes	no
3577	Computer peripheral equipment	yes	yes	yes	no
5045 pt.	Wholesale trade of computers and equipment	yes	no	no	no
5734 pt.	Retail trade of computers and equipment	yes	no	no	no
3578	Calculating and accounting machines	yes	yes	yes	no
3579	Office machines, nec	yes	yes	yes	no
3671	Electron tubes	yes	no	yes	no
3672	Printed circuit boards	yes	no	yes	no
3674	Semiconductors	yes	no	yes	no
3675	Electronic capacitors	yes	no	yes	no
3676	Electronic resistors	yes	no	yes	no
3677	Electronic coils	yes	no	yes	no
3679	Electronic components, nec	yes	no	yes	no
3695	Magnetic and optical recording media	yes	no	no	no
3823	Industrial instruments for measurement	yes	no	yes	no
3825	Instruments for measuring electricity	yes	no	yes	no
3826	Laboratory analytical instruments	yes	no	yes	no
3651	Household audio and video equipment	yes	no	yes	no
3661	Telephone and telegraph equipment	yes	yes	yes	no
3663	Radio and TV communications equipment	yes	no	yes	no
4812	Radiotelephone communications	yes	no	yes	yes
4813	Telephone communications	yes	yes	yes	yes
4822	Telegraph and other message communications	yes	no	yes	yes
4832	Radio broadcasting	yes	no	no	yes
4833	Television broadcasting	yes	no	no	yes
4841	Cable and other pay TV services	yes	no	yes	yes
4899	Communications services, nec	yes	no	no	yes
7371	Computer programming services	yes	yes	yes	yes
7372	Prepackaged software	yes	yes	yes	yes
5045 pt.	Wholesale trade of software	yes	no	no	no
5734 pt.	Retail trade of software	yes	no	no	no
7373	Computer integrated systems design	yes	yes	yes	no
7374	Computer processing and data preparation	yes	yes	yes	yes
7375	Information retrieval services	yes	yes	yes	yes
7377	Computer services management	yes	yes	yes	no
7378	Computer rental and leasing	yes	yes	yes	no
7379	Computer related services, nec	yes	yes	yes	no
	Other Industries				
2711	Newspaper publishing	no	no	no	yes
2721	Periodical publishing	no	no	no	yes
2731	Book publishing	no	no	no	yes
2741	Misc. Publishing, including databases	no	no	no	yes
2761	Manifold business forms	no	yes	no	no
2771	Greeting card publishing	no	no	no	yes
3652	Phonographic records	no	no	yes	no
3669	Other communications equipment	no	no	yes	no
3812	Search and navigation equipment	no	no	yes	no
3822	Environmental controls	no	no	yes	no
3824	Fluid meters and counting devices	no	no	yes	no
3827	Optical instruments	no	no	yes	no
3829	Other measuring and controlling devices	no	no	yes	no
3844	X-ray apparatus	no	no	yes	no
3845	Electromedical apparatus	no	no	yes	no
3861	Photographic equipment and supplies	no	yes	yes	no
7383, 89	News syndicates, business services, nec	no	no	no	yes
78	Motion pictures	no	no	no	yes

APPROACH USED TO MEASURE IT INDUSTRIES

This paper measures the contribution of IT industries to economic output and growth, inflation, business investment, and employment. Output of IT industries is measured in terms of value added. Value added is equal to total receipts (also known as sales or revenues) and other operating income less purchases of intermediate goods and services from other industries (adjusted for salable inventories) and imports minus purchased operating expenses. Value added can be thought of more directly; i.e., value added is the sum of all earned income of an industry including its salaries and wages, benefits, business taxes, and profits.

Value added can be added across industries to produce an aggregate measurement of the IT sector. The value added of all industries is equal to the Gross Domestic Income (GDI). This method of estimating these industries' share of the economy is commonly called an "income" side approach.

A "product" side approach could be used as an alternative. The product side approach adds final expenditures (final demand) on commodities produced by industries by major segments of the economy—consumption, investment, net exports, and government. Final demand across all industries is equal to Gross Domestic Product (GDP). Theoretically, the estimates from the income and the product sides should be the same. In practice, they are not and the difference between GDI and GDP is officially known as the "statistical discrepancy."[21]

The income, rather than the product, side approach was used in this analysis since the industry detail (shown in Table 4) available using government value added data exceeds the detail of the available data on commodities. Also, the commodity data are not consistently reported across all components of GDP. The income side approach based on industry data, therefore, allows for more precision in measuring industries. On the other hand, the income side approach forces the analyst to make a number of assumptions about the data, detailed in the next section on value added.

The IT workforce is defined as all employees in IT industries and all workers in IT-related occupations, across all industries and government. Care was taken to not double count workers with IT-related occupations working in IT industries. IT employment is presented in two parts--(1) total employment across IT industries and (2) total employment in occupations that are considered to be IT-related. Data are based on historical reporting and projections made by the BLS. The occupations chosen as IT-related were selected in consultation with BLS and other agencies (Table 6).

Table 6. IT-Related Occupations, By BLS Occupation Classification

Occupation	BLS Code*
Engineering, science, and computer systems managers	130170008
Electrical and electronics engineers	221260054
Computer systems analysts, engineers, and scientists	251970087
Electrical and electronic technicians and technologists	225250250
Broadcast technicians	340280274
Computer programmers	251060275
Communications equipment operators	571000332
Computer operators	561000340
Data entry keyers, except composing	560170405
Duplicating, mail, and other office machine operators	562000407
Central office and PBX installers and repairers	855020643
Data processing equipment repairers	857050651
Electrical power line installers and repairers	857230652
Electronics repairers, commercial and industrial equipment	857170654
Telephone and cable TV line installers and repairers	857020656
Electrical and electronic equipment assemblers, precision	931140716
Electromechanical equipment assemblers, precision	931110707
Electronic semiconductor processors	929020927

*Codes used in industry-occupation matrices for 1996-2006

VALUE ADDED OF IT INDUSTRIES, 1990-95

Sources used to provide value added are from published U.S. government documents. The specific sources of data that follow are from the Department of Commerce's Bureau of the Census or BEA.[22] The following is a description of the data and estimates made to derive value added for the (1) manufacturing IT industries, (2) the software and services IT industries, (3) the communications services IT industries, (4) the wholesale trade of computer equipment and software, and (5) the retail trade of computer equipment and software (Table 7).

Value added for IT manufacturing industries, including the hardware and communications equipment IT industries were taken directly from the *Annual Survey of Manufacturers* (ASM) and the *1992 Census of Manufacturers* (COM) published by the Bureau of the Census. The latest published ASM is for 1995. The 1996 ASM will be available in 1998. The next COM will be for 1997 and will include industries classified according to the NAICS definitions. Value added of the hardware IT sector increased from $116.1 billion in 1990 to $183.6 billion in 1995. The IT communications equipment sector increased from $24.5 billion in 1990 to $39.9 billion in 1995.

Value added for the software and services IT industries was derived using the Census series

Table 7. Information Technology Industries: Share of the Economy and Contribution to Economic Growth, 1990 -1998

Industry	SIC	1990	1991	1992	1993	1994	1995	1996	1997	1998
		(Value Added: $millions, except as noted)						estimate	estimate	estimate
Total Gross Domestic Product (GDP)*		5,726,400.0	5,906,600.0	6,199,700.0	6,505,500.0	6,932,400.0	7,293,600.0	7,636,600.0	8,081,000.0	8,461,644.0
Year-to-Year GDP Change (%)			3.15%	4.96%	4.93%	6.56%	5.21%	4.70%	5.82%	4.71%
Hardware										
Computers and equipment	3571,2,5,7	28,676.8	25,091.1	26,630.8	26,941.6	31,351.6	32,931.2	37,153.6	41,273.2	45,081.8
Computers and equipment wholesale sales	5045 pt	33,599.0	35,747.0	39,465.0	42,275.0	43,249.0	50,756.0	61,129.0	67,907.0	74,173.3
Computers and equipment retail sales	5734 pt	1,857.2	1,888.5	1,915.3	1,994.9	2,505.2	2,513.8	2,836.1	3,150.6	3,441.3
Calculating and office machines, nec	3578,9	2,606.6	2,327.4	2,613.3	2,742.2	2,811.1	3,036.2	3,172.8	3,322.0	3,478.1
Electron Tubes	3671	1,317.8	1,131.0	1,280.4	1,135.8	1,357.3	1,472.9	1,542.7	1,622.9	1,716.8
Printed circuit boards	3672	4,997.2	3,443.9	4,348.3	4,160.0	5,041.7	5,718.5	6,518.6	7,104.9	7,602.8
Semiconductors	3674	17,855.0	20,151.9	22,299.7	26,465.2	36,266.3	51,272.0	57,932.8	64,305.4	70,092.2
Passive electronic components	3675-9	13,099.4	13,923.4	16,485.0	16,071.8	18,435.2	19,097.6	22,110.7	25,515.5	29,801.9
Industrial instruments for measurement	3823	3,764.7	3,765.7	4,182.9	4,238.0	4,585.6	4,998.5	5,139.7	5,345.2	5,546.9
Instruments for measuring electricity	3825	5,352.4	5,455.6	5,721.1	5,594.2	6,678.0	7,512.3	7,766.0	8,030.0	8,399.0
Laboratory analytical instruments	3826	3,018.7	3,134.0	3,004.8	3,356.8	3,635.3	4,270.6	4,278.9	4,553.1	4,780.9
Total Hardware		116,144.8	116,059.5	127,946.6	134,975.5	155,916.3	183,579.6	209,580.9	232,129.7	254,115.0
Software/Services										
Computer programming services	7371	14,902.9	16,341.6	18,137.5	19,548.9	22,673.8	26,178.3	n.a.	n.a.	n.a.
Prepackaged software	7372	10,615.1	11,760.6	14,174.0	15,835.0	17,729.6	19,971.7	n.a.	n.a.	n.a.
Prepackaged software wholesale sales	5045 pt	1,697.0	1,806.0	1,994.0	2,136.0	2,185.0	2,564.0	n.a.	n.a.	n.a
Prepackaged software retail sales	5734 pt	93.8	94.7	96.1	100.0	125.6	126.1	n.a.	n.a.	n.a.
Computer integrated systems design	7373	9,424.2	10,033.5	11,505.0	12,465.5	13,829.2	15,025.1	n.a.	n.a.	n.a.
Computer processing and data preparation	7374	10,256.1	10,833.9	12,226.0	13,009.4	15,332.9	17,924.5	n.a.	n.a.	n.a.
Information retrieval services	7375	2,435.2	2,534.1	2,803.9	1,963.2	3,188.4	3,768.5	n.a.	n.a.	n.a.
Computer services management	7376	1,369.0	1,514.6	1,860.2	1,811.2	1,932.0	2,135.2	n.a.	n.a.	n.a.
Computer rental and leasing	7377	1,587.9	1,438.9	1,488.1	1,352.5	1,324.2	1,329.0	n.a.	n.a.	n.a.
Computer maintenance and repair	7378	4,273.9	4,244.5	4,859.0	4,615.2	4,740.4	5,023.7	n.a.	n.a.	n.a.
Computer related services, nec	7379	3,006.0	3,424.6	4,291.2	5,147.5	6,685.9	8,549.1	n.a.	n.a.	n.a.
Total software and services	7371-9	59,661.1	64,027.0	73,435.0	77,984.4	89,747.0	102,595.2	116,958.5	133,332.7	151,999.3
Communications										
Household audio and video equipment	3651	1,892.0	2,122.4	2,280.1	2,567.4	2,650.2	2,343.0	2,913.7	2,830.4	2,767.6
Telephone and telegraph equipment	3661	9,619.4	9,502.5	12,463.1	13,589.9	14,235.6	14,925.2	15,613.8	16,463.5	17,373.7
Radio and TV and communications equipment	3663	11,278.0	10,339.3	12,246.9	11,929.8	16,825.3	19,862.0	23,019.9	25,445.1	27,854.3
Magnetic and optical recording media	3695	1,675.6	1,959.9	2,091.5	2,388.0	2,629.4	2,787.8	3,446.9	3,367.8	3,293.0
Total Communications Hardware		24,465.0	23,924.1	29,081.6	30,475.1	36,340.5	39,918.0	44,994.3	48,106.8	51,288.6
Telephone and telegraph communications	481,22, 99	119,100.0	123,700.0	129,700.0	134,600.0	142,100.0	144,100.0	149,600.0	157,379.2	163,674.4
Radio broadcasting	4832	3,742.5	4,039.9	3,980.3	5,218.6	5,573.5	6,149.6	7,291.5	8,014.2	8,695.8
Television broadcasting	4833	11,757.1	11,828.7	11,944.9	14,694.0	15,606.5	17,102.7	18,372.8	19,354.0	20,975.6
Cable and other pay TV services	4841	12,100.4	14,631.4	15,574.8	21,087.4	21,320.0	24,247.7	24,935.7	28,427.0	31,838.3
Total Communications Services		146,700.0	154,200.0	161,200.0	175,600.0	184,600.0	191,600.0	200,200.0	213,174.3	225,184.0
Total All Information Technology Industries		346,970.9	358,210.6	391,663.2	419,035.1	466,603.8	517,692.8	571,733.7	626,743.6	682,586.9
Share of the Economy (%)		6.1%	6.1%	6.3%	6.4%	6.7%	7.1%	7.5%	7.8%	8.1%
Contribution to Economic Growth (%)			6.24%	11.41%	8.95%	11.14%	14.14%	15.76%	12.38%	14.67%

Sources: Bureau of the Census and Bureau of Economic Analysis for 1990-1995;
Estimates derived for 1996-1998 using Commerce's "U.S. Industry and Trade Outlook."

Note: Value added estimates from various sources (see text)
*GDP as measured by earned income (Gross Domestic Income)

on services—Current Business Report *Service Annual Survey* (latest available for 1995) and the *1992 Census of Service Industries.* The *Service Annual Survey* provides estimated receipts for taxable firms by 4-digit SIC industries. The value added of the software and services IT sector increased from $59.7 billion in 1990 to $102.6 billion in 1995.

Value added for software and services is not separately reported so that estimates of value added are derived using the methodology outlined below:

Calculating Receipts Less Cost of Goods Sold—The first part of the value added calculation (receipts less cost of goods sold) for software and services IT industries was derived using the 1990-1995 annual total receipts by industry from the *Service Annual Survey* and subtracting cost of goods sold based on the proportion of cost of goods sold to receipts that existed in 1992.

The *1992 Census of Services Industries* provides a Subject Series called *Sources of Receipts and Revenue* from which the cost of goods sold can be computed. For the software and services IT industries, the cost of goods sold is mostly negligible; i.e., the cost of goods sold for most of these industries was less than 2.0 percent in 1992. Therefore, for these industries, cost of goods sold were made equal to zero. However, there were three software and services IT industries where the cost of goods sold were significant; i.e., exceeded 2.0 percent. They are (1) the computer rental and leasing industry (SIC 7377) where cost of goods sold in 1992 was equal to 8.6 percent of total receipts, (2) the computer maintenance and repair industry (SIC 7378) was 7.6 percent, and (3) the computer services, not elsewhere classified, industry (SIC 7379) was 2.4 percent. Goods sold from these computer services sectors are primarily computers and computer equipment.

Subtracting Purchased Operating Expenses—The *1992 Census of Service Industries* series includes another Subject Series called *Capital Expenditures, Depreciable Assets, and Operating Expenses.* This report lists operating expenses by type and kind of business for payroll, benefits, taxes, depreciation and amortization charges, lease and rental payments, telephone and other purchased communications, purchased utilities, purchased office supplies, and advertising services for 1992. *Purchased* operating expenses include the depreciation charges, utilities, office supplies, and advertising services. Payroll, benefits, and taxes represent value added. Thus the second part of the value added calculation can be made by using the proportion of purchased operating expenses to total receipts for software and services IT industries that existed in 1992 to subtract from the total receipts less cost of goods sold from 1990 through 1995.

Specifically, the proportion of value added to total receipts for software and services IT industries in 1992 are as follows: computer programming services (SIC 7371), 72.6 percent; prepackaged software, (SIC 7372), 66.8 percent; computer

integrated systems design (SIC 7373), 75.8 percent; computer processing and data preparation (SIC 7374), 59.8 percent; information retrieval services (SIC 7375), 71.3 percent; computer services management (SIC 7376), 71.3 percent; computer rental and leasing (SIC 7376), 62.4 percent; computer maintenance and repair (SIC 7378), 63.4 percent, and computer related services, nec (SIC 7379), 68.8 percent.

Value added used for the IT communications services industries were taken directly from BEA's Gross Product Originating (GPO) by industry time series instead of using a calculated value added from the Census data. The value added of the communications services sector increased from $146.7 billion in 1990 to $191.6 billion in 1995.

The reasons for using the BEA data are: (1) the BEA industries and the list of industries used in the study matched exactly,[23] (2) the difference from the published BEA value added and the calculated estimates of value added from the revenue and operating expense data from the Bureau of the Census *Annual Survey of Communications Services* was less than one percent for each year between 1990 and 1995, and (3) the BEA data were published; the derived value added data from Census were not. It was felt that a published number prevails over a computed number and that value added should, theoretically, equal GPO.

Value added for wholesale trade of computer equipment and software were added to the list of IT industries, as sales from manufacturers' branch offices are counted by the Census as a wholesale sale and not as a part of manufacturers' shipments. Wholesale sales of computers and equipment increased from $33.6 billion in 1990 to $50.8 billion in 1995. Wholesale sales of computer software increased from $1.7 billion in 1990 to $2.6 billion in 1995.

The primary source for these data is the Bureau of the Census Current Business Report's *Annual Benchmark Report for Wholesale Trade, January 1987 Through February 1997*. In this report, gross margins (sales less cost of goods sold) by wholesale industries at the aggregate level are reported. Thus, the first part of the value added calculation (sales less cost of goods sold) is reported directly as gross margins. To take the aggregate reporting to the 4-digit SIC detail needed for this report, additional computations were made:

Computing Gross Margins at 4-Digit SIC Level The annual benchmark report provides gross margins for 3-digit SIC industries only. For purposes of this report, it was necessary to isolate SIC 5045, Wholesale sales of computer equipment and software, which is a subset of SIC 504, Wholesale sales of professional & commercial equipment and supplies. To achieve this, the *1992 Economic Census of Wholesale Trade* was used to derive estimates for value added at the 4-digit SIC level (SIC 5045) and incorporate branch office sales.

In this report, data at the 4-digit SIC level are provided that include sales and purchased operating expenses of all the wholesale sales of computer equipment

and software—from merchant wholesalers, from manufacturers' sales from branch offices, and from wholesale sales from agents, brokers, and commission merchants. In 1992, manufacturer sales of computer equipment and software from their branch offices represented 53 percent of all wholesale sales. These sales are unreported in the annual data. The 1992 benchmark report also provides separate categories of SIC 5045—wholesale sales of computer equipment and wholesale sales of computer software.

Value added at the 4-digit level is calculated using the same proportions of (1) merchant wholesaler sales to manufacturer branch offices' sales over the period and (2) purchased operating expenses (costs of goods sold are already accounted for in the gross margin data) to sales. Gross margin data at the 3-digit level from the annual report are used as controls to derive the 4-digit value added estimates.

Value added for retail trade of computer equipment and software (SIC 5734) were derived in almost the same way as the wholesale estimates. Retail sales of computers and equipment increased from $1.9 billion in 1990 to $2.5 billion by 1995. Retail sales of computer software increased from $93.8 million in 1990 to $126.1 million by 1995.

In this case, the Bureau of the Census *Annual Benchmark Report for Retail Trade: January 1987 Through December 1996* was used to obtain total sales and gross margins by the aggregate industry category—a combination of SICs 5722, 31, 34 (radio, television and computer stores). The *1992 Census of Retail Trade* was then used to disaggregate the aggregate sector into its parts and provide operating expenses of the industry. The 1992 report also provides sales data on both retail sales of computers equipment and software. The proportions developed for 1992 were then applied to the controls in the remaining years to provide estimates of retail sales at the 4-digit level, much the same way used to derive the estimates of value added for the wholesale IT industries.

The sum of the value added of all the IT industries compared to total nominal GDP[24] was used to compute the IT share of the economy. The nominal share of the economy and contribution to nominal economic growth are computed based on GDP, rather than GDI, although GDI would be a more appropriate measure. This was done since (1) GDP is a far more familiar concept than GDI, (2) GDP is thought to be a more accurate measure of the economy, and (3) the difference between the GDP and GDI IT industry share and contribution to growth are small. In 1996, if IT value added were based on GDI, the share of the economy would have been 7.1 percent rather than 7.4 percent (GDP calculation) and the IT contribution to the growth of the economy would have been 13.4 percent instead of 14.5 percent (GDP calculation).

The IT contribution to annual economic growth was calculated simply as the proportion of the annual change in IT industries' total value added over the total annual change in GDP. In 1990, value added of the IT sector was $347.0 billion or 6.0 percent of total GDP. In 1995, value added of the IT sector was $517.7 billion, accounting for 7.1 percent of total GDP, and 16.1

percent of total economic growth.

VALUE ADDED OF IT INDUSTRIES, ESTIMATES FOR 1996-98

In order to provide for more recent measurement of value added for IT industries, estimates were made based on projections of industry shipments provided in the "*U.S. Industry and Trade Outlook, '98*" (Outlook) jointly published by the Department of Commerce and DRI/McGraw-Hill. For each of the IT industries, estimates of shipments (sales), revenue, or receipts were taken directly or derived (for some IT industries, aggregate industry projections needed to be disaggregated to the IT level of industry detail) from the Outlook report.

To arrive at the value added for the IT industries for 1996 through 1998, the projected shipments (from the Outlook) were multiplied by the average ratio of value added to either sales, revenue, or receipts, from the 1990 through 1995 value added data. In 1996, total value added of the IT sector was $571.1 billion, 7.5 percent of total GDP, and accounted for $14.6 percent of economic growth. In 1998, it is estimated that total value added of the IT sector will be $682.6 billion, account for 8.2 percent of total GDP, and account for 14.9 percent of total economic growth.

VALUE ADDED OF IT INDUSTRIES IN REAL 1992 CHAIN WEIGHTED DOLLARS

Nominal value added for IT industries were deflated to constant 1992 chain weighted dollars by using deflators calculated from BEA's published time series on GPO by industry (Table 8). Deflators were calculated by dividing the nominal dollar GPO by the constant dollar GPO for the appropriate industries in the IT sector. Deflators for computer manufacturing were provided separately. Nominal dollar value added of computer manufacturing was deflated using BEA's quality-adjusted "hedonic" regression deflators. The regressions relate prices of computer and peripheral equipment models to characteristics of those models, selected to represent factors related to the cost of producing the models. The resulting implicit chain-type deflators for computers and equipment (SIC 3571, 72, 75, 77) used in calculating the real value added of computers were:

Year	Deflator
1990	1.353
1991	1.203
1992	1.000
1993	0.839
1994	0.750
1995	0.593
1996	0.418

Table 8. Information Technology Industries: Real Value Added

Industry	SIC	1990	1991	1992	1993	1994	1995	1996
		(Value Added: millions of chained 1992$)						
Total Gross Domestic Income (GDI)		6,117,800.0	6,069,100.0	6,199,700.0	6,338,200.0	6,596,800.0	6,768,700.0	6,982,700.0
Year-to-Year GDI Change (%)			-0.80%	2.15%	2.23%	4.08%	2.61%	3.16%
Hardware								
Computers and equipment	3571,2,5,7	21,148.1	20,857.1	26,630.8	32,111.6	41,802.1	55,533.2	88,884.2
Computers and equipment wholesale sales	5045 pt	32,985.9	35,111.5	39,465.0	41,595.9	41,456.2	47,937.4	58,349.3
Computers and equipment retail sales	5734 pt	2,015.4	1,949.4	1,915.3	1,970.6	2,447.8	2,454.3	2,753.7
Calculating and office machines, nec	3578,9	2,503.9	2,281.1	2,613.3	2,846.1	3,022.7	3,507.2	3,931.1
Electron tubes	3671	1,284.5	1,104.5	1,280.6	1,172.5	1,489.1	1,930.2	2,332.1
Printed circuit boards	3672	4,871.0	3,363.2	4,348.3	4,294.4	5,531.2	7,493.8	9,854.3
Semiconductors	3674	17,404.2	19,679.6	22,299.7	27,320.3	39,787.5	67,189.1	87,577.9
Passive electronic components	3675-9	12,768.7	13,597.1	16,485.0	16,591.1	20,225.1	25,026.3	33,425.1
Industrial instruments for measurement	3823	4,233.3	4,000.1	4,182.9	4,054.7	4,246.7	4,284.3	3,764.0
Instruments for measuring electricity	3825	6,018.7	5,795.2	5,721.1	5,352.3	6,184.5	6,438.9	5,687.3
Laboratory analytical instruments	3826	3,394.5	3,329.1	3,004.8	3,211.6	3,366.6	3,660.4	3,133.6
Total Hardware		108,628.2	111,067.9	127,946.8	140,521.1	169,559.5	225,455.1	299,692.6
Software and Services								
Total software and services	7371-9 5045 pt 5734 pt	64,905.5	68,142.8	74,435.0	78,219.1	86,628.4	98,252.4	108,586.5
Total Hardware, Software and Services		173,533.7	179,210.7	202,381.8	218,740.2	256,187.9	323,707.5	408,279.1
Communications								
Communications Hardware	3651, 61 63, 95	23,847.3	23,363.4	29,081.6	31,459.8	39,868.9	52,310.3	68,019.4
Telephone and telegraph communications	481,22, 99	120,595.4	125,101.1	129,700.0	133,598.0	137,894.2	136,393.8	141,198.6
Broadcasting and cable TV services	4832	28,600.0	31,500.0	31,500.0	38,100.0	38,800.0	41,700.0	40,400.0
Total Communications Services		149,195.4	156,601.1	161,200.0	171,698.0	176,694.2	178,093.8	181,598.6
Total Communications		173,042.7	179,964.5	190,281.6	203,157.8	216,563.1	230,404.1	249,618.0
Total All Information Technology Industries		346,576.4	359,175.2	392,663.4	421,898.0	472,751.0	554,111.6	657,897.1

Source: DOC's Economics and Statistics Administration estimates

The hedonic deflators for computers were not used to calculate the wholesale and retail trade of computer equipment and software. Instead, the wholesale trade and retail trade implicit deflators were used since these industries consist primarily of the wholesale and retail distribution network. The BEA also publishes quality-adjusted price indexes for semiconductors.[25] However, to be conservative, the implicit GPO deflator for "Electronic and other Electric Equipment" was used for semiconductors. The following implicit GPO deflators were also used for the remaining IT industries: communications services deflator for the communications services industries; the electronic and electric equipment deflator for the communications equipment industries; the business services deflator for the software and services industries; the electronic and other electric equipment deflator for the IT electronics components industries; and the instruments and related products deflator for the IT instrument industries.

IT contribution to real economic growth was computed using a methodology described in detail in BEA's May 1997 *Survey of Current Business* article called "BEA's Chain Indexes, Time Series, and Measures of Long-Term Economic Growth" by J. Steven Landefeld and Robert P. Parker. The box on page 63 provides a "Note on Computing Alternative Chained Dollar Indexes and Contributions to Growth."

The methodology to compute real chain weighted dollar contribution to economic growth is not the same straight forward process used in determining contribution to growth for nominal dollars or if the real dollars would have been fixed. Basically, the chain-type weights require that growth from year-to-year for each of the IT industries' value added be rebased by moving the nominal value added for each of the industries by the change in the real value added. This basically sets each of the years as the base, or equal to 100, so that the difference between the nominal base and the calculated change is equal to the growth of IT industries.

The rebased growth of IT industries was calculated in two ways and then averaged. First, growth for one year, say 1995, is based on the change in real growth (from the rebased nominal for 1995) to the next year, 1996. In this study, this is called the "next year" method. The changes in real growth from year-to-year, rebasing coefficients, are multiplied by the nominal value added (rebased so that each year equals 100.0) for each of the IT industries. The change from the nominal to the rebased change is the calculated change in the real. Second, growth for 1995 is also calculated on the change in real growth (again from the rebased nominal 1995) from the prior year, 1994. In this study, this is called the "prior year" method. The change in IT industries for both of these methods are averaged to derive a rebased change in IT industries for each of the years (Table 9). The contribution to real economic growth is then calculated as the total average change in the rebased IT industries over the annual change in real GDI (Table 10).

Table 9: Information Technology Industries: Average Annual Real Growth

(Prior Year and Next Year Method)

(Millions of Rebased 92$)

Industry	SIC	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996
		(Change in IT Components--Prior Year)						(Change in IT Components--Next Year)						(Change in IT Components--Average)					
Hardware																			
Computers and equipment	3571,2,5,7	-394.6	6,945.8	5,480.8	8,130.3	10,298.3	19,777.2	-350.1	5,773.7	4,598.4	7,267.9	8,142.5	13,940.7	-372.3	6,359.7	5,039.6	7,699.1	9,220.4	16,858.9
Computers and equipment wholesale sales	5045 pt	2,165.1	4,432.3	2,130.9	-142.0	6,761.5	11,024.1	2,164.1	4,353.5	2,165.7	-145.7	6,862.3	10,907.9	2,164.6	4,392.9	2,148.3	-143.9	6,811.9	10,966.0
Computers and equipment retail sales	5734 pt	-60.8	-33.0	55.3	483.1	6.7	306.7	-63.9	-34.1	56.0	488.4	6.7	308.4	-62.4	-33.6	55.6	485.7	6.7	307.5
Calculating and office machines, nec	3578,9	-231.9	338.9	232.8	170.2	450.6	367.0	-227.3	332.2	224.3	164.2	419.4	342.1	-229.6	335.6	228.6	167.2	435.0	354.6
Electron Tubes	3671	-184.7	180.3	-108.1	306.7	402.1	306.7	-184.3	176.1	-104.7	288.6	336.6	265.9	-184.5	178.2	-106.4	297.6	369.3	286.3
Printed circuit boards	3672	-1,546.9	1,008.7	-53.9	1,198.1	1,788.9	1,801.3	-1,544.0	985.1	-52.2	1,127.3	1,497.7	1,561.5	-1,545.4	996.9	-53.1	1,162.7	1,643.3	1,681.4
Semiconductors	3674	2,334.3	2,683.0	5,020.6	12,077.0	24,976.6	15,558.7	2,330.0	2,620.1	4,863.5	11,363.9	20,910.2	13,487.2	2,332.2	2,651.5	4,942.0	11,720.4	22,943.4	14,522.9
Passive electronic components	3675-9	849.9	2,957.2	106.1	3,520.3	4,376.3	6,409.1	848.3	2,887.9	102.8	3,312.4	3,663.8	5,555.8	849.1	2,922.6	104.4	3,416.3	4,020.1	5,982.5
Industrial instruments for measurement	3823	-207.4	172.1	-128.2	200.7	40.6	-607.0	-219.5	182.8	-134.0	207.3	43.9	-710.5	-213.5	177.4	-131.1	204.0	42.2	-658.7
Instruments for measuring electricity	3825	-198.8	-69.8	-368.8	869.8	274.7	-876.9	-210.4	-74.1	-385.5	898.6	296.8	-1,026.3	-204.6	-71.9	-377.1	884.2	285.8	-951.6
Laboratory analytical instruments	3826	-58.2	-305.3	206.8	162.0	317.2	-614.6	-61.6	-324.3	216.1	167.4	342.8	-719.3	-59.9	-314.8	211.5	164.7	330.0	-667.0
Total Hardware																			
Software and Services																			
Total software and services	7371-9 5045 pt 5734 pt	2,975.7	5,912.2	3,733.3	8,384.1	12,042.5	10,790.9	3,041.8	6,207.7	3,772.7	8,712.0	12,137.8	11,130.9	3,008.7	6,059.9	3,753.0	8,548.1	12,090.1	10,960.9
Services																			
Communications																			
Total Communications Hardware	3651, 61 63, 95	-496.4	5,855.4	2,378.2	8,145.9	11,340.3	11,987.6	-495.5	5,718.2	2,303.8	7,664.9	9,494.0	10,391.4	-496.0	5,786.8	2,341.0	7,905.4	10,417.2	11,189.5
Telephone and telegraph communications	481,22, 99	4,449.8	4,547.4	3,898.0	4,328.4	-1,546.2	5,076.3	4,455.2	4,598.9	3,927.2	4,427.2	-1,585.2	5,090.7	4,452.5	4,573.1	3,912.6	4,377.8	-1,565.7	5,083.5
Broadcasting and cable TV services	4832	2,798.6	0.0	6,600.0	753.3	3,176.5	-1,480.8	2,807.9	0.0	7,102.4	766.8	3,303.4	-1,628.2	2,803.3	0.0	6,851.2	760.0	3,240.0	-1,554.5
Total Communications Services																			
Total Communications																			
Sum of the Average IT Industries Year-to-Year Changes														12,242.2	34,014.4	28,920.1	47,649.5	70,289.6	74,362.1

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

Table 10. IT Contribution To Real Economic Growth
(billions of 92$)

Year	Real GDI	Change	Real IT	Change In IT*	Contribution To Real Growth
1990	6,117.8		346.6		
1991	6,069.1	-48.7	359.2	12.2	n.a.
1992	6,199.7	130.6	392.7	34.0	26.0%
1993	6,338.2	138.5	421.9	28.9	20.9%
1994	6,596.8	258.6	472.8	47.6	18.4%
1995	6,768.2	171.4	554.1	70.3	41.0%
1996	6,982.7	214.5	657.9	74.4	34.7%
1997	7,248.0	265.3	775.4	75.2	28.3%**

* Calculated based on method described in text.
** Estimated for real GDI and real IT

Total GDI and price deflators for IT industries are not yet available for 1997, therefore, real GDI was estimated based on the 3.8 percent real growth in GDP, which is available. Real value added for IT industries for 1997 was estimated based on the relationship between nominal IT and calculated real IT for 1996.

IT CONTRIBUTION TO LOWERING INFLATION

Since GDI was used in this analysis to calculate the contribution to real economic growth, overall inflation was calculated from the implicit price deflator for GDI; i.e., an overall price index calculated as nominal GDI over real GDI (Table 11).

The year-to-year change in the index is the annual change in overall prices as measured by the index. Nominal and real value added of IT industries are subtracted from total nominal and real GDI. The index and the year-to-year change in the index are recalculated to determine the overall inflation rate, using the implicit deflator for GDI, without the value added of IT industries.

Table 11. IT Industries Contribution To Lowering Overall Inflation

Year	Nominal	Real*	Index	Change
	($billions)			
Total Gross Domestic Income (GDI)				
1990	5,726.4	6,117.8	0.936	
1991	5,906.6	6,069.1	0.973	4.0%
1992	6,199.7	6,199.7	1.000	2.8%
1993	6,505.5	6,338.2	1.026	2.6%
1994	6,932.4	6,596.8	1.051	2.4%
1995	7,293.6	6,768.2	1.078	2.6%
1996	7,636.0	6,982.7	1.094	1.5%
1997**	8,081.0	7,248.0	1.115	2.0%
Total GDI, less IT Industries				
1990	5,379.4	5,771.2	0.932	
1991	5,548.4	5,709.9	0.972	4.3%
1992	5,807.0	5,807.0	1.000	2.9%
1993	6,086.5	5,916.3	1.029	2.9%
1994	6,465.8	6,124.0	1.056	2.6%
1995	6,775.9	6,214.1	1.090	3.3%
1996	7,064.3	6,424.8	1.117	2.4%
1997**	7,454.3	6,472.6	1.152	3.1%

*1992 = 100 ** Estimate

IT EQUIPMENT INVESTMENT AND NET CAPITAL STOCK

BEA produces annual estimates of investment flows and capital stock by industry and by type of asset. BEA defines information processing equipment (IT equipment) to include: office, computing, and accounting machinery, communications equipment, photocopy and related equipment, and instruments. Estimates of IT equipment spending as a share of total business equipment spending were derived from inflation-adjusted investment expenditures on the above assets. BEA recently developed a new, chain-weighted deflation method which is preferable to the fixed-weighted deflators previously used because they allow for changes in prices and output

composition over time.[26] However, chain-weighted estimates are not additive and it would be misleading to use the IT capital spending share to approximate a non-IT capital spending share. Also, BEA warns that chain-weighted estimates may lose some accuracy as one moves away from the base period and thus, may not be suitable for time series analysis.

Industries that were considered heavy users of IT equipment were determined in two ways–the level of overall use of IT equipment relative to total equipment use and their IT investment per employee. (Tables 12 and 13) Fifty-three industries (exc. farming) were ranked according to both measures of IT intensity and the top 15 industries were designated as "major users" of information technology.

Net capital stock is the cumulative value of past gross investment less the cumulative value of past depreciation. Total net capital stock of equipment includes non-IT industrial equipment, transportation equipment, etc. in $1987. Investment in IT equipment per employee includes annual purchases of IT equipment ($1987) divided by the number of workers in each industry. The most recent investment and net capital stock data by industry and by asset type are for 1994. BEA expects to release data for 1995 and 1996 in the spring of 1998.

EMPLOYMENT TRENDS AND PROJECTIONS

The employment numbers used in this analysis are from the Current Employment Statistics (CES) survey, conducted monthly by the Bureau of Labor Statistics (BLS) in conjunction with state employment security agencies (Table 14). Private employment includes all full and part-time employees except those in the agricultural and government sectors. These data can be found at the BLS website (http://www.bls.gov). BLS also collects employment data through the Covered Employment and Wages (ES202) program, which are published annually in *Employment and Wages, Annual Averages.* When CES employment figures were not available at the necessary level of detail (4-digit SIC level), employment levels were estimated by applying the 4-digit SIC level employment distribution of the ES202 numbers to the aggregate (3-digit SIC level) CES numbers. When CES employment numbers were not available at the 3-digit SIC level, ES202 employment numbers were used.

BLS publishes employment projections by industry to 2006, but mainly at the 2- and 3-digit SIC levels. Historical employment trends (1990 to 1996) were used to extrapolate employment demand of 4-digit industries to 2006. Five entire 2- or 3-digit industries were included among our list of IT industries -- computer and office equipment (357), electronic components and accessories (367), communications equipment (366), communications services (48), and computer and data processing services (737). For these industries, the projected employment levels were scaled to match officially published BLS projections. For the remaining industries, the unadjusted extrapolated employment estimates were used.

Estimates of employment by wholesale and retail sellers of computer equipment and software

Table 12. IT Intensity: IT Net Capital Stock Share of Total Equipment Stock, 1994

RANK		IT EQUIPMENT STOCK (bils. $1987)					SHARE OF TOTAL EQUIPMENT (percent)				
		1990	1991	1992	1993	1994	1990	1991	1992	1993	1994
1	Telephone and telegraph	111.6	108.7	107.1	105.4	108.1	85.9	86.2	86.3	86.3	86.3
2	Insurance agents, brokers, and services	0.9	1.0	1.2	1.4	1.7	75.6	78.2	81.4	84.2	86.0
3	Security and commodity brokers	2.3	2.2	2.2	2.4	2.7	75.0	75.2	76.2	78.3	80.7
4	Holding and other investment offices	4.3	4.1	4.1	4.7	5.2	73.7	73.9	74.9	77.6	79.6
5	Motion pictures	4.3	5.0	5.5	6.2	7.0	69.9	71.0	71.6	72.5	73.7
6	Insurance carriers	21.3	24.4	28.1	33.3	38.8	55.0	57.2	59.7	62.8	65.6
7	Radio and television	17.8	19.4	20.6	22.2	24.0	58.1	59.2	59.5	60.2	61.0
8	Miscellaneous services	8.2	9.2	10.0	12.1	14.8	44.5	47.4	49.7	53.6	57.2
9	Wholesale trade	62.8	67.9	74.7	83.4	95.0	47.9	49.8	51.6	53.8	56.1
10	Legal services	4.5	4.9	5.3	5.7	6.1	49.0	50.8	52.4	54.2	56.0
11	Educational services	0.2	0.3	0.3	0.4	0.4	40.4	43.3	46.2	50.6	55.3
12	Health services	17.4	17.5	17.9	18.4	18.8	50.3	50.9	51.8	52.5	53.1
13	Retail trade	51.1	58.3	68.3	81.1	98.1	37.6	39.7	42.1	44.2	46.2
14	Instruments and related products	7.7	8.4	9.0	9.9	10.4	37.2	39.3	41.1	43.6	45.4
15	Real estate	68.9	71.3	70.4	73.6	80.3	40.6	41.5	42.3	43.4	44.7
16	Local & interurban passenger transport	2.0	1.9	1.7	1.5	1.4	39.7	40.1	40.0	39.7	39.0
17	Personal services	2.3	2.6	3.1	4.0	5.1	27.9	30.2	32.4	35.8	38.7
18	Amusement and recreation services	2.2	2.3	2.3	2.5	2.8	29.6	30.7	31.4	33.1	35.2
19	Chemicals and allied products	21.1	23.8	26.3	28.9	32.1	27.9	29.9	31.5	32.8	34.1
20	Transportation by air	10.7	10.6	12.2	13.4	14.4	25.6	25.9	28.5	30.6	33.4
21	Electronic and other electrical equip.	13.4	14.1	14.3	16.2	18.1	25.3	26.3	26.7	28.8	30.9
22	Hotels and other lodging places	2.7	2.7	2.5	2.4	2.3	26.7	28.0	28.6	29.7	30.6
23	Stone, clay, and glass products	2.7	2.9	3.1	4.0	4.9	17.7	19.4	21.2	25.6	29.7
24	Commercial and mutual depository inst.	33.9	35.0	38.3	44.2	52.2	22.3	22.6	23.9	26.2	29.2
25	Industrial machinery and equipment	10.5	11.4	12.4	15.4	20.4	17.4	18.7	20.2	23.9	29.1
26	Railroad transportation	5.6	5.8	5.9	6.2	6.7	20.9	22.5	24.0	25.7	27.8
27	Printing and publishing	3.7	4.2	4.6	5.6	6.9	16.9	18.4	19.9	22.8	26.1
28	Misc. repair services	0.5	0.6	0.8	1.2	1.7	11.3	13.3	16.0	20.6	25.0
29	Pipelines, except natural gas	0.0	0.0	0.0	0.0	0.1	19.1	20.5	21.3	22.9	23.6
30	Petroleum and coal products	3.1	4.1	4.7	5.3	5.7	13.3	16.2	18.0	19.6	20.8
31	Business services	13.9	14.1	15.4	18.6	24.4	13.9	14.0	15.0	17.0	20.4
32	Lumber and wood products	1.3	1.3	1.3	1.5	1.6	15.5	16.7	17.7	18.9	20.1
33	Furniture and fixtures	0.4	0.5	0.5	0.6	0.8	12.5	13.3	14.4	17.1	20.1
34	Auto repair, services, and parking	13.1	14.0	14.1	15.2	17.5	17.5	18.3	17.9	18.6	20.0
35	Nondepository credit institutions	5.7	6.5	7.9	10.6	13.9	11.0	12.2	13.9	16.9	20.0
36	Electric, gas, and sanitary services	29.1	30.9	33.4	35.9	39.2	15.5	16.3	17.4	18.4	19.3
37	Other transportation equipment	2.9	3.0	3.1	3.7	4.8	12.5	13.1	13.7	15.9	19.0
38	Leather and leather products	0.1	0.1	0.1	0.1	0.1	9.5	10.5	11.8	14.4	17.1
39	Water transportation	1.2	1.4	1.6	2.1	2.4	7.1	8.4	10.6	13.9	17.0
40	Food and kindred products	5.2	6.2	7.2	8.4	10.1	11.2	12.5	13.8	15.0	16.4
41	Mining	8.7	8.3	7.7	7.5	7.5	14.5	15.0	15.2	15.7	16.3
42	Textile mill products	1.6	1.7	1.7	1.9	2.0	11.9	12.9	13.8	14.8	15.8
43	Tobacco manufactures	0.5	0.5	0.5	0.5	0.4	15.4	16.1	15.9	15.8	15.5
44	Misc. manufacturing industries	0.3	0.4	0.4	0.5	0.7	7.8	9.0	10.2	12.2	14.3
45	Construction	3.4	3.6	3.8	3.9	4.2	10.4	11.2	12.1	12.7	13.4
46	Rubber and misc. plastics products	1.6	1.8	1.9	2.2	2.7	8.3	9.0	9.6	10.6	12.3
47	Motor vehicles and equipment	2.2	2.5	2.8	3.8	5.4	6.3	7.2	7.8	9.8	12.2
48	Primary metal industries	3.9	4.2	4.7	5.3	6.2	6.7	7.4	8.3	9.3	10.7
49	Fabricated metal products	2.1	2.2	2.1	2.3	2.8	5.5	5.9	6.0	6.7	7.8
50	Paper and allied products	2.7	3.0	3.2	3.6	4.3	5.1	5.6	5.9	6.6	7.5
51	Transportation services	1.1	1.0	1.0	1.0	1.0	6.5	6.3	6.2	6.3	6.4
52	Trucking and warehousing	1.6	1.5	1.4	1.4	1.4	4.6	4.9	5.0	5.1	5.2
53	Apparel and other textile products	0.1	0.1	0.1	0.1	0.1	3.0	3.2	3.4	3.5	3.3
	All Nonfarm Private Industries	$604.5	$638.0	$678.6	$747.7	$847.0	27.4	28.6	29.9	31.7	33.7

Source: Bureau of Economic Analysis

Table 13. IT Intensity: IT Investment per Employee, 1994

Rank	$1987	1990	1991	1992	1993	1994
1	Telephone and telegraph	$14,084	$13,710	$15,429	$15,082	$19,441
2	Real estate	8,843	10,167	8,018	11,175	13,890
3	Radio and television	12,728	10,961	10,173	11,900	12,726
4	Nondepository institutions	4,431	5,941	8,010	10,692	12,458
5	Electric, gas, sanitary	8,005	6,782	7,987	8,663	10,427
6	Petroleum and coal products	6,290	10,081	8,826	9,762	9,557
7	Commercial and mutual depository institutions	4,275	3,912	5,456	7,240	9,056
8	Insurance carriers	4,704	5,560	6,593	8,099	8,927
9	Holding and other investment offices	3,398	3,394	4,621	7,224	7,616
10	Chemicals and allied products	4,477	5,896	6,003	6,382	7,522
11	Auto repair, services, and parking	2,990	4,211	3,498	4,517	5,943
12	Railroad transportation	3,216	3,210	3,177	4,056	5,385
13	Motion pictures	2,924	3,828	3,682	4,478	4,893
14	Industrial machinery and equipment	1,744	1,801	2,085	3,306	4,652
15	Wholesale trade	2,320	2,583	3,082	3,648	4,308
16	Stone, clay, and glass products	1,534	1,553	1,798	3,244	3,728
17	Water transportation	1,772	1,683	2,660	3,936	3,660
18	Electronic and other electric equipment	1,998	1,896	1,792	3,008	3,145
19	Transportation by air	2,202	1,372	3,407	3,065	3,032
20	Primary metal industries	1,333	1,568	1,814	2,186	2,793
21	Instruments and related products	1,802	2,100	2,168	2,715	2,691
22	Motor vehicles and equipment	815	955	905	1,941	2,645
23	Miscellaneous repair services	387	748	1,066	1,759	2,354
24	Mining	1,525	1,730	1,364	2,016	2,321
25	Food and kindred products	900	1,264	1,378	1,619	2,078
26	Paper and allied products	1,404	1,240	1,113	1,505	2,074
27	Personal services	623	838	1,020	1,499	1,887
28	Printing and publishing	923	902	1,012	1,480	1,861
29	Legal services	1,753	1,418	1,503	1,573	1,763
30	Business services	580	703	924	1,264	1,696
31	Security and commodity brokers	842	882	1,061	1,510	1,639
32	Retail trade	548	780	986	1,193	1,458
33	Tobacco manufactures	1,405	2,265	1,326	1,465	1,235
34	Other transportation equipment	396	402	437	778	1,122
35	Rubber and miscellaneous plastics products	522	546	564	701	1,090
36	Hotels and other lodging	367	281	130	199	1,058
37	Insurance agents, brokers, and services	327	452	623	828	929
38	Miscellaneous services	361	417	416	616	764
39	Transportation services	562	669	671	734	741
40	Pipelines, except natural gas	216	474	573	652	702
41	Fabricated metal products	416	398	333	526	696
42	Miscellaneous manufacturing industries	274	339	392	550	692
43	Textile mill products	548	494	478	627	656
44	Furniture and fixtures	289	261	312	528	626
45	Amusement and recreation services	396	423	354	477	584
46	Lumber and wood products	372	327	284	491	554
47	Health services	437	352	366	393	381
48	Leather and leather products	158	154	192	299	363
49	Local and interurban passenger transportation	518	297	66	148	205
50	Construction	122	155	156	146	189
51	Trucking and warehousing	151	113	111	128	159
52	Educational services	42	50	57	78	89
53	Apparel and other textile products	26	20	22	20	10
	Average Nonfarm Private Industries	**$1,400**	**$1,525**	**$1,690**	**$2,080**	**$2,500**

Sources: Bureau of Economic Analysis and Bureau of Labor Statistics

Table 14. Information Technology Industries: Employment Trends and Projections, 1985 to 1996 and 2006

Industry	SIC	1985	1990	1991	1992	1993	1994	1995	1996	2006*	Change 1985-1996	AAG 1985-1996 (Percent)	Change 1996-2006	AAG 1996-2006 (Percent)
						(Units 000s)								
Total Private Employment		80,992	91,098	89,847	89,956	91,872	95,036	97,885	100,076	115,168	19,084	1.9	15,092	1.4
Year to Year Change in Employment				-1.4%	0.1%	2.1%	3.4%	3.0%	2.2%					
Hardware														
Electronic computers	3571	325.5	278.5	258.8	241.9	216.1	201.1	190.0	189.5	105.6	-136.0	-4.8	-83.9	-5.7
Computers and equipment wholesalers	5045pt.	273.2	294.9	295.5	277.6	270.9	271.8	285.7	301.0	281.5	27.8	0.9	-19.4	-0.7
Computers and equipment retailers	5734pt.	54.1	71.3	72.1	75.4	78.2	84.5	93.7	103.6	185.5	49.5	6.1	81.9	6.0
Computer storage devices & peripheral equipment	3572,7	98.3	94.3	94.3	91.3	93.2	97.9	104.5	115.3	157.6	17.0	1.5	42.3	3.2
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	76.4	64.8	62.2	57.8	54.1	55.2	57.7	58.2	50.8	-18.2	-2.4	-7.4	-1.3
Electron tubes	3671	46.9	31.9	28.8	26.9	24.8	24.5	24.0	23.0	15.4	-23.9	-6.3	-7.6	-3.9
Semiconductors	3674	279.1	239.6	231.6	217.4	213.8	220.5	235.2	256.1	280.4	-23.0	-0.8	24.3	0.9
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	170.8	169.4	161.0	156.6	161.6	168.2	187.0	194.3	262.4	23.5	1.2	68.1	3.1
Electronic components, n.e.c.	3679	149.8	141.4	133.4	126.5	127.5	131.0	134.6	136.6	141.8	-13.2	-0.8	5.2	0.4
Industrial instruments for measurement	3823	58.1	66.6	63.1	61.0	60.5	62.0	64.2	66.2	64.3	8.1	1.2	-1.9	-0.3
Instruments for measuring electricity	3825	109.0	91.0	84.2	76.1	72.8	71.2	71.2	75.0	48.8	-34.0	-3.3	-26.2	-4.2
Analytical instruments	3826	25.0	30.0	28.1	28.1	28.1	26.9	28.1	31.1	29.5	6.1	2.0	-1.6	-0.5
Total Hardware		1,666.2	1,573.6	1,513.1	1,436.6	1,401.6	1,414.8	1,475.9	1,549.8	1,623.7	-116.4	-0.7	73.8	0.5
Software/Services														
Computer programming services	7371	79.0	150.8	156.9	168.6	188.3	209.9	245.3	271.9	708.1	192.9	11.9	436.2	10.0
Prepackaged software	7372	55.0	112.8	124.4	130.8	144.8	157.4	180.8	198.9	476.4	143.9	12.4	277.5	9.1
Prepackaged software wholesalers	5045pt.	13.8	14.9	14.9	14.0	13.7	13.7	14.4	15.2	14.2	1.4	0.9	-1.0	-0.7
Prepackaged software retailers	5734pt.	2.7	3.6	3.6	3.8	4.0	4.3	4.7	5.2	9.4	2.5	6.2	4.1	6.0
Computer integrated systems design	7373	60.0	97.5	98.7	102.5	109.5	116.4	129.9	142.4	244.5	82.4	8.2	102.1	5.6
Computer processing and data preparation	7374	192.0	196.7	198.2	204.4	207.3	209.5	223.1	231.3	268.8	39.3	1.7	37.5	1.5
Information retrieval services	7375	39.0	47.7	45.2	45.2	46.2	48.0	56.9	68.4	98.0	29.4	5.2	29.6	3.7
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	91.0	126.6	131.1	141.2	154.9	172.9	205.3	242.4	643.9	151.4	9.3	401.5	10.3
Computer maintenance and repair	7378	25.0	39.8	42.5	42.8	41.8	44.5	48.6	52.6	69.3	27.6	7.0	16.7	2.8
Total Software/Services		557.5	790.4	815.6	853.3	910.4	976.6	1,109.1	1,228.3	2,532.6	670.8	7.4	1,304.9	7.5
Communications Equipment														
Household audio and video equipment	3651	65.7	62.4	61.2	59.8	59.5	59.9	55.7	54.9	45.3	-10.8	-1.6	-9.6	-1.9
Household audio and video equip. retailers	5731	110.8	116.6	119.1	120.1	128.4	148.2	166.2	181.1	382.9	70.3	4.6	201.8	7.8
Telephone and telegraph equipment	3661	169.0	126.3	116.7	109.6	110.0	109.5	111.7	112.6	79.0	-56.4	-3.6	-33.6	-3.5
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	148.0	137.2	134.4	128.9	129.0	138.3	153.2	156.6	176.0	8.6	0.5	19.4	1.2
Magnetic and optical recording media	3695	20.0	18.9	20.0	18.3	18.2	18.8	16.7	17.0	13.5	-3.0	-1.5	-3.5	-2.3
Total Communications Equipment		513.5	461.4	451.4	436.7	445.1	474.7	503.5	522.2	696.7	8.7	0.2	174.5	2.9
Communications Services														
Telephone communications	481	920.7	913.0	909.2	885.2	879.0	893.4	899.7	897.7	834.7	-23.0	-0.2	-63.0	-0.7
Telephone and telegraph communications	482,489	51.8	36.6	31.5	25.6	24.4	24.7	26.7	25.8	13.3	-26.0	-6.1	-12.5	-6.4
Radio broadcasting	4832	113.0	118.8	116.5	112.9	113.3	113.5	113.0	114.6	101.6	1.6	0.1	-13.0	-1.2
Television broadcasting	4833	115.4	114.7	113.6	114.6	116.2	118.7	122.7	128.3	145.8	12.9	1.0	17.5	1.3
Cable and other pay TV services	4841	117.9	125.8	128.0	130.6	136.2	144.5	155.5	171.1	264.6	53.2	3.4	93.5	4.5
Total Communications Services		1,318.8	1,308.9	1,298.8	1,268.9	1,269.1	1,294.8	1,317.6	1,337.5	1,360.0	18.7	0.1	22.5	0.2
Total IT-Producing Industries		4,056.0	4,134.3	4,078.8	3,995.5	4,026.3	4,161.0	4,406.1	4,637.9	6,212.9	582	1.2	1,575.0	3.0
Share of Total Employment		5.0%	4.5%	4.5%	4.4%	4.4%	4.4%	4.5%	4.6%	5.4%				
Contribution to Employment Growth	(percentage point)			-0.1	-0.1	0.0	0.1	0.3	0.2					

* ESA estimates based on BLS projections.
Source: Bureau of Labor Statistics

(SICs 5045 and 5734) were divided among the hardware and software/services categories using the same distribution as value added -- 95 percent to hardware and 5 percent to software/services. The contribution to employment growth was estimated by computing the ratio of the annual change in IT industry employment to the change in total private employment and applying that ratio to the annual percent change in total private employment.

TOTAL WAGES AND EARNINGS PER WORKER IN IT INDUSTRIES

Total wages are collected as part of the BLS ES202 program and include gross wages and salaries, bonuses, stock options, tips and other gratuities and in some cases the value of meals and lodging (Table 15).[27] Wage projections are not available.

Average annual earnings per employee were computed using the employment and wage data described above (Table 16). Note that these simple averages are for purposes of comparing relative wages across industries and should not be interpreted as official BLS estimates of median earnings. Estimates of earnings per worker include all occupations in each industry and should not be interpreted as average earnings for specific occupations.

IT-RELATED OCCUPATIONS

Occupations considered to be IT-related were first selected from the BLS occupation classification system (Table 6). Then, these IT-related occupations were reviewed by the BLS and others. Occupations considered to be essential to IT and to electronic commerce were maintained. Other occupations were deleted from the category.

The primary sources for the number of employees in each occupation in each industry were from the BLS *National Industry-Occupation Matrix 1983-95 Time Series* and the 1996 to 2006 projections in the *Occupational Outlook Handbook (Handbook).* The mean wage for each occupation is from the OES website (http://stats.bls.gov/oes/national/oes_nat.htm). The mean hourly wage was used to compute an annual average wage of all employees with IT occupations. Employees with IT occupations were counted across all industries, including Government (Tables 17 and 18). A net employment estimate and an average mean wage for all IT workers was derived by combining employment and wages of IT industries with employment and wages of workers with IT occupations, being careful not to double count workers with IT occupations in IT industries (Table 19).

Table 15. Information Technology Industries: Wage Growth, 1985 to 1996

		1985	1990	1991	1992	1993	1994	1995	1996	Change 1985-1996
					($millions)					
All Private Industries		$1,526,164	$2,114,282	$2,152,022	$2,282,598	$2,365,301	$2,494,459	$2,658,927	$2,837,335	$1,311,171
IT Industries		$112,627	$149,859	$154,101	$162,394	$168,222	$179,301	$200,123	$224,883	$112,256
IT Share of Total		7.4%	7.1%	7.2%	7.1%	7.1%	7.2%	7.5%	7.9%	
Hardware										
Electronic computers	3571	10,640	12,924	12,577	12,666	11,811	11,187	11,317	11,821	1,181
Computer and equipment wholesalers	5045pt.	9,537	13,658	14,550	14,572	14,343	14,373	15,513	17,318	7,781
Computer and equipment retailers	5734pt.	1,108	2,071	2,243	2,431	2,389	2,710	3,164	3,585	2,477
Computer storage devices & peripheral equipment	3572,7	2,764	3,389	3,678	3,761	3,975	4,200	4,861	5,823	3,059
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	2,196	2,544	2,566	2,500	2,424	2,447	2,687	2,883	688
Electron tubes	3671	1,257	1,029	991	1,032	932	974	1,005	938	-320
Semiconductors	3674	7,872	9,131	9,390	9,670	10,126	10,923	12,654	14,124	6,251
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	3,152	4,101	4,062	4,023	4,276	4,622	5,291	5,754	2,603
Electronic components, n.e.c.	3679	3,261	3,825	3,847	3,759	3,908	4,185	4,430	4,695	1,434
Industrial instruments for measurement	3823	1,425	2,111	2,082	2,140	2,168	2,297	2,467	2,679	1,254
Instruments for measuring electricity	3825	2,906	3,349	3,334	3,234	3,202	3,431	3,671	4,052	1,146
Laboratory analytical instruments	3826	699	1,032	1,009	1,088	1,102	1,147	1,243	1,484	785
Total Hardware		**$46,817**	**$59,164**	**$60,328**	**$60,876**	**$60,656**	**$62,496**	**$68,303**	**$75,156**	**$28,339**
Share of Total		**3.1%**	**2.8%**	**2.8%**	**2.7%**	**2.6%**	**2.5%**	**2.6%**	**2.6%**	
Software/Services										
Computer programming services	7371	2,316	6,312	6,755	7,793	8,954	10,507	12,935	15,721	13,405
Prepackaged software	7372	1,811	5,133	6,147	7,455	7,890	8,968	11,517	14,086	12,275
Prepackaged software wholesalers	5045pt.	482	690	735	736	725	726	784	875	393
Prepackaged software retailers	5734pt.	56	105	113	123	121	137	160	181	125
Computer integrated systems design	7373	1,894	4,270	4,406	4,977	5,441	6,140	7,107	8,517	6,623
Computer processing and data preparation	7374	4,460	5,990	6,099	7,026	7,490	7,673	8,868	9,968	5,509
Information retrieval services	7375	980	1,560	1,584	1,659	1,797	1,852	2,401	3,181	2,201
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	2,761	5,214	5,669	6,491	7,254	8,459	10,640	13,853	11,092
Computer maintenance and repair	7378	673	1,365	1,448	1,566	1,567	1,657	1,838	2,108	1,435
Total Software/Services		**$15,433**	**$30,639**	**$32,957**	**$37,826**	**$41,239**	**$46,119**	**$56,250**	**$68,490**	**$53,057**
Share of Total		**1.0%**	**1.4%**	**1.5%**	**1.7%**	**1.7%**	**1.8%**	**2.1%**	**2.4%**	
Communications Equipment										
Household audio and video equipment	3651	1,766	1,806	1,890	1,955	2,015	2,210	1,803	1,924	157
Household audio and video equipment retailers	5731	1,395	2,112	2,246	2,393	2,491	2,971	3,370	3,662	2,267
Telephone and telegraph equipment	3661	4,779	4,698	4,471	4,645	4,994	5,129	5,574	6,256	1,477
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	3,940	4,729	4,769	5,037	5,202	5,541	6,547	6,917	2,977
Magnetic and optical recording media	3695	401	587	664	685	706	741	656	770	368
Total Communications Equipment		**$12,282**	**$13,932**	**$14,040**	**$14,715**	**$15,408**	**$16,592**	**$17,950**	**$19,529**	**$7,247**
Share of Total		**0.8%**	**0.7%**	**0.7%**	**0.6%**	**0.7%**	**0.7%**	**0.7%**	**0.7%**	
Communications Services										
Telephone communications	4810	28,497	33,991	34,796	36,641	38,037	40,248	42,083	44,347	15,850
Telephone and telegraph communications	482,489	1,422	1,453	1,343	1,068	1,076	1,166	1,296	1,503	81
Radio broadcasting	4832	2,062	2,624	2,621	2,654	2,750	2,946	3,079	3,319	1,258
Television broadcasting	4833	3,564	4,786	4,541	4,749	4,901	5,193	5,789	6,509	2,945
Cable and other pay TV services	4840	2,551	3,270	3,475	3,865	4,155	4,541	5,373	6,029	3,479
Total Communications Services		**$38,094**	**$46,124**	**$46,776**	**$48,977**	**$50,919**	**$54,094**	**$57,620**	**$61,707**	**$23,613**
Share of Total		**2.5%**	**2.2%**	**2.2%**	**2.1%**	**2.2%**	**2.2%**	**2.2%**	**2.2%**	

Source: Bureau of Labor Statistics

Table 16. Information Technology Industries: Annual Wages Per Worker

	SIC	1985	1990	1991	1992	1993	1994	1995	1996	Change 1985-1996	AAG 1985-1996 (Percent)
Average All Private Industries		**$18,843**	**$23,209**	**$23,952**	**$25,375**	**$25,746**	**$26,248**	**$27,164**	**$28,352**	**$9,508**	**3.8**
IT Industries		**$27,768**	**$36,248**	**$37,781**	**$40,644**	**$41,781**	**$43,091**	**$45,420**	**$48,488**	**$20,720**	**5.2**
Hardware											
Electronic computers	3571	32,689	46,406	48,597	52,360	54,655	55,629	59,563	62,379	29,690	6.1
Computer equipment wholesalers	5045pt.	34,908	46,314	49,238	52,492	52,947	52,880	54,299	57,536	22,627	4.6
Computer equipment retailers	5734pt.	20,478	29,051	31,105	32,243	30,553	32,072	33,769	34,605	14,128	4.9
Computer storage devices & peripheral equipment	3572,7	28,114	35,938	39,003	41,194	42,650	42,901	46,517	50,501	22,387	5.5
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	28,738	39,259	41,254	43,253	44,806	44,330	46,568	49,537	20,799	5.1
Electron tubes	3671	26,808	32,257	34,410	38,364	37,581	39,755	41,875	40,774	13,965	3.9
Semiconductors	3674	28,206	38,109	40,544	44,480	47,362	49,537	53,801	55,149	26,943	6.3
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	18,453	24,209	25,230	25,690	26,460	27,479	28,294	29,616	11,163	4.4
Electronic components, n.e.c.	3679	21,772	27,051	28,838	29,715	30,651	31,947	32,912	34,371	12,600	4.2
Industrial instruments for measurement	3823	24,528	31,697	32,995	35,082	35,835	37,048	38,427	40,464	15,936	4.7
Instruments for measuring electricity	3825	26,661	36,802	39,596	42,497	43,984	48,188	51,559	54,029	27,369	6.6
Laboratory analytical instruments	3826	27,973	34,400	35,907	38,719	39,217	42,639	44,235	47,727	19,755	5.0
Hardware		**$28,098**	**$37,598**	**$39,871**	**$42,375**	**$43,277**	**$44,173**	**$46,279**	**$48,494**	**$20,396**	**5.1**
Software/Services											
Computer programming services	7371	29,311	41,857	43,053	46,222	47,552	50,057	52,731	57,818	28,507	6.4
Prepackaged software	7372	32,933	45,505	49,413	56,995	54,489	56,976	63,700	70,821	37,888	7.2
Prepackaged software wholesalers	5045pt.	34,921	46,318	49,343	52,594	52,903	53,012	54,437	57,572	22,652	4.6
Prepackaged software retailers	5734pt.	20,733	29,074	31,479	32,328	30,183	31,847	34,018	34,838	14,105	4.8
Computer integrated systems design	7373	31,569	43,795	44,640	48,556	49,689	52,749	54,711	59,810	28,241	6.0
Computer processing and data preparation	7374	23,228	30,452	30,772	34,374	36,131	36,625	39,749	43,098	19,870	5.8
Information retrieval services	7375	25,121	32,704	35,044	36,704	38,896	38,583	42,197	46,501	21,380	5.8
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	30,345	41,185	43,242	45,970	46,830	48,924	51,827	57,150	26,804	5.9
Computer maintenance and repair	7378	26,929	34,296	34,071	36,589	37,488	37,236	37,819	40,072	13,143	3.7
Software/Services		**$27,683**	**$38,764**	**$40,413**	**$44,329**	**$45,292**	**$47,224**	**$50,721**	**$55,760**	**$28,078**	**6.6**
Communications Equipment											
Household audio and video equipment	3651	26,883	28,942	30,882	32,692	33,866	36,895	32,370	35,039	8,156	2.4
Household audio and video equipment retailers	5731	12,590	18,113	18,858	19,925	19,400	20,047	20,277	20,221	7,631	4.4
Telephone and telegraph equipment	3661	28,281	37,197	38,312	42,381	45,400	46,840	49,902	55,562	27,281	6.3
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	26,624	34,468	35,484	39,077	40,326	40,065	42,735	44,173	17,549	4.7
Magnetic and optical imaging devices	3695	20,074	31,058	33,200	37,432	38,791	39,415	39,281	45,274	25,200	7.7
Communications Equipment		**$23,919**	**$30,195**	**$31,103**	**$33,696**	**$34,617**	**$34,953**	**$35,650**	**$37,398**	**$13,478**	**4.1**
Communications Services											
Telephone communications	481	30,951	37,230	38,271	41,393	43,273	45,050	46,774	49,400	18,449	4.3
Telephone and telegraph communications	482,489	27,444	39,699	42,635	41,719	44,098	47,206	48,539	58,258	30,814	7.1
Radio broadcasting	4832	18,244	22,088	22,498	23,508	24,272	25,956	27,248	28,964	10,720	4.3
Television broadcasting	4833	30,880	41,726	39,974	41,440	42,177	43,749	47,180	50,732	19,853	4.6
Cable and other pay TV services	4841	21,633	25,994	27,148	29,594	30,507	31,426	34,553	35,238	13,605	4.5
Communications Services		**$28,885**	**$35,239**	**$36,015**	**$38,598**	**$40,122**	**$41,778**	**$43,731**	**$46,136**	**$17,251**	**4.3**

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

Table 17. Employment in IT Occupations
By Major IT Industries, 1996

Total All Occupations	All Industries (Incl Govt)	Private Industries (No Govt)	Non-IT Industries (Incl Govt)	Total IT	Computers	Audio & Video	Comm. Equip.	Electronic Comp.	Inst's nec	Comm.	Wholesale Trade est.	Retail Trade est.	Computer Serv.	Govt
Engineering, science, and computer systems managers	342,893	311,965	271,652	71,241	9,594	630	7,995	10,794	298	8,480	585	5	32,860	30,928
Electrical engineers	354,079	319,147	238,098	115,981	29,815	1,231	20,910	26,704	0	18,132	552	0	18,637	34,932
Computer systems analysts, engineers, and scientists	874,417	766,986	581,231	293,186	31,056	1,036	14,205	16,122	313	16,264	1,776	15	212,398	107,431
Computer programmers	548,014	513,996	324,424	223,590	14,027	268	2,424	4,049	126	9,685	1,137	8	191,866	34,018
Electrical technicians	295,707	275,440	220,928	74,779	11,486	1,395	10,117	22,133	88	11,661	2,793	1	15,105	20,267
Communications equipment operators	327,350	315,542	232,183	95,167	349	115	353	662	75	89,619	253	44	3,697	11,808
Computer operators	285,261	241,038	231,651	53,610	1,685	145	801	1,306	224	6,408	964	8	42,068	44,223
Broadcast technicians	44,058	43,847	9,699	34,359	0	0	0	0	0	34,359	0	0	0	211
Data entry keyers	17,828	17,828	13,205	4,623	0	0	0	0	0	0	0	0	4,623	0
Duplicating machine operators, etc.	196,039	162,787	187,538	8,501	245	0	147	127	0	2,370	212	23	5,377	33,252
Billing machine operator, etc.	100,614	97,724	98,145	2,469	0	0	0	0	0	850	549	9	1,060	2,890
Central office and PBX installers	77,786	77,786	27	77,759	0	0	0	0	0	77,759	0	0	0	0
Data processing equip. repairers	76,050	75,411	44,266	31,784	2,169	0	100	0	0	437	1,320	0	27,758	639
Electrical powerline installers	106,749	103,512	86,588	20,161	0	0	0	0	0	20,161	0	0	0	3,237
Electronics repairers	53,308	38,930	46,436	6,872	0	249	1,958	1,850	0	2,391	424	0	0	14,378
Cable and TV Line Installers	200,621	199,951	46,013	154,608	0	0	0	0	0	154,608	0	0	0	670
Electrical equipment assemblers	194,286	194,286	88,497	105,789	46,047	1,146	16,402	42,194	0	0	0	0	0	0
Electromechanical equipment assemblers	50,859	50,859	35,332	15,527	4,089	0	3,573	7,688	177	0	0	0	0	0
Electronic semiconductor processors	58,276	58,276	1,754	56,522	1,828	0	98	54,596	0	0	0	0	0	0
	4,204,195	3,865,311	2,757,667	1,446,528	152,390	6,215	79,083	188,225	1,301	453,184	10,568	113	555,449	338,884

Total Net Employment equals IT Industry Employment	4,637,900
plus Employees with IT Jobs in Non-IT Industries	2,757,667
Total Net	7,395,567

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

Table 18. Employment in IT Occupations
By Major IT Industries, 2006

Total All Occupations	All Industries (Incl Govt)	Private Industries (No Govt)	Non-IT Industries (Incl Govt)	Total IT	Computers	Audio & Video	Comm. Equip.	Electronic Comp.	Inst's nec	Comm.	Wholesale Trade est.	Retail Trade est.	Computer Serv.	Govt
Engineering, science, and computer systems managers	497,960	459,916	379,949	118,011	9,670	674	8,761	14,580	322	9,794	820	6	73,384	38,044
Electrical engineers	456,919	418,990	292,686	164,233	31,029	1,359	23,659	37,247	0	21,590	627	1	48,721	37,929
Computer systems analysts, engineers, and scientists	1,838,139	1,665,373	1,010,988	827,151	38,319	1,385	18,536	26,516	436	25,164	3,251	23	713,522	172,766
Computer programmers	665,227	635,804	317,735	347,492	9,700	196	1,822	3,753	91	8,137	1,125	6	322,662	29,423
Electrical technicians	338,636	319,460	247,248	91,388	9,647	1,228	8,216	29,544	77	11,578	3,317	1	27,780	19,176
Communications equipment operators	294,879	286,812	238,559	56,320	190	67	210	484	41	48,224	198	26	6,880	8,067
Computer operators	193,561	167,865	156,141	37,420	754	75	404	823	120	3,691	689	4	30,860	25,696
Broadcast technicians	50,597	50,397	12,911	37,686	0	0	0	0	0	37,686	0	0	0	200
Data entry keyers	9,879	9,879	6,438	3,441	0	0	0	0	0	0	0	0	3,441	0
Duplicating machine operators, etc.	148,785	137,321	140,161	8,624	134	0	87	93	0	1,626	166	14	6,504	11,464
Billing machine operator, etc.	99,077	96,769	96,512	2,565	0	0	0	0	0	635	483	7	1,441	2,308
Central office and PBX installers	82,321	82,321	26	82,295	0	0	0	0	0	82,295	0	0	0	0
Data processing equip. repairers	114,221	113,614	48,695	65,526	1,822	0	0	0	0	438	1,274	0	61,992	607
Electrical powerline installers	109,303	106,227	88,016	21,287	0	0	0	0	0	21,287	0	0	0	3,076
Electronics repairers	60,333	51,452	52,758	7,575	0	244	1,967	2,291	0	2,636	437	0	0	8,881
Cable and TV Line Installers	241,652	241,015	51,431	190,221	0	0	0	0	0	190,221	0	0	0	637
Electrical equipment assemblers	193,097	193,097	88,448	104,649	34,807	1,123	16,474	52,245	0	0	0	0	0	0
Electromechanical equipment assemblers	51,170	51,170	36,386	14,784	2,747	0	3,262	8,654	121	0	0	0	0	0
Electronic semiconductor processors	58,276	58,276	1,754	56,522	1,828	0	98	54,596	0	0	0	0	0	0
	5,504,032	5,145,758	3,266,843	2,237,189	140,647	6,351	83,496	230,826	1,208	465,002	12,386	87	1,297,187	358,274

Total Net Employment equals IT Industry Employment	6,212,900
plus Employees with IT Jobs in Non-IT Industries	3,266,843
Total Net	9,479,743

Source: DOC's Economics and Statistics Administration estimates based on DOL's Bureau of Labor Statistics data

Table 19. IT Employment and Average Annual Wages: Workers With IT Occupations in Non-IT Industries Plus All Workers in IT Industries, 1996

Occupations	All Industries (Incl. Govt)	Non-IT Industries (Incl. Govt)	Mean Wage ($ per hour)	40-Hour Week ($)	52-Week Year ($)	Annual Wages Non-IT Industries IT Occupations
Engineering, science, and computer systems managers	342,893	271,652	31.58	1,263.20	65,686.40	17,843,835,048.87
Electrical and electronics engineers	354,079	238,098	25.59	1,023.60	53,227.20	12,673,270,320.57
Computer systems analysts, engineers, and scientists 1/	874,417	581,231	26.40	1,056.00	54,912.00	31,916,558,934.37
Computer programmers 2/	548,014	324,424	23.25	930.00	48,360.00	15,689,158,064.74
Electrical and electronic technicians and technologists	295,707	220,928	16.25	650.00	33,800.00	7,467,364,209.76
Communications equipment operators 3/	327,350	232,183	11.65	466.00	24,232.00	5,626,266,055.16
Computer operators	285,261	231,651	11.97	478.80	24,897.60	5,767,563,239.34
Broadcast technicians	44,058	9,699	14.92	596.80	31,033.60	300,994,886.40
Data entry keyers	17,828	13,205	8.88	355.20	18,470.40	243,901,632.00
Duplicating, mail, and other office machine operators 4/	196,039	187,538	9.14	365.60	19,011.20	3,565,314,661.43
Billing, posting, and calculating machine operators	100,614	98,145	9.50	380.00	19,760.00	1,939,352,685.09
Central office and PBX installers and repairers	77,786	27	19.16	766.40	39,852.80	1,076,025.60
Data processing equipment repairers	76,050	44,266	14.16	566.40	29,452.80	1,303,749,280.20
Electrical powerline installers and repairers	106,749	86,588	18.23	729.20	37,918.40	3,283,278,419.20
Electronics repairers, commercial and industrial equip.	53,308	46,436	16.25	650.00	33,800.00	1,569,521,116.80
Telephone and cable television line installers	200,621	46,013	15.16	606.40	31,532.80	1,450,918,726.40
Electrical and electronic equipment assemblers	194,286	88,497	10.23	409.20	21,278.40	1,883,074,564.80
Electromechanical equipment assemblers	50,859	35,332	10.94	437.60	22,755.20	803,986,726.40
Electronic semiconductor processors	58,276	1,754	11.70	468.00	24,336.00	42,685,344.00
	4,204,195	2,757,667				113,371,869,941.13
Total Net Employment equals IT Industry Employment	4,637,900				avg. per worker	48,488.00
plus Employees with IT Jobs in Non-IT Industries	2,757,667				avg. per worker	41,111.52
Total Net	7,395,567					
Total Wages for IT Industries						224,882,495,200.00
Total Wages for Workers With IT Occupations in Non-IT Industries						113,371,882,619.92
Total Wages IT						338,254,377,819.92
Total Average Wage						45,737.45

ENDNOTES

1. As measured by the 1996 to 1997 change in the Consumer Price Index.

2. Testimony of Alan Greenspan in the "Monetary Policy Testimony and Report to the Congress." February 24, 1998. http://www.bog.frb.fed.us/boarddocs/hh

3. In this income side approach to measuring IT industries, earned income is the concept used in measuring the size of the economy. For that reason, Gross Domestic Product is measured in terms of its total income. Total income across industries is known as Gross Domestic Income. The methodology section of this report provides greater explanation as to the use of this concept.

4. Annual average wages of the IT workforce, all employees in IT industries and all workers with IT-related occupations across all industries, was $45,737. Annual average wages of employees in IT industries only was $48,000.

5. As a result, actual prices have dropped in some cases, and quality-adjusted prices have fallen even more rapidly. Deflating nominal output by quality-adjusted prices results in relatively rapid growth in the estimate of real output. This strong real growth boosts the contribution of these industries to total real growth in the economy well above their contribution to nominal growth.

6. Gross Domestic Income (GDI) was used as the measure of the economy for basing the estimates of IT industries contribution to real economic growth. See the section titled "Data and Methodology" for more information regarding GDI.

7. Year-to-year change in chain weighted 1992 dollar value added cannot be calculated directly. Rather, IT value added by industry is rebased using the movement of the real dollars to rebase the nominal. A more complete description is provided in the "Data and Methodology" section.

8. Intel, "Moore's Law: Changing the PC Platform for Another 20 Years," http://developer.intel.com/solutions/archive/issue2/focus.htm.

9. Inflation in the overall economy as measured by an implicit price deflator for GDI.

10. Estimates derived by adding chain-weighted 1992 dollars.

11. David, P.A. "Computer and the Dynamo, The Modern Productivity Paradox In a Not-Too-Distant Future." Stanford University.

12. Thomas Edison's Pearl Street Station in New York City began generating electricity on September 4, 1882. Smithsonian Institution, National Museum of American History.

13. Workers with IT-related occupations in IT industries are already counted in the employment by industry totals. To avoid double counting, they need to be included in the industry side or the occupation side, but not both.

14. Warnke, Jacqueline. "Computer Manufacturing: Change and Competition." *Monthly Labor Review*. August 1996. p.20.

15. IT-related occupations are described using the BLS *Occupational Outlook Handbook* and can be found at http://www.bls.gov/ocohome.htm.

16. Sternberg, Gary. "Jobs Associated With the Internet." *Occupational Outlook Quarterly.* Bureau of Labor Statistics. Summer 1997. pp.2-9.

17. Bureau of the Census. Current Population Survey Table No. 671. "Workers Using Computers on the Job: 1993." http://www.census.gov/prod/1/gen/95statab/labor.pdf

18. In some cases, industries were considered to be included if they incorporated computer or semiconductor technology as an integral part of its inputs. A whole host of industries could have been included in this category; e.g., Metal Cutting Machine Tools (SIC 3541), Autos (SIC 3711), and Aircraft (SIC 3721), and Electromedical and Electrotherapeutic Apparatus (SIC 3845) to name a few. To be conservative, we added a narrow subset of these industries; i.e., industrial instruments for measurement, instruments for measuring electricity, and laboratory analytical instruments.

19. OECD ICCP Committee. "A Draft Definition of the ICT Sector." A discussion document prepared by the Statistical Panel. August 1997, pp. 28-47.

20. American Electronics Association. "Cybernation, The Importance of the High-Technology Industry to the American Economy." May 1997, chapter titled "AEA's Definition of the High-Tech Industry."

21. For a discussion of the statistical discrepancy and the relationship between the product and income side approach to GDP accounting see:

    Lum, Shirley K. S. and Robert E.Yuskavage. "Gross Product by Industry, 1947-96." *Survey of Current Business*. November 1997. pp. 20-34.

22. Publications and data can be accessed on the Internet. The Census home page can be accessed through http://www.census.gov while the BEA home page can be accessed through http://www.bea.doc.gov.

23. BEA estimates of gross product were not used for the other IT industries since the BEA industry series does not match exactly with other IT industries.

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APPENDIX 2

BUILDING OUT THE INTERNET

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FIGURES AND TABLES

BUILDING OUT THE INTERNET

Every day people "surf the Internet" without contemplating what the Internet is, where it came from, who is using it, or what will become of it in the future. While it is unnecessary for the typical user to know all the details of the technical operation of the Internet, an understanding of the structure and origins of the Internet provides a basis for understanding the issues and constraints that we face as a larger share of our day-to-day activities moves online.

This section provides a brief, non-technical overview of the Internet that describes:

- The Internet's origins as a tool for government and academic researchers to link to remote supercomputers and communicate with one another, and its subsequent expansion as new technologies made it easier for non-technical people to use.

- The global reach of the Internet and its rapid growth in terms of the number of computers connected to it and the number of people using it.

- The rise of commercial activity on the Internet.

- Steps being taken in the United States to ensure more widespread access to the Internet.

- Potential constraints to commercial activity on the Internet such as security, privacy, reliability, and the development of a predictable tax and legal environment for electronic transactions.

- Issues posed by bandwidth constraints and the technological advances that may ease these constraints.

THE INTERNET: AN OVERVIEW

Today's Internet is based on a commercial system of network backbones (high-speed data lines) that originated in U.S. Defense Department research during the 1960s. The Defense Advanced Research Projects Agency (DARPA) sought communications technologies that would enable undisrupted communications even if major switching centers were incapacitated. This effort led to research into packet-switching technologies that, in turn, led to the 1977 development of two packet-switching protocols—the Transmission Control Protocol (TCP) and the Internet Protocol (IP)—that are fundamental to the operation of the Internet.

Packet-switching differs from circuit switching, the technology used for conventional telephone service. A circuit-switched system opens a direct circuit from the message's origin to its destination. For example, a person making a phone call from San Francisco to New York City gets a unique connection across the network for the duration of the call.

In a packet-switched system, however, a message is broken into chunks or "packets." Each packet is individually addressed and routed across the network to its destination where the message is reassembled. Packets that do not arrive at their destination are automatically retransmitted. Packet-switching is conceptually similar to the way the postal service works. That is, each letter or postcard is individually addressed and moves geographically from point to point as it travels towards its destination. Two postcards mailed from a post office in San Francisco may take different routes to New York City, but once they arrive at the New York City post office they are assembled with the other mail going to the destination address and delivered. Each packet is like a postcard (except that a packet is only part of a message and a postcard is typically a complete message) and network routers are like the mail stops along the way.[1] In a packet-switched system, packets are routed in transit and thus can be routed around congestion or failures in the infrastructure.

Another key step in the evolution of the Internet was the establishment in 1986 of several national supercomputer centers by the National Science Foundation (NSF). The NSF funded a network to link the supercomputer sites and offered to let regional and university computer networks link to this backbone. In addition to using the network to remotely access the NSF supercomputers, the research community developed applications, such as electronic mail, file transfer protocols, and news groups, to facilitate information sharing with colleagues.[2] The linking of university networks to the NSF backbone network, initially to gain remote access to the supercomputer sites, was the genesis of today's Internet.

Network traffic grew as the Internet expanded and evolved, but it was not until the development of the World Wide Web and the advent of graphical Web browsers that the Internet began to generate broad interest outside the academic and government research communities. The World

Wide Web protocols for transferring hypertext (a protocol for creating dynamic links within or between documents) via the Internet were first used in experimental form in 1989 at the European Center for Particle Research in Switzerland.[3] In the early 1990s, the National Center for Supercomputing Applications at the University of Illinois used these protocols to develop a graphical point-and-click interface called Mosaic. Mosaic, the first of the Web browsers, made the Internet easier for non-technical people to use. In the wake of these developments, the Internet began a phase of rapid expansion that continues to this day.

Internet Growth

The Internet is international in scope. While the United States has the most extensive Internet infrastructure, almost every country has some connectivity. The level of connectivity varies by country—ranging from e-mail only to full Internet access. The United States has the highest number of Internet hosts, although Finland, Iceland, and Denmark have higher numbers of Internet hosts on a per capita basis.[4] English is the dominant language of the Internet and is used for approximately 82 percent of Web pages worldwide.[5]

Two commonly used measures of the growth of the Internet are the number of hosts and domains on the Internet. A host is a computer that is connected to the Internet that has a unique Internet Protocol (IP) address.[6] A domain name represents a record within the Domain Name System, such as whitehouse.gov. A top-level domain refers to the final section of an Internet address—com, gov, net, org, and so forth.

The number and growth of Internet hosts and domains give us a rough estimate of the minimum size of the Internet and the rate at which it is expanding.[7] The number of Internet hosts increased from 1.3 million in January 1993 to 19.5 million in July 1997. Over the same period, the number of domains—names registered within the Domain Name System—increased from 21,000 to 1.3 million (Table 1).

Table 1. Hosts and Domains Advertised in the Domain Name System

(thousands)				
	Hosts		Domains	
Date	Number	Growth	Number	Growth
Jul-97	19,540	21%	1,301	57%
Jan-97	16,146	25%	828	70%
Jul-96	12,881	36%	488	103%
Jan-96	9,472	43%	240	100%
Jul-95	6,642	37%	120	69%
Jan-95	4,852	51%	71	54%
Jul-94	3,212	45%	46	53%
Jan-94	2,217	25%	30	15%
Jul-93	1,776	35%	26	24%
Jan-93	1,313		21	

Note: Growth rates for July 1995 forward based on non-rounded source data.
Source: *Network Wizards* http://www.nw.com/

The statistics on cumulative registrations for the com, net, and org top-level domains provide additional evidence of this growth. Network Solutions reports that the net cumulative registrations for these three domains increased from 7,100 in December 1992 to 1.5 million in December 1997.[8]

COMMERCIAL ACTIVITY ON THE INTERNET

The number of commercial top-level domains, one indicator of commercial activity, grew from 27,400 to 764,000 between January 1995 and July 1997.[9] The existence of a business Web page, however, does not necessarily mean that the Web page enables commercial transactions. Some sites are simply a brochure for a company that conducts business offline, while others are full-fledged store fronts for companies that exist solely on the Internet. One 1997 survey of large firms in North America, Europe, and Asia found that 98 percent of the companies surveyed had established some commercial presence on the Internet, but only 47 percent allowed interactive communications and only 15 percent engaged in full-scale business over the Internet.[10]

Nonetheless, commercial transactions over the Internet are expanding—at a rate that is too rapid to gauge with precision. Forrester Research, for example, estimated business-to-business transactions would grow from $7.8 billion in 1997 to $326.4 billion in 2002.[11] At the close of 1997, however, a single company, Cisco Systems, was already reporting a run rate of $3.2 billion in network equipment sales from its Web site.* Early reports of 1997 year-end retail sales online also suggested strong growth.

Many companies are also taking advantage of Internet protocols to create Internet-like networks for company-only use (intranets) or for use by the company and its business partners (extranets). Intranets and extranets connected to the public Internet typically are protected from unauthorized access by security programs known as firewalls.

Text Box 1. Examples of Infrastructure Technologies

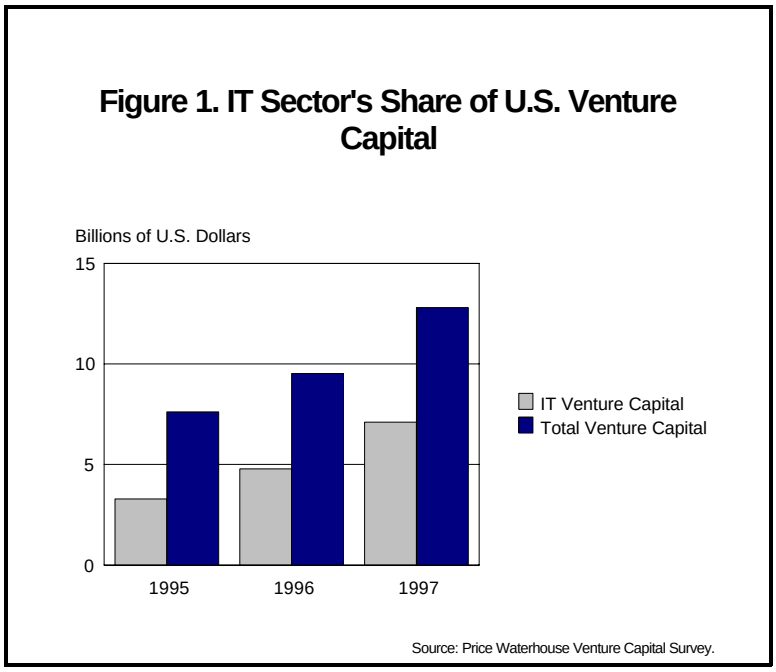
Hardware: Semiconductors (microprocessors, microcontrollers, memory and specialized logic chips), storage devices (disc drives, tape drives, cd roms), batteries, display technologies (cathode-ray tubes, liquid crystal displays), transmission media (coaxial cable, twisted pair copper wire, fiber optic cables, switches, routers, antennas, satellites) remote access devices (modems, cable modems, wireless modems).

Software: Operating systems (desktop, mobile, server), Web browsers, search engines, security software (authentication, authorization, encryption, firewalls), system management software, languages and software development tools, middleware (transport stacks, network operating systems), database management systems, groupware software, workflow software.

Services: Online and Internet access provision, wireless, wireline and satellite service provision, message transport (value added networks), Web site development.

* The run rate is the annual rate of sales based on sales in a single month; in this case December 1997.

The development and expansion of the Internet and Internet-like networking infrastructures that make electronic commerce possible are the result of new developments and the converging technologies from a number of hardware, software, and services industries. Private forecasters, such as Forrester Research, Zona Research, and International Data Corporation predict rapid growth in revenue generated by these industries.



The amount of venture capital funds pouring into business sectors associated with electronic commerce provides additional evidence that investors anticipate continued growth in these industries. The share of venture capital going to the information technology sectors—Software & Information, Communications, Computer & Peripherals, Electronics & Instrumentation, and Semiconductors/Equipment industries—has increased as a share of overall U.S. venture capital (Figure 1). In 1995, these categories represented $3.3 billion (44.2 percent) of a total of $7.6 billion in U.S. venture capital. In 1997, they accounted for $7.1 billion (55.8 percent) of $12.8 billion in U.S. venture capital.[12]

Constraints on Commercial Use

Individuals and businesses cite a number concerns about using the Internet for commercial purposes. Businesses have raised three potential inhibitors to the widespread adoption of Internet commerce: (1) the lack of a predictable legal environment; (2) concerns that governments will overtax, overregulate, or censor the Internet; and (3) uncertainty about the Internet's performance, reliability and security. Consumers cite concerns about security of transactions and the privacy of electronic information.

Businesses

To feel comfortable about using the Internet in communications with its suppliers and customers, a business needs to be sure of the identity of the party at the other end of the transaction and that any agreement made electronically is legally binding. The U.S. Federal government supports the development of both a domestic and global uniform commercial legal framework that will recognize, facilitate, and enforce electronic transactions worldwide. Internationally, the U.S. Federal government is working with the United Nations Commission on International Trade Law. This group has completed work on a model law that supports the commercial use of international contracts in electronic commerce. The Federal government is also working with the International Chamber of Commerce, which has issued model commercial code guidelines.

Companies also typically transmit confidential information on a regular basis, and they want assurance that these transmissions will remain secure. Today, a business verifies identities with passwords, electronic signatures, and Internet Protocol (IP) addresses. Discussions are underway to develop greater security on the Internet. Topics under discussion include encryption, digital signatures, and digital certificates.

> Encryption—A technology that encodes a message before it is sent and decodes it when it is received. Encryption used to protect a message from unauthorized viewing and alteration.
>
> Digital Signatures—An electronic version of a signature. One of a number of signature alternative technologies, it uses cryptographic techniques to verify that the person who sent the message in fact sent the message and that the contents have not been altered since the message was sent.
>
> Digital Certificates—An electronic third party "voucher" that a message is authentic. This is conceptually similar to paper-based certificates, such as birth certificates, passports, and drivers licences. The certificate (e.g., a driver's license) issued by a credible third party (state government) indicates that the information carried in the message (name, address, etc.) is authentic.

Companies are also concerned about the potential for excessive taxation of the Internet. The U.S. Federal government believes that no new discriminatory taxes should be imposed on Internet commerce. It also believes that no customs duties should be imposed on electronic transmissions. The application of existing taxation on commerce conducted over the Internet should be consistent with the established principles of international taxation, should be neutral with respect to other forms of commerce, should avoid inconsistent national tax jurisdictions and double taxation, and should be simple to administer and easy to understand.

Companies are also concerned that government may over-regulate or censor the Internet, passing cumbersome regulations that limit content or make too complex or unpredictable the ways that

buyers and sellers can conduct business. The U.S. government supports the development of the Internet as a market-driven arena, not a regulated one. This means that governments should refrain from passing regulations to govern the Internet. Where possible, rules for Internet behavior should be set through private collective action rather than government regulation. The aim of these rules should be to empower consumers to protect their own privacy, control the content they see, and protect themselves against inappropriate commercial behavior. Competition and consumer choice should be the guiding principles of Internet commerce.

Some companies are concerned about the Internet's performance and reliability. Businesses that have conducted Electronic Data Interchange transactions over private value added networks know through experience that important information will likely arrive at its destination, on schedule, and intact. If problems arise, a single network service provider is accountable and responsible for resolving them. The Internet offers no such guarantees. As a public network of interconnected networks and service providers, there is no single entity responsible for ensuring that a message leaves one point and arrives, intact, at another.

Consumers

Most Internet purchases are currently made by entering credit card and delivery information on a computerized form and transmitting it electronically to the retailer. Even though consumers are accustomed to giving credit card information over the telephone, many are reluctant to give it online for fear that it will be stolen or misused. This reluctance is often cited as the largest barrier to the growth of Internet retail trade. Web retailers suggest that this difficulty may be largely a matter of perception and that over time concerns about credit card security will decline as more people shop online.

The privacy of information provided by Web users or recorded as a user moves around the web is also a key concern of individuals contemplating using the Internet for commercial and non-commercial purposes. A majority of respondents to a recent *Business Week/Harris* poll reported privacy as the main reason they do not use the Internet. More than three-quarters of current users say they would use the Web more if privacy were guaranteed.[13]

A remote transaction, such as an online purchase, requires the provision of some information—for example, the name and address of the purchaser. A purchase made online may trigger the creation of a customer profile in a Web merchant’s database. Collecting data on a customer’s past purchases enables a company to personalize service, by informing a customer of the release of a new book by a favorite author, for example. Some Web sites request that visitors provide personal information upon entering the site. In exchange for that information, they may offer "membership" services such as new product announcements or newsletters. An Internet user may also unwittingly leave an electronic "footprint" of visits to different Web sites. In any of these cases, the consumer may have little control over how this information is compiled or distributed.

The U.S. Federal government is encouraging the private sector to establish codes of conduct and self-regulation. It maintains that effective self-regulation involves substantive rules, as well as the means to ensure that consumers know the rules, that companies comply with them, and that consumers have appropriate recourse when injuries result from noncompliance. Consumers need to know the identity of the collector of their personal information, the intended uses of the information, and the means by which they may limit its disclosure. They should be given the opportunity to exercise choice with respect to whether and how their personal information is used. Companies creating, maintaining, using, or disseminating records of identifiable personal information must take reasonable measures to ensure its intended use and must take reasonable precautions to protect it from loss, misuse, alteration, or destruction. In addition, a consumer should have the opportunity to access, in a reasonable and appropriate manner, personal information that has been compiled by a company, and should be able to correct or amend that information when necessary.

GROWTH OF INTERNET USAGE

Internet usage is difficult to measure. A person may have access to the Internet, but not use it, or have full access but only use basic applications like e-mail. A person may have multiple Internet accounts—for example at home and at work or school. Alternatively, a user may not have an account at all and instead use the Internet at a library or a cyber café.

Due to the rapid growth of Internet usage, estimates of the number of people online in the United States and worldwide are released regularly.[14] Estimates ranged from 51 million to 62 million people online in the United States, to as many as 101 million people online worldwide in 1997.[15] While absolute numbers may vary by source, few analysts disagree that Internet usage is growing rapidly.

A 1997 CommerceNet/Nielsen study of Internet users in the United States and Canada suggests that recent Web users are younger, more highly educated, and have higher household incomes than the population as a whole.[16]

- 48.0 percent have an associate college degree or a higher level of education, compared to 28.3 percent in the population as a whole.

- The average age of recent Web users is 34.5 years, compared to 43.5 years for the population as a whole.

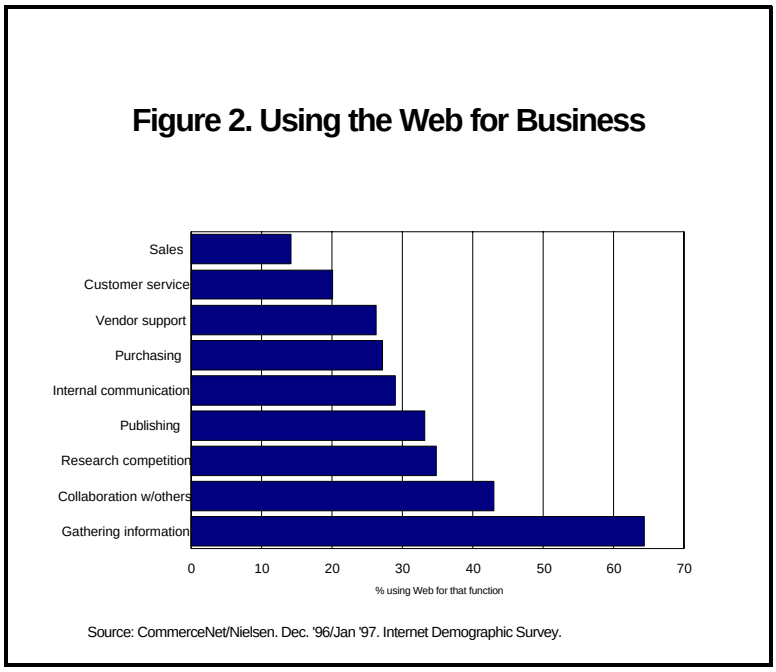
- 33.9 percent have household incomes of $60,000 or more, compared to 19.5 percent for the population as a whole.

Recent World Wide Web users use the Web for a variety of purposes:

- 53.1 percent use it for personal reasons, 23.2 percent for work, and 22.3 percent for school.

- 33.4 percent have used the Web for business purposes, with business activities ranging from gathering product and service information to selling products and services (Figure 2).

A more recent survey conducted during Fall 1997 indicates that use of the Web for business purposes had increased in essentially all of the categories shown in Figure 2. Furthermore, by Fall 1997, 10.1 million people (16.1 percent of recent Web users) had made purchases online up from 7.4 million six months earlier.[17]



Access For Everyone—Universal Service

The demographic statistics point to one of the challenges of the new era of communications—making sure that all segments of the population have the opportunity to use these new technologies.

The United States has a long history of supporting "Universal Service" in telecommunications. The concept in general terms was written into Section 1 of the 1934 Communications Act:

... to make available, so far as possible, to all the people of the United States a rapid, efficient, Nationwide, and worldwide wire and radio communication service with adequate facilities at reasonable charges ...[18]

The extension of the universal service concept to ensure that information resources are available to all at affordable prices was a key goal of the *1993 National Information Infrastructure: Agenda for Action*.[19]

The 1996 Telecommunications Act provided the legal framework under which the expansion of the universal service concept became possible.[20] The new framework created opportunities for greater investment in high technology communications, networking, and Internet access at schools, public libraries, and hospitals, particularly in poor and rural areas.[21] The structure for this expanded universal service was established in May 1997 via the Federal Communication Commission's Universal Service Order. Beginning January 1, 1998, up to $2.25 billion annually will be available to provide eligible schools and libraries with discounts, ranging from 20 percent to 90 percent, for all telecommunications services, Internet access, and internal connections. The level of these "E-Rate" discounts will be correlated to indicators of poverty and high cost for schools and libraries.[22] Universal service provisions will also provide support for public and not-for-profit health care providers who do not have access to the Internet on a local dial-up basis and who presently have to pay to charges to reach the Internet.

While there is still much more to be done to ensure widespread access to the Internet and other advanced technologies, important first steps have been taken. For example, programs such as the Telecommunications and Information Infrastructure Assistance Program at the Department of Commerce have been established to facilitate the creation of public-private partnerships to bring

advanced communications technologies to communities throughout the United States. Federal grant money from this program, combined with private funds and volunteer work by people at the grass roots level, has already brought advanced technologies to schools, police stations, and community centers that might otherwise have been left behind.[23]

ACCESSING THE INTERNET

A connection to the Internet requires an Internet-enabled device and a communications link to the Internet. Together, they play a critical role in determining which electronic commerce goods and services a person can access. Various companies are bringing new Internet-enabled appliances to the market, giving consumers a broad range of options for connecting to the Internet. These technologies may compete directly with the PC as the main household Internet access device and include network computers or Internet television, or access may be bundled into other communications devices, such as telephones, pagers, or handheld computers. At the same time, technology options enabling faster connections to the Internet for residential users are expanding and becoming more widely available.

THE COMMUNICATIONS LINK—THE IMPORTANCE OF BANDWIDTH

The delivery of e-mail, images, software, or any other electronic product or service depends on the capacity—that is, the bandwidth—of the telecommunications system. Bandwidth, measured in terms of bits per second, determines the speed at which data can flow through the computer and communications systems without interference.[**]

In simple terms, communications networks operate by converting text, images, or sounds into numbers, sending signals representing those numbers across the network, and then converting the signals back into text, sounds, or images. For example, on a digital network, information (text, picture, or sound) is converted into strings of ones and zeros (digitized) and then transmitted across the network via signals (light pulses, electrical current pulses, or radiowave frequency changes) that represent either ones or zeros. The bandwidth of the system is the rate at which the signals can be transmitted without confusing the ones and zeros. As Michael Dertouzos, the Director of the MIT Laboratory for Computer Science, describes it, if we were sending smoke signals, the bandwidth would be the rate at which we could flap our blanket and still be able to distinguish the individual puffs of smoke. If we flap too fast, we end up with a column of smoke that means nothing.[24]

In the early days of the Internet, most messages were simple text that did not require large amounts of bandwidth. However, following the advent of the World Wide Web, the desire to transmit information requiring large amounts of bandwidth—images, sounds, software, streaming video, telephony, and so forth—increased rapidly. A fast/high bandwidth connection can make a

[**] A bit (*b*inary dig*it*) is the smallest indivisible unit of digital information—either a one or a zero. One byte = 8 bits. Kbps = kilobits per second = 1,000 bits per second; mbps = megabits per second = 1,000,000 bits per second; gbps = gigabits per second = 1,000,000,000 bits per second.

vast difference in a person's willingness to access products and services electronically (Table 2). An Internet user probably will not spend 46 minutes waiting for a 3.5-minute video clip (approximately the amount of video represented by a 10 megabyte file) to download, but would wait if it took only a minute or a few seconds to download the same file.[25] Thus, the bandwidth of a consumer's connection to the Internet is a prime determinant of the products and services that can be delivered electronically.

Many businesses already have access to, and resources to afford, high-bandwidth connections through various dedicated services now available from Internet Service Providers and local phone companies. Generally, however, residential users are constrained by low bandwidth connections. Residential users typically access the Internet via a dial-up connection using a 14.4 to 56 kbps analog modem over a normal telephone line. During the fall of 1997, the majority of U.S. users connected at speeds of 28.8 to 33.3 kbps.[26]

The options for high-speed residential Internet access are, however, increasing rapidly (Table 3). Analog modem speeds have increased from a then state-of-the-art speed of 14.4 kbps in 1993 to 56 kbps in 1997. Integrated services digital network (ISDN) technologies, which offer faster access, have become widely available, although without a large increase in penetration for Internet use. In 1997, trials of various Digital Subscriber Line (DSL) technologies were initiated.[27]

Cable TV companies are in the process of upgrading their infrastructures to enable 1.2 to 27 mbps shared capacity Internet access speeds. Options for wireless Internet access from terrestrial and satellite service providers are also increasing—some of them offering high-speed access for residential users.

Table 2. Transfer Speed Comparison for a 10-megabyte File

Modem Speed/Type	Transfer Time
9.6 Kbps modem	2.3 hours
14.4 Kbps modem	1.5 hours
28.8 Kbps modem	46 minutes
128 Kbps ISDN	10 minutes
1.54 Mbps T-1 connection	52 seconds
4 Mbps cable modem	20 seconds
8 Mbps ADSL technology	10 seconds
10 Mbps cable modem	8 seconds

Source: FCC, CS Docket No. 96-496, 1997; ASDL from Werbach 1997, p. 75.

Table 3. Major End-use Internet Access Technologies

Technology	Downstream	Upstream	Penetration	Comments
POTS—"Plain Old Telephone Service" (analog voice telephony)	14.4-56 kbps	14.4-56 kbps	94 percent of homes have POTS services.	Requires no additional telco investment and only a computer and (inexpensive) analog modem at the user premises.
ISDN—Integrated Services Digital Network	56-128 kbps (230 kbps under development)	56-128 kbps (230 kbps under development)	Approximately 70% of access lines are now capable of supporting ISDN, but less than 5% of Internet subscribers use ISDN.	New pricing, standardization, marketing efforts may increase penetration.
xDSL—Digital Subscriber Line	384 kbps (SDSL) 768 kbps (HDSL) 1.5-8 Mbps (ADSL)	384 kbps (SDSL) 768 kbps (HDSL) 1.5-8 Mbps (ADSL)	Significant deployment of SDSL and HDSL today for corporate networks and T1 services.	Commercial ASDL deployment by most telcos planned to begin in 1997.
Cable Modems	1.2-27 Mbps (shared capacity)	128 kbps-10 Mbps (shared capacity) or POTS line used for upstream.	Commercially available in 1997.	Several companies have deployed infrastructure.
Wireless	28.8 kbps (900 Mhz) 1.5 Mbps—Local Multipoint Distribution Service (LMDS) 1.5 Mbps—Multichannel Multipoint Distribution Services (MMDS)	28.8 kbps (900 Mhz) 1.5 Mbps (LMDS) 1.5 Mbps (MMDS)	Some technologies under development that could provide wireless Internet access.	Actual bandwidth will depend on environmental factors as well as details of deployment.
Satellite	400 kbps	POTS line used for upstream		DirectTV® available. Several other systems under development.

Source: Primarily from Werbach, Kevin. "Digital Tornado: The Internet and Telecommunications Policy. Federal Communications Commission, OPP Working Paper Series, # 29. March 1997. p. 75.

Communications carriers have also dramatically increased bandwidth by: (1) increasing capacity (e.g., laying more fiber and cable, launching more satellites); (2) upgrading to a higher bandwidth infrastructure (e.g., replacing cable with fiber, upgrading to faster electronic switches); (3) developing technologies that squeeze more bandwidth out of the existing infrastructure (e.g., asynchronous transfer mode, wave division multiplexing); and (4) developing compression technologies that squeeze data into fewer bytes. For example, new electronics that double the capacity of existing fiber optic lines have been deployed every one to two years. In the late 1970s, a strand of fiber could carry 2 mbps. By 1997, a single strand could carry 10 gbps, a five thousand-fold increase in capacity.[28] According to Lucent Technologies, a single strand of optical fiber today can transmit 400 gigabits per second, enabling carriers to build networks capable of transmitting the equivalent of over 90,000 volumes of an encyclopedia in one second.[29]

Internet Appliances

The Web surfer's options for gaining access to the Internet are also expanding. Currently the primary Internet appliance is the personal computer (PC). While the PC is not likely to disappear as an important Internet appliance in the near future, additional devices will likely supplement it. The two most commonly cited reasons for the limited household penetration of PCs, currently at about 43 percent, is that they are expensive and difficult to use.[30] Not surprisingly, new and proposed Internet appliances, such as Internet TVs and smart phones, are based on familiar consumer electronics that non-technical consumers will likely find less intimidating and easier to use than the PC.

The Internet TV uses a TV as its monitor and a set-top box to connect to the Internet via a telephone line (or potentially a cable TV network connection). These products take advantage of the existing penetration of televisions in U.S. households (98 percent) and the consumer's familiarity with set-top boxes, which are used to unscramble premium cable channels in many of the 66.2 percent of U.S. households with cable television.[31] Internet TV promises full browser capabilities, the ability to download and save information, printing capability, and e-mail (via either an on-screen key board or a wireless keyboard). The first movers in the Internet TV market offered Internet access via a special Internet service provider as a separate TV channel. Next generation offerings promise interactivity that will enable a Web surfer to watch a TV program and simultaneously interact with that program via the Internet connection. Video game consoles are another popular consumer electronics device with potential as an Internet appliance for connecting the TV to the Internet from the home. A number of video game manufacturers, such as Sega Enterprises, Ltd. and Nintendo Co. Ltd., are introducing Web browsing capabilities into their game consoles.[32]

The telephone, another wide-spread and easy-to-use household and mobile appliance, is also becoming a popular medium for Internet access. Cellular and Personal Communications service providers have developed smart phones—wireless telephones capable of browsing the Internet and sending and receiving e-mail messages.[33] Alphanumeric pagers are becoming "information delivery devices" capable of receiving sports scores, stock quotes, news and weather updates, and

e-mail delivered from the Internet.[34] Some Personal Digital Assistants (PDAs), personal organizers, and handheld PCs are also capable of receiving Internet messages, such as e-mail.

The rise of a broad range of Internet appliances does not point to a decline in the use of personal computers. Computer prices continue to fall, reducing the price barrier to the spread of their use. Some now cost less than $1000. At the same time, hardware and software companies have been working to make them easier to use.[35] The emergence of new appliances is just one facet of the complex evolution of the information technology industries. For example, at the same time that Internet TV is offering Internet access, PCs are able to receive TV broadcasts (albeit usually of primitive picture quality due to bandwidth constraints) transmitted over the Internet. Similarly, a PC can be used to make telephone calls over the Internet. Thus, as consumers are being offered new technologies to browse the Internet or access Internet e-mail, the Internet is becoming a new way to access familiar services, such as telephone service or television broadcasts.

Text Box 2. Telecommunications—An Industry in Transition

The large scale changes that are taking place in the telecommunications industry are important to the Internet because the infrastructures are largely intertwined. Internet backbones are typically high-speed communications lines leased from telecommunications companies. Internet traffic travels over virtually all of the interconnected telecommunications networks. Furthermore, many telecommunications companies have expanded to provide Internet access services.

Since the 1980s, telecommunications in the United States have undergone a process of deregulation that has brought increasing competition to the industry. Until the early 1980s, American Telephone & Telegraph (AT&T) served 80 percent of U.S. telephone lines under a regime regulated by U.S. State and Federal governments. In 1982 the U.S. courts acted to break up the AT&T monopoly and in1984 the AT&T divestiture created a system of competitive long distance markets and monopoly local services. This was the beginning of an era of telecommunications deregulation in the United States.

In 1996, Congress passed and President Clinton signed into law sweeping legislation of the communications industries—the Communications Act of 1996. This legislation calls for increased competition among telecommunications companies and contemplates an end to different and separable communications markets defined by regulation instead of competition. The Internet embodies the purpose behind this goal—Internet networks make no distinction between text, images, sounds, or video.

Around the world, other countries have also taken steps to deregulate, privatize, and increase competition in their telecommunications industries. These steps include the recently signed World Trade Organization agreement on basic telecom services, which was agreed to by 72 countries, which will accelerate liberalization and deregulation of basic telecommunications services.

NEXT GENERATION INTERNET

In October 1996, the Clinton administration announced its support for the Next Generation Internet (NGI) Initiative, an initiative to provide funding to academic, government, and industry research communities to advance research into experimental network applications, services, and infrastructure. The Clinton Administration's Fiscal Year 1999 budget allocates $850 million for research and development for the Large Scale Networking and High-end Computing and Computation research and development program. Of this proposed funding, $110 million will go to the NGI Initiative.[36]

The NGI will enable the development of high-performance test networks among research centers to "provide system-scale testing of advanced services and technologies and to support testing of advanced applications."[37] Two NGI goals are to develop a broadly based network that will connect research institutions across the country at end-to-end performance speeds 100 times that of the current Internet and to develop an ultra-high-speed network among a select group of institutions that will function at speeds 1000 times faster than the current Internet.[38]

The NGI initiative will also work in conjunction with networking projects, such as Internet2, a collaborative effort by more than 100 U.S. research universities to create and sustain a leading edge network for developing network engineering and management tools and broadband applications for advanced research and education.[39]

Thus, as in the development of the early networking technologies that foreshadowed the Internet, the next generation of networking technologies will likely stem from study of pre-competitive technologies by the academic, government, and industrial research communities. This research will provide a foundation for a faster, more reliable, and more secure public Internet in the future.

CONCLUSION

During the 1990s the Internet has grown dramatically, both in terms of the number of computers connected to it and the number of people using it. This growth has been so rapid that it is difficult to gauge it with precision; however it is clear that the Internet is becoming an important medium for communicating information and conducting commerce.

Ten million people in the United States and Canada have already used the Web to purchase a good or service online. A great many more use the Web to gather product and service information before making an offline purchase. Many companies use the Internet for procurement, customer service, sales, and other key business processes. Consumers are being offered faster connections and a broader range of devices to connect to the Internet. In addition, new and proposed Internet appliances, such as Internet TVs and smart phones, will likely make the Internet easier and less intimidating for non-technical people to use.

New research has been proposed and is underway in government, academic, and private sector research communities that foreshadows the next generation of networking technologies. This research promises a strong foundation for a faster, more reliable, and more secure public Internet in the future.

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Endnote Table

Date	Survey Host Count	Adjusted Host Count	Growth	
Jan 98	29,670,000		13.9	first NEW Survey
Jul 97	19,540,000	26,053,000	19.4	last OLD Survey
Jan 97	16,146,000	21,819,000	30.4	
Jul 96	12,881,000	16,729,000	16.6	
Jan 96	9,472,000	14,352,000	75.0	
Jul 95	6,642,000	8,200,000	40.2	
Jan 95	4,852,000	5,846,000		

Source: *Network Wizards* http://www.nw.com/

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    As amended by the Telecommunications Act of 1996, that provision now reads:

    > ...to make available, so far as possible, to all the people of the United States, without discrimination on the basis of race, color, religion, national origin, or sex, a rapid, efficient, Nation-wide, and world-wide

wire and radio communication service with adequate facilities at reasonable charges...

The full text of the amended 1934 Communications Act can be found at http://www.fcc.gov/telecom.html.

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    Historically, the PC has been expensive relative to other consumer electronics. In 1997, however, several manufacturers announced the plans to market complete multimedia PC systems for less than $1000. According to Business Week, by the end of 1997 sub-$1000 PCs accounted for 30 percent of all computers sold through U.S. computer and electronic stores (*Ibid. p. 28)*.

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APPENDIX 3

ELECTRONIC COMMERCE BETWEEN BUSINESSES: ANALYSIS AND CASE STUDIES

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ELECTRONIC COMMERCE BETWEEN BUSINESSES

The Internet has the potential to greatly expand the value of goods and services businesses trade electronically. Estimated at more than $8 billion in 1997, the value of goods and services traded between businesses over the Internet (excluding transfer of funds or financial securities purchased) far exceeds online transactions between businesses and consumers. And, given the pace at which businesses are beginning to use the Internet to manage interactions with their business partners, it will continue to grow very rapidly. Analysts predict businesses will trade as much as $300 billion over the Internet in the next three to five years. Others think it could be much higher.[1]

Electronic commerce between businesses is not new. Businesses began sending and receiving purchase orders, invoices and shipping notifications electronically via EDI in the late 1970s. Analysts estimate that businesses already trade well over $150 billion in goods and services using EDI over private value-added networks.[2]

But, because EDI over private networks was initially expensive and required training and installation, it was out of the reach of many small and medium-sized businesses. The Internet makes electronic commerce affordable to even the smallest home office. Companies of all sizes can now communicate with each other electronically, through a web of interconnected networks including the public Internet, intranets, extranets and value-added networks.

The rapid growth of business-to-business electronic commerce is being driven by lower purchasing costs, a reduction in inventories, lower cycle times, more efficient and effective customer service, lower sales and marketing costs, and new sales opportunities.

Lower purchasing costs

Buying materials or services for a corporation can be an expensive, multi-step process. Companies lower procurement costs by consolidating purchasing and developing relationships with key suppliers to benefit from volume discounts and tighter integration in the manufacturing process. They cast a wide net for lower-cost sources of supply, and they use EDI over private networks to reduce labor, printing and mailing costs.

The Internet has the potential to further reduce procurement costs by automating previously manual tasks. It opens the door to doing business electronically with new suppliers and with small and medium-sized suppliers who formerly communicated only via fax or phone. Its global reach and real-time communication capabilities are driving the creation of new online marketplaces for production and non-production materials.

U.S. businesses spend about $250 billion each year on materials, services and supplies not used in the production process. Buying office supplies, computer equipment, and parts for maintenance, repair and operation of equipment (otherwise known as MRO supplies) is typically a manual process and can be very costly and inefficient.

Purchase orders for indirect and MRO supplies are often for low-dollar value amounts. At $80-125 on average just to cut a purchase order, processing costs alone can add significantly to the cost of a low-dollar value item. Individual divisions and offices tend to purchase their own supplies rather than consolidating purchases across the company. About 30 percent, or $83 billion, of all indirect and MRO purchases are made outside authorized contracts and cost businesses a premium of up to 50 percent.[3]

When surveyed about their plans, one out of four purchasing managers stated that they have plans to use the Internet for MRO purchasing. Fewer than 10 percent of them currently do.[4] Following are some examples of Internet-based procurement and sales marketplaces.

The Trading Process Network, a joint venture between GE Information Services and Thomas Publishing, is an Internet-based trading network linking buyers and sellers of a range of goods and services, including thermal engineering and management solutions, precision fasteners and machined parts, industrial cleaning products, plastics, contract manufacturing solutions, computers, and engineering, inspection and procurement services.

One of the solutions, TPNMart, is an electronic catalog, requisitioning and ordering solution targeting the indirect/MRO purchasing process. Buyers can search the catalog and prepare shopping lists for repeat ordering or single purchases. Solutions are customized to incorporate pricing negotiated between the buyer and the seller, and built-in approval and routing processes incorporate a company's particular buying guidelines. The system also offers purchasing card and EDI support. Professionals in sourcing departments estimate that TPNMart will lead to a 10-15 percent overall cost savings from a combination of sourcing productivity, usage control and various process quality improvements.[5]

Using TPNPost, buyers can identify qualified suppliers worldwide, distribute requests for quotes (RFQs) and specifications, transmit electronic drawings to multiple suppliers simultaneously, hold multiple bidding rounds and receive and manage bids. With TPN Post, sellers can use the Internet to find, download and view bidding projects they have been invited to bid on, prepare and submit bids to the buyer, receive results and generate reports of bidding activity.

Digital.market has created an online sourcing and procurement system for electronic components. Customers can upload parts lists, full bills of material, approved vendor lists and select their preferred distributors to serve as the basis for their request for quotes. Using this information, digital.market automatically retrieves quotes from distributors, which customers can convert to one or more purchase orders. In the next step, digital.market automatically routes the purchase order to the preferred distributor and places it in the distributor's order-entry system as an EDI

purchase transaction. Finally, digital.market delivers the order confirmation with a delivery date. Distributors pay a small transaction fee for orders placed using the service.

Wiznet Purchasing Extranet connects buyers to over 50,000 manufacturers' industrial catalogs, 5 million data sheets and product specifications from 30,000 suppliers. Each week, the Purchasing Extranet facilitates an excess of 130,000 product inquiries and more than 14,000 e-mail exchanges between suppliers and sourcing professionals.

FastParts, Inc. reports that an estimated 10 percent of annual shipments of electronic components end up as surplus inventory. In 1996, the company established a subscribers-only, Internet-based spot market patterned after the NASDAQ model to help industry participants trade semiconductors and electronic components more efficiently in the global marketplace. FastParts provides the trading facility and coordinates all trade fulfillment activities, from collecting funds to shipping parts to ensuring buyer and seller anonymity. Its revenues come from a percentage of the value of each completed trade.[6] According to FastParts, sellers recover about 50 percent of the value of their components and buyers receive a 30-50 percent discount on prices compared with prices from brokers.[7]

In Fall 1997, ChemConnect Trading Exchange had over 1,500 manufacturers, distributors and traders using its service to advertise chemicals for sale, advertise requests for quotes and sell surplus, off-specification and by-product chemicals. The service reported $320 million in requests for bids on its "Chemicals Wanted" exchange in September 1997.

Reduced Inventory/The Right Products in Stock

Having more accurate forecasts of what sells and what does not can increase inventory turns and keep the right products in stock. The Internet and private networks can be used to make sure the information gets to those who need to see it, when they need to see it.

About two years ago, the airline industry began a push to move spare parts inventory out of their hangars back to their suppliers. Boeing saw its overall order volume increase, particularly for "priority" or "rush" orders. (The longer a priority order remains unfilled, the longer an airplane could be grounded.) Boeing reacted by moving its own inventory closer to its customers, stocking it based on its customers' historical needs. It also cut its response time on routine orders from 10 days to next day and from same day to 2 hours on priority orders.

Historical experience goes a long way in ensuring that the right inventory is ready to ship when the airlines need it most. Combining history with as much information about future needs would be even more effective in ensuring the right inventory of needed parts. Because aircraft servicing is highly regulated—the FAA has guidelines about how often and how thoroughly aircraft must be serviced—many future needs can be anticipated, but that information has to be communicated from the airline to its suppliers.

Boeing envisions a system in which airlines would incorporate needs for scheduled maintenance scheduled activities directly into their spare parts ordering processes. For instance, if a part was needed, the system would first scan the database of parts in inventory and, if a match was found, assign that part to the future order. If the needed part was not already in stock, a production order could be generated and sent to the supplier well in advance of the need.

All links in the chain would be better served—airlines would have the parts when they needed them (and would be able to track the status of the parts they ordered), Boeing would be able to plan its inventory better (currently, 50 percent of Boeing's orders are high priority—if Boeing cannot find the parts in the inventory, it has to place an expedited order, sometimes meaning higher production and shipping costs that affect adversely Boeing's profit margin), and Boeing's suppliers would benefit from having to respond to fewer "expedited" orders.

For this strategy to be successful, communication from the airline to the airplane manufacturer to the supplier is critical. With the Internet's potential to reach all participants at a low cost, it will play a key role in making this work.

Over 75 percent of personal computers (PCs) are sold through third-party distribution. But lower-cost direct marketers, Dell and Gateway 2000 in particular, have been gaining market share. Compaq, Hewlett-Packard, IBM and their resellers have been gearing up their responses, and electronic commerce plays a key role.

The mid-1980s saw the birth of two computer companies that challenged the industry's reliance on third-party distribution: Dell, founded in 1984, and Gateway 2000, which followed a year later. By the 1990s, both companies had become multi-billion dollar companies by selling directly to businesses and individuals through catalogs, over the telephone, and, more recently, via the Internet. In addition, they follow a "build-to-order" model rather than the traditional "build-to-stock" model used in third-party distribution. In the build-to-order model, a computer is produced only after a customer orders it. With the price of integrated circuits and other key components dropping radically from month to month with new technological advances, postponing the ordering of these parts can significantly reduce the product's overall cost. As a result of these initiatives, Dell and Gateway typically have a 100 percent advantage in inventory turns over their competitors, resulting in lower inventory carrying costs and less risk associated with price protection and returns.[8]

Over the past year, Compaq Computer Corporation, International Business Machines (IBM) and Hewlett-Packard have begun to modify their sales and inventory practices to lower their costs and, at the same time, offer more value to their end customers. The Internet plays a key role in their strategies. It is used to locate and purchase parts, link suppliers into up-to-the-minute inventory and design information, and collaborate with suppliers and resellers on more accurate and flexible forecasts and production plans.

IBM's Authorized Assembler Program (AAP) provides an illustration. Up to 50 percent of IBM Personal Computer Co.'s volume now goes through AAP, which transfers responsibility for assembly and physically managing parts inventories from IBM to its resellers. Distributors and resellers can track current sales and inventory levels down to the individual part and use an extranet to reorder from IBM when supplies are low. By getting resellers to order from a handful of base configurations, IBM has reduced the number of PC configurations it makes from 3,000 in 1996 to 150 today and the number of different part items it manages from 50,000 to 16,000. Before IBM implemented the Internet-based AAP, resellers were only able to track inventories of already-assembled PCs. The new system keeps updated records of every part in every PC that has been shipped through a reseller. IBM plans to extend the system to PC parts suppliers, letting them ship parts directly to resellers or even end users while tracking inventories and purchases over an extranet.[9]

IBM's resellers report benefits from the new way of doing business. CompuCom's Chairman and CEO Ed Anderson relates: "In the old days, half of our orders were shipped in five days and the other half were shipped in 35 days...one of the big benefits of [channel assembly] is by getting the piece goods and components, we can make them in three days...since we started ramping up IBM volumes in February, our inventory turns have doubled or tripled."[10]

More Efficient Logistics

Matching an order with a product and then getting it to the customer in the time frame promised at as low a cost as possible is, in simple terms, the goal of a company's logistics operation. In some cases, this may involve the use of warehouses and consolidation points (where products from different parts of the world or the country get transferred to trucks or containers along with other products going to the same place). A logistics department typically work with customs agents and freight forwarders, delivery companies and handling companies. Depending on where the product comes from, whether it gets sent via express mail, truck or ship, some products can be shipped from point to point in a few hours; others might take weeks.

Ensemble, a subsidiary of the Hallmark Company, develops tailored solutions for retailers of cards, gift bags, posters and other gifts. The company finds a market need, develops a product and presents its ideas to a retailer. Its internal operations end there. Ensemble partners with companies around the world to manufacture the products. It has one partner for distribution. USCO Distribution Services of Naugatuck, Connecticut, handles all of Ensemble's order fulfillment, receipt of inbound goods, warehousing and outbound transportation in the United States. Ensemble requires USCO to ship orders in a 24-hour time period with inventory integrity and accuracy.[11]

Being able to track a product each step of the way from the factory to the end customer makes outsourcing the logistics function possible. Orders placed over the telephone, by fax or the Internet are electronically communicated to the logistics company's internal system. If the

product is in a warehouse, a picking order is automatically generated, the product is loaded onto a truck or mailed to the customer's home. Each of these processes gets recorded in the system for tracking purposes so that whoever needs to see its movement—whether the customer service representative at the logistics company or the manufacturer, or the end customer himself—knows where it is and when to expect its arrival.

The Internet not only supports the business operations of the logistics company, it also drives new business opportunities. Many businesses which use the Internet, including L.L. Bean, Insight Direct, and others, look to partners to supply and distribute their products. As retailing of tangible goods over the Internet grows, so too, will opportunities for logistics and delivery companies.

Lower sales and marketing costs

An individual sales person can handle only as many customer accounts as he can physically visit or contact by telephone. The greater the number of accounts, the greater the sales force. Even direct marketing companies whose businesses rely on people to take orders by telephone increase staffing as order volumes increase.

By contrast, a Web business can add new customers with little or no additional cost. Because its sales function is housed in a computer server rather than physical store locations or sales people, its reach is bounded only by the capacity of the servers to respond to inquiries and orders.

Boise Cascade, a $2 billion office products wholesaler, put its catalog of 10,000 parts on its Web site in January 1997. Boise expected that one to two percent of its customers would order from the site in its first year. More than 4 percent did. By the end of 1998, Boise anticipates that about 10 percent of its customers will be ordering from the Web site. The site has already paid for itself. Boise paid 'in the low hundred thousands' to set up the system. After 6 months of operation, it had saved more than $1 million by reducing the time customer service representatives take orders on the phone.[12]

The Future

Businesses that use the Internet to buy, sell, distribute and support products and services are realizing significant cost savings and increased sales opportunities. And, the benefits only increase as the network of businesses conducting electronic commerce grows.

Businesses highlight three issues as potential inhibitors to the widespread adoption of Internet commerce: the lack of a predictable legal environment, concerns that government will overtax the Internet, and uncertainty about the Internet's performance, reliability and security.

Companies are taking different approaches to address the current technical limitations. Some use the Internet to purchase lower-value, indirect materials while keeping their higher-value, direct material purchases over private value-added networks. Some are creating extranets, or "virtual private networks" that limit access to a certain pre-qualified set of businesses and their partners.

The U.S. government supports the development of both a domestic and global uniform commercial legal framework that will recognize, facilitate and enforce electronic transactions worldwide. The Government supports legislation that would prohibit imposing new discriminatory taxes on Internet commerce and it believes that no customs duties should be imposed on goods and services transmitted electronically between countries.

As the Internet's performance and reliability improve over time, and as predictable legal frameworks emerge, the growth of business-to-business electronic commerce will accelerate.

FEDERAL EXPRESS

A number of delivery and logistics companies, including Federal Express, the United Parcel Service (UPS), the U.S. Postal Service and others are using the Internet in key business processes. The example of Federal Express illustrates the role played by the Internet and private networks in improving efficiency and customer satisfaction.

Federal Express (FedEx) delivers 2.5 million packages daily to 211 countries around the world with an on-time delivery rate of 99 percent.[13]

Electronic commerce has been at the heart of FedEx's operations for more than a decade. Back in the mid-1980s, the company rolled out a program called FedEx PowerShip® that gave its major customers a window into FedEx's computer systems. Employees at shipping docks could place orders for package pick-up directly into their FedEx PowerShip terminals, automate the paperwork and track the status of their orders electronically.

In 1995, FedEx introduced FedEx Ship, a free software program that would work on any personal computer with a modem connection. Because it could be used on any PC, FedEx Ship made its way from shipping docks into other departments. Production planners that needed access to delivery status information for a rush order could now see when a supplier shipped the part and when it was due to arrive.

FedEx PowerShip and FedEx Ship® soon became the standard way of doing business with Federal Express. Two-thirds of the company's shipping transactions from 550,000 customers came via these two online services.

FedEx Connects Its Customers Electronically

Service	Date introduced	Customers using service
FedEx PowerShip®	1982	Largest customers
FedEx Ship®	1995	Mid-size/less frequent customers
interNetShip^{K}	7/1996	Any customer

In July 1996, FedEx launched FedEx InterNetShip^{K}, extending online capabilities to the Internet. Within eighteen months, 75,000 customers are using the service. A fedex.com customer can request a parcel pickup or find the nearest drop-off point, print packing labels, request invoice adjustments and track the status of their deliveries without leaving the Web site. Recipients of deliveries can request that FedEx send them an e-mail when the package has shipped.

The company's Web site is just the tip of the iceberg of FedEx's extensive use of networks. Its own proprietary network, FedEx COSMOS®, handles 54 million transactions a day. Through the

information available on the network, the company can keep track of every package every step of the way from the point a customer requests a parcel pick-up to the point it reaches its final destination. When a customer enters a pick-up request, a courier is notified electronically of the time and location. Once at the customer's office, the courier scans the bar code on the package into his hand-held system, recording that the package has been picked up. FedEx employees record and track the package's progress electronically from the van to a FedEx plane to a sorting center where it gets sorted and loaded onto another FedEx plane, to the truck that it gets unloaded onto, to the customer's home or office.

FedEx also plays a role in other companies' core logistics processes. In some instances, FedEx operates the merchant server on which a retailer's Web site runs. In others, FedEx operates warehouses that pick, pack, test and assemble products as well as handle the delivery—which sometimes involves consolidating products with other shipments and clearing customs. And the nature of FedEx's customers' products—high tech, high value or perishable—means that the orders they process have to be filled almost immediately. The information network that enables FedEx's core business to meet its delivery commitments is the same foundation for its growing logistics business as well.

Hundreds of thousands of tracking requests per month come from links from over 5,000 Web sites to fedex.com. These FedEx customers can add a product tracking feature to the other services they offer to their online customers. If a customer buys a router from Cisco Systems and wants to know when it is supposed to arrive, he does not have to make any phone calls to get the details. Instead, he can go to Cisco's Web site, enter the order number, and find out that the router is on a FedEx truck and will arrive the next morning. This information appears directly in the Cisco site in a matter of moments.

Up until five years ago, National Semiconductor (NatSemi) used to deal with a variety of different companies to get a product from its Asian factories to customers across the world, including freight forwarders, customs agents, handling companies, delivery companies and airlines. Five years ago, they decided to outsource this entire process to FedEx. Today, virtually all of NatSemi's products, manufactured in Asia by three company factories and three subcontractors, are shipped directly to a FedEx distribution warehouse in Singapore. Each day, NatSemi sends its orders electronically to FedEx. FedEx makes sure the order gets matched to a product and the product is delivered directly to the customer when promised. By going with FedEx as a one-stop shop for their logistics needs, NatiSemi has seen a reduction of the average customer delivery cycle from four weeks to one week and their distribution costs drop from 2.9 percent of sales to 1.2 percent.[14]

Not only does FedEx handle all the back-end logistics for its customers, it also leverages its vast network of technical couriers to handle customer service functions like repairs and returns. If a customer notifies a retailer that the computer he just purchased has a malfunctioning hard drive, the retailer sends an electronic message to a FedEx courier to go to the site and try to repair the hard drive, swap it out for a new one, or collect the computer and return it to the company.

Benefits to FedEx

FedEx's proprietary network forms the underpinning of the company's electronic commerce today. The Internet extends the reach of the proprietary network, electronically connecting customers that had communicated with FedEx by phone, paperwork or not at all in the past. And, as more companies sell tangible goods over the Internet with the promise of quick delivery, FedEx benefits from increased business opportunities.

For competitive reasons, FedEx has not publicly shared the full extent of benefits it has realized from information technology and electronic networks, except to say that it has enabled FedEx to continuously lower its cost to deliver each package. They point to some examples:

- *Avoided Costs*: If not for FedEx PowerShip®, FedEx would have had to hire an additional 20,000 employees to pick up packages, answer phone calls at the call centers and key in air bills. With PowerShip®, a good deal of the routine tasks are automated or transferred from FedEx to the customer. Couriers spend less time recording information at the customer's site, and phone service representatives spend less time answering calls from customers who now place orders and track their own shipments online.

- *Lower Operating Costs***:** Customers use FedEx InterNetShipᴷ to track over 1 million packages per month (and the volume increases at double-digit percentage levels month to month). Approximately half of those calls would have gone to FedEx's toll-free number instead.

- *Better Customer Service***:** Customers still have a choice for how they interact with the company, whether by phone, fax or other means. Nearly 950,000 of them find it easier and more convenient to communicate with FedEx electronically.

CISCO SYSTEMS

Cisco Systems sold $6.4 billion worth of routers, switches and other network interconnect devices during its 1997 fiscal year. As its business forms the underpinning of the Internet and private networks, it is perhaps not surprising that Cisco should be a leader in using the Internet to make its business processes more effective. From employee self-service stock options, training seminars and work team collaboration to customer service and ordering, the company continually develops new applications for business processes that it feels can be better done online than otherwise. It avoids "mega" projects. New applications are generally created within three to six months.

Cisco's Web site has evolved over several years, beginning with technical support for customers and evolving into the world's largest Internet commerce site. Today, Cisco offers nearly a dozen Internet-based applications to both end-use customers and reseller partners.

Customer Service

Cisco began providing electronic support in 1991 with a "pre-Web" system using the Internet. Software downloads, defect tracking and technical advice were the first applications. In the Spring of 1994, Cisco put its system on the Web, and re-named its site Cisco Connection Online.

Today, Cisco's customers and reseller partners log onto Cisco's Web site more than 900,000 times a month to receive technical assistance, check orders, or download software. The online service has been so well-received that nearly 70 percent of all customer service inquiries are satisfied online.

Cisco Performs Key Functions On the Internet

	% total volume	Date launched
Technical support/service	70%	1994
Ordering	40%	July '96
Software updates	90%	April '93

Figures represent share of total volume for different functions handled via Cisco's Web site.

Online Ordering

Cisco builds virtually all its products to order, so there are very few off-the-shelf products. Before the Cisco Web site, ordering a product could be complicated. Generally, an engineer at the customer site knew what type of product was needed and how it should be configured. The engineer communicated this information to the procurement department who then created the

purchase order and sent it to Cisco via fax, phone or e-mail. A Cisco customer service administrator keyed the order into Cisco's system. If the order went through "clean," it would be booked and production was scheduled within 24 hours. Nearly one out of four orders didn't get a "clean" bill of health, however. Instead, when Cisco's system tried to validate the order, it discovered an error in how the product was configured. The "dirty" order would be rejected, the customer contacted, and the procurement cycle would begin again.

Cisco began deploying Web-based commerce tools in July 1995. Then, in July 1996, the Internet Product Center allowed users to purchase any Cisco product via the World Wide Web.

Today, that same engineer can sit down at a PC, configure a product online, know immediately if there are any errors, and route the order to the procurement department. As that customer's pricing is already programmed into the Cisco site, the authorized purchaser can complete the order with a few keystrokes. And, instead of calling Cisco to find out the status of the order, invoice or account information (including the exact installation site of equipment the customer has purchased from Cisco), a customer with the proper authorization can access that information directly on the Web site.

Cisco's largest customers would like to take advantage of the features of immediate and automatic access to Cisco's online ordering, configuration and technical support tools. Because of their large volumes, however, they do not want to go into Cisco's Web site each time they place an order or have a question. A program that was launched in November 1997 interactively links the customer's and Cisco's computer systems over the Internet and private networks, so that before an order is placed, Cisco configuration and pricing tools have already validated it.

With the online pricing and configuration tools, about 98 percent of the orders go through Cisco's system the first time, saving time both at Cisco and the customer's site. Lead times have dropped 2 to 3 days, and customer's productivity has increased an average of 20 percent per order.

In the five months of its operation in 1996, Cisco booked just over $100 million of sales on the Internet. For the first 10 months of 1997, the figure grew ten-fold, to top $1 billion. If it continued selling at its December 1997 pace of over $260 million a month, Cisco would sell about $3.2 billion online in a year. The company expects to close 1998 with $4 billion in annualized online sales.

Order Status

Each month, Cisco's Web site receives about 150,000 order status inquiries. When will the order be ready? How should it be classified for customs? Is it eligible for NAFTA? What export control issues apply? Cisco gives customers the tools to find all this information on its Web site.

In addition, Cisco records a ship date, the method of shipment and the current location of each product. The company's primary domestic and international freight forwarders regularly update Cisco's database electronically with the status of each shipment, typically via EDI. The new information in the database automatically updates Cisco's Web site, keeping the customer current on the movement of the order. As soon as the order ships, Cisco sends the customer a notification message via e-mail or fax.

Benefits

In total, Cisco estimates that putting its applications online has saved the company $363 million per year, or approximately 17.5 percent of total operating costs.

With 70 percent of its technical support and customer service calls handled online, Cisco's technical support productivity has increased by 200-300 percent per year, translating to roughly $125 million lower technical support staff costs. Customers download new software releases directly from Cisco's site, saving the company $180 million in distribution, packaging and duplicating costs. Having product and pricing information on the Web and Web-based CD-ROMs saves Cisco an additional $50 million in printing and distributing catalogs and marketing materials to customers.

Cisco Saves Using Networked Business

Operating cost	Savings/year
Technical support	$125 M
Human resources	$8 M
Software distribution	$180 M
Marketing materials	$50 M
TOTAL	$363 M

*Savings represent approx.17.5% of Cisco's total operating expenses

The Future

Cisco expects online sales to grow to 60 percent of total volume over the next year. If analyst projections for Cisco's overall sales to grow to $10.5 billion by July of 1999 are correct, then its online sales should reach $5-6 billion by then.

DELL COMPUTER CORPORATION

Dell's computer business was founded on concepts that bucked conventional wisdom. While the rest of the industry was building personal computers to stock, and selling them through value-added resellers, distributors and retail stores, Dell was creating a new business model. Dell would build to order and sell the computers through its own sales force, mail order and telephone center. This way, distribution and retail markups common in the traditional channel would be avoided and Dell's inventory carrying costs would be much lower.

As of December 1997, Dell was the second largest supplier of desktop PCs, with 9.7 percent of the market and a 10-15 percent price advantage versus its major competitors who distribute their products through the indirect channel.[15]

Dell saw the advantages of the Internet and began exploiting them before others in its industry. In July 1996, Dell's customers could configure and order a computer directly from Dell's Web site. In six months' time, Dell was selling $1 million worth of computers via the Internet each day. Its volume doubled a few months later. Dell reports having sold $6 million per day several times during the 1997 holiday selling season.

Dell's Daily Online Sales and Weekly Technical Support Volumes Tripled During 1997

	1Q97	2Q97	3Q97	4Q97
Sales/day	$1 M	$2 M	$3 M	$3 M++
Tech support queries/wk	30,000	45,000	60,000	120,000
Visitors/wk	213,000	225,000	250,000	400,000
% sales outside U.S.	0	5%	10%	17%

The company's Web site also provides technical support and order status information, including the ability to download software directly from the site. The site responds to more than 120,000 technical support queries each week.

About 90 percent of Dell's overall sales are to businesses and 10 percent to consumers. Online, the customer mix is very different: about 90 percent of its sales are to small businesses and consumers. Dell's large corporate customers use Dell's Web site to get product information, order status and technical help. Most still do not place orders electronically.

Dell is working to make its online service attractive enough for its large corporate customers to use for purchasing and customer service. Customized "premier pages" allow some of its major customers to purchase Dell computers from the company's own intranet. The premier pages

incorporate the customer's corporate discounts, specific computer configurations and codes identifying those authorized to make purchases on the company's behalf. MCI estimates it has saved 15 percent in computer procurement costs due to this service. In the past, 16 purchasing agents in 4 different locations were responsible for purchasing computers. When working with Dell to develop the rules for the online service, MCI consolidated its computer purchasing (and realized a greater discount due to their higher volumes). The company also cut its purchase order cycle time from 4-6 weeks to within 24 hours.[16]

Benefits of the Internet

- *Additional revenues***:** Eighty percent of the consumers and half of the small businesses who purchased on Dell's Web site had never purchased from Dell before. One out of four say they wouldn't have purchased if it wasn't for the Web site. And, their average purchase is higher than Dell's typical customer.

- *Lower Sales/Marketing Costs*: Dell's Web site gives enough product, pricing and technical support to help guide a customer through the purchasing process—information customers previously accessed by calling a telesales representative. As a result, Dell has been able to generate an increased sales volume to its consumer market with lower labor costs. Dell expects that its advertising costs should also be lower for its Internet customers, as 30 percent of these customers had not seen a Dell ad, yet still bought online.

- *Lower Service/Support Costs***:** Dell saves several million dollars each year by having basic customer service and technical support functions available on the Internet.

  Each week, about 20,000 customers use the Web site to check their order status. Some percentage of these would have come into the call center, at a cost of $3-5 per call. If just 10 percent of these customers had called rather than using the online service, those 2,000 calls would have cost Dell $6,000-$10,000 per week.

  30,000 software files are downloaded each week from Dell's site. Answering these requests by phone and then sending each customer the software by mail would cost $150,000 per week.

  Customers who access troubleshooting tips online save Dell a $15 call to a technical support person. If 2-3 percent of the 30,000-40,000 technical information queries the Web site receives each week had reached Dell's technical support staff, it would have cost an additional $9,000-18,000 per week.

  One large customer in the auto industry reports saving $2 million in its own technical support "help desk" costs. Rather than calling up Dell's telephone support center and usually holding for about 3-5 minutes, they go to Dell's Web site for help.

- *Enhanced customer relationships***:** perhaps the greatest potential Dell sees for the Internet is its ability to enhance the company's relationship with its customers. Ultimately, one-to-one marketing and tailored customer service can be used to shorten a customer's repurchase cycle and allow them to sell more into corporate accounts. When a customer first boots up her computer, the computer introduces her to the "Dell Channel," a customer service feature tailored specifically to that customer's computer model and particular configuration. Dell believes that the ability to tailor customer service solutions and product offerings to individual customers will improve customer service and satisfaction and open up new selling possibilities.

The Future

Dell expects to conduct half its total business—sales, service and support—online shortly after the year 2000.

BOEING

Boeing's online strategy is to provide a single point of online access through which airlines and maintenance providers can "pull" the data needed to maintain and operate airplanes, regardless of whether the data is from the airframe builder, component supplier, engine manufacturer, or the airline itself. With data from all of the 300 key suppliers of airplane parts (and a growing base of data for the key engine manufacturers), Boeing's goal is to provide its customers with one-stop shopping for online maintenance information.

Spare Parts Business

Ordering spare parts has been a multi-step process for many of Boeing's customers. When a mechanic needs a part, he informs the purchasing or materials department who approves the order and sends it to Boeing via phone, fax or telex. The largest airlines began to streamline the ordering process nearly 20 years ago. Due to the volume and regularity of their orders, the largest airlines established EDI (Electronic Data Interchange) connections with Boeing over value added networks. Not all customers were quick to follow suit, however. It took until 1992 or 1993 to get 10 percent of the largest customers representing 60 percent of the volume to order through EDI. The numbers have not changed much since then.

Boeing views the Internet as a great opportunity to encourage more of its customers to order electronically. With the initial investment limited to a standard PC and basic Internet access, even its smaller customers can participate. And, because of its interactive capabilities, many customer service functions handled by the telephone center can also be handled via the Internet.

In November 1996, Boeing debuted its PART Page on the Internet, giving its customers around the world the ability to check parts availability and pricing, order parts, and track order status. Less than a year later, about 50 percent of Boeing's customers use it for 9 percent of all parts orders and a much larger percentage of customer service inquiries. In its first year of operation, the Boeing PART Page handled over half a million transactions, including inquiries, from customers around the world.

Boeing's primary objective for the PART Page was to improve service to its customers. Boeing also expects to realize significant operating savings as more of its customers communicate using the Internet. In addition, the PART Page could lead to new sales opportunities.

Some rough calculations point to productivity improvements even in its first year of production.

Boeing's spare parts business processed about 20 percent more shipments per month in 1997 than it did in 1996 with the same number of data entry people. In addition, as many as 600 phone calls to telephone service staff have been avoided because customers can access information about pricing, availability and order status online.

Over time, Boeing anticipates that the PART Page will result in fewer parts being returned because of an administrative error. Today, the person who needs the part relays that information to another individual who orders it. Sometimes one more hand-off occurs before the information gets to Boeing. These information hand-offs can result in the wrong part being shipped. If the wrong part gets shipped out, it gets returned and the cycle begins again. The PART Page eliminates the hand-offs and thereby reduces the potential for error.

The PART Page gives customers another reason for buying parts from Boeing—an easy way to order and information about the status of that order. Boeing feels that customers who are satisfied with their after-market support, they are more likely to buy parts directly through Boeing rather than a competitor and predisposed to buy Boeing aircraft the next time they make such a purchase.

Technical drawings/support

When unscheduled maintenance is required on an airplane, mechanics are traditionally forced to choose between making repeated, time-consuming trips to the crew room to consult paper or microfilm reference materials or resorting to "rip and replace" troubleshooting.

Airline maintenance is spread out over a wide geographical area. It takes place everywhere in the world the airline flies. At an airport, maintenance activities may take place at the gate, in the line-maintenance department or at the maintenance operations center.

Because information is hard to access, maintenance of aircraft is not as efficient as it could be.

Repair solutions are too open to interpretation. Mechanics may replace a part from an airplane even when it is not the cause of the problem. In 50 percent of the cases where a part has been removed and replaced with another part, there's no fault found with the original part. One European airline estimates that buying new parts or keeping additional inventory of parts to handle the "no fault found" problem costs them $12 million a year.

Documents are not suited for quick reference. Having paper and microfilm-based documents means that the mechanic has to anticipate what he needs, collect it, and then take it with him to service the airplane. If he chooses incorrectly, it may mean leaving the airplane to get the right information.

A mechanic typically has to service several different types of planes, each with its own set of instruction manuals and unique parts. When conducting a maintenance check, the mechanic's team has to review several sources to determine which repairs need to be made—enterprise data which keeps the plane's maintenance history, problems recorded by the plane's computer, and any faults the crew notes. Once the faults are identified, then information as well as parts have to be gathered and brought to the airplane.

Information may be drawn from maintenance manuals, fault isolation manuals, parts catalogs, wiring diagrams, schematics, drawings, revisions to manuals, service bulletins, FAA dispatch deviation guidelines and standards information for each model of aircraft. A single manual may contain as many as 30,000 pages. For the sixty percent of mechanics' hours that are spent on unscheduled maintenance, 30 minutes are spent just pulling together the information they need. Making sure that the right information is in the right person's hands at the right time and the right place can be a real challenge.

Boeing began its efforts to reduce the amount of paper-based technical information back in 1990, with REDARS, a system for accessing engineering drawings electronically. In March 1995, REDARS was extended to Boeing's worldwide customer base via commercial and private networks. In April 1996, Boeing On Line Data (BOLD) went into production, incorporating not only the engineering drawings but manuals, catalogs and other technical information that used to be available only in paper or microfiche format. As of October 1997, BOLD has 7,500 users across 40 customers, and another 60 customers in the pipeline.

> On a Friday in 1997, Sabena Airlines had a fire which burned down its engineering library. All the technical drawings and support documents they needed to maintain and repair their aircraft were destroyed. That afternoon, a Boeing On-line Data team went out to Sabena. Through the weekend, the team worked to set up a telecommunications line and connect Sabena to Boeing's electronic library. By Monday, Sabena's maintenance team had online access to all the technical drawings and most of the support documentation they needed.

The Portable Maintenance Aid (PMA), still in beta test, solves the next issue—making the information portable so that it can be accessed by people who need information wherever they may be working. Having that information stuck in a computer in an office is not helpful to a mechanic when he's servicing an airplane. Boeing's PMA, now available on a laptop with information on CD-ROM or a computer's hard drive (with a networked version soon to be introduced), addresses this problem. Whether at the gate, in the hangar or in the maintenance department, a mechanic or technician is able to access all the information he needs to make decisions about necessary repairs at the time and place he needs the information. All the maintenance data and part information are available electronically with an interface optimized for either troubleshooting at the gate or accessing data in the hangar.

Benefits to Boeing's customers

Little data are available to measure the full impact of BOLD or PMA as they are so new. However, even early users show benefits in:

- *Increased productivity*: spending less time searching for information frees up engineers and maintenance technicians to focus on more productive activities. One U.S. airline saved $1 million when it gave 400 users access to Boeing's REDARS program. Seeing the results of the initial implementation, the airline expanded the service to 2000 users. A European airline estimates that it will save $1.5 million from BOLD in the first year due to a nearly 4 percent boost in production and engineering staff productivity.

Airline Estimates Significant Savings from Boeing Online Maintenance Tools:

• Ownership cost:	$0.4 M
• Productivity increase:	$1.5 M
• Fewer delays:	$0.3 M
• Increased revenue:	$3 M
• Lower library/facilities costs:	$0.03M
Net Savings 1st Year	**$5 M**

Source: Boeing, using cost/benefit results from mid-sized European airline

- *Reduced costs***:** with information available online at the gate through PMA rather than back in the crew office, delays at the gate due to missing information can be reduced. The European airline mentioned above estimates that PMA will reduce delays by 5-10 percent on flights using newer Boeing aircraft.

- *Increased revenues*: every 3000 hours, an airline does a schedule C maintenance check which can keep an airline grounded for up to a week. Not having information readily available can extend the process. The longer the maintenance check, the less revenue opportunity. Through BOLD and PMA, the European airline estimates it will save 1-2 days/year for each aircraft, resulting in $3 million in incremental revenue.

GARDEN ESCAPE

"Our goal is to get to a point where a customer says I want to do my gardening the third week in April and be able to satisfy their order. No one can come close to this today." - - James O'Neill, Vice President of Operations and CFO, Garden Escape

Born of the World Wide Web, Garden Escape offers gardeners a selection of thousands of seeds, perennials, roses, bulbs, greenhouses, tools and other products from around the world from which to choose. Serious gardeners can use online software tools to design their ideal garden. Garden Escape has an online magazine, a chat room, and daily tips from the magazine's editors. Questions about horticultural terms can be answered with the help of the online glossary, or by calling Garden Escape's toll-free number. If the customer service representative does not know the answer, he will contact an expert who will send the customer a reply by e-mail.

Although not required, about 150,000 people have registered with Garden Escape in order to benefit from extra member services. Members can save graphic layouts of gardens, create a personalized notebook to keep track of their favorite varieties, planting instructions, and any other important notes. A variety of other personalized services are also available, including a gift registry and important-date reminder, personal shopper, order status, and an out-of-stock reminder service.

As the founders see it, the key to Garden Escape's eventual success is its ability to leverage the unique advantages the Internet brings. If Garden Escape simply duplicated what people could get at their local nursery, the business would not be very compelling. Instead, the site has to offer customers a shopping experience they could not easily duplicate (or duplicate at all) through traditional sources.

Garden Escape founders started by taking an inventory of all the resources a gardener uses today: nurseries and seed catalogs for plants and tools, other retailers for specialty outdoor products; books and magazines for tips on the plants and flowers that flourish or perish in certain soil and climate conditions; clubs where hobbyist gardeners share suggestions with other enthusiasts; and the extensive array of catalogs, books and CD-ROMs that help with garden design.

Next, they looked at the characteristics of the market. A $50 billion industry, the "gardening lifestyle" market includes everything needed to decorate outdoors, from plants and tools to furniture and accessories. The market is highly fragmented: almost all the best quality products come from niche suppliers. A $100 million company is a large company in this industry.

Then, they looked at the product mix a typical gardening center carries. Due to the seasonality of the business, only one-third of the product line is carried year-round: hard goods like tools, benches, and other non-perishable products. The vast majority of the inventory is seasonal: perennials for the spring and fall, antique roses for the spring, and so on.

By offering a virtual, rather than real, inventory, Garden Escape offers a selection of products that even the largest nursery could not possibly stock—10,000 products covering those that ship in the spring but bloom in the fall, products whose hardiness makes them suitable for New England but not Santa Fe, and vice versa, and an array of colors and varieties catering to different tastes.

They provide published information from horticultural experts, and using the interactive features of the Internet, they create online environments for gardeners and horticultural experts to share ideas and gardening tips.

Automated customer service saves Garden Escape money and leads to new sales opportunities. Each time Garden Escape replies to a customer's question, it stores both the question and answer in a database. That way, the knowledge base continues to expand and customer service staff (and customers in time) can search the database online and receive immediate answers. Garden Escape believes this will not only make customer service more efficient and effective, it also has the potential to generate revenues. A question from a customer in Michigan about when to plant tulips can trigger the correct technical response as well as a special promotion on tulip bulbs or books on tulips.

Growers tend to be small businesses without sophisticated ordering or production planning systems. Garden Escape's growers are no exception. About half of the company's purchase orders are transmitted to its growers by e-mail or fax. The other half are communicated over an extranet. Some suppliers can check their orders online and print out picking lists and packing labels. Then, they update Garden Escape with revised inventory levels and order shipments. Milaeger's Gardens, a supplier of perennials out of Wisconsin, reports that communicating via the extranet meant that they can handle $100,000 in orders from Garden Escape with one person instead of the three they usually require for that volume of business.

Future expectations

Although the company has yet to turn a profit, Garden Escape is confident its business model has significant advantages compared to the traditional model of distribution in the gardening industry.

Garden Escape believes that the Internet will prove to be a cost effective marketing channel relative to traditional retail and direct marketing channels. This cost structure will offer Garden Escape the flexibility to continue to invest heavily in value-added services on the Web site and offer them to its customers at no charge as well as potentially pass along savings to the customer in the form of lower retail prices. The following chart compares the costs involved when a grower retails its own products via mail order (old cost) versus a model where the grower and Garden Escape work in tandem and share business information through the Internet (new cost):

Expenses	Old Cost ($)	Old Cost (% retail)	New Cost ($)	New Cost (% retail)	Internet enables:
Production/labor	$26	26%	$20	22%	Better forecasting
Advertising/mkting	$25	25%	$2	2%	More effective marketing
Order entry/cust. service	$7	7%	$3	3%	Electronic orders
Financing/bad debt	$2	2%	$1	1%	
Rent/inventory/holding	$8	8%	$8	9%	
Pick/pack/ship	$9	9%	$6	6%	Electronic picking/packing labels
Admin. overhead	$8	8%	$5	6%	Automatic inventory updates/order status
Operating income	$15	15%	$5	6%	
Wholesale cost			$50	55%	
Garden Escape operating expenses			$23	25%	
Garden Escape operating income			$17	20%	
Customer Retail	$100	100%	$90	100%	
Shipping Costs	$10	10%	$9	10%	
Delivered Retail price	$110	110%	$99	110%	
Customer info gathering/shopping	$15	15%	$5	6%	One-stop shopping and information
Total Cost	$125	125%	$104	116%	

In the new model, Garden Escape predicts it can gain up to a 10 percent cost efficiency over traditional gardening retail channels, while maintaining profitability for both itself and its strategic growers/suppliers. Detailed information about customers' buying habits transmitted in real-time to the growers leads to better forecasting and better production planning, reducing production and labor costs. Targeted marketing to Garden Escape's members electronically instead of through catalogs and other advertising saves on printing and distribution costs. Communicating orders, inventory information and delivery status electronically reduces telephone calls and data entry costs. Because information is more timely and does not get passed through different hands, errors that cause rework and delays are also reduced. Finally, Garden Escape places a value on the time that customers spend tracking down the information and products they need to plant a garden. Garden Escape saves them time by having everything they need under one umbrella.

Garden Escape is still putting the pieces in place to realize its cost structure targets. If sales and technical integration continue at their current pace, the company anticipates it will reach them in about eighteen months.

W.W. GRAINGER, INC.

Seventy years ago, William Wallace Grainger saw an opportunity to launch a business distributing electric motors. During the 1920s, factories were converting from one large, direct current motor powering their entire assembly line operation to multiple motors using alternating current. Using a simple 8-page wholesale catalog, the MotorBook, and postcards for direct mail, Grainger began receiving and filling customer orders. Through the years, more products were added to the MotorBook as customers needs grew for a quick and convenient supply of maintenance, repair and operating (MRO) supplies.

Today, W.W. Grainger, Inc. is the leading distributor of MRO supplies and related information to the commercial, industrial, contractor and institutional markets in North America. The company is headquartered in Lincolnshire, Illinois, with operations throughout the United States and Canada, and in Mexico and Puerto Rico. In 1997, sales exceeded $4 billion. The company's numerous business units focus on serving the diverse MRO needs of more than 1.3 million customers.

The company's largest business unit, Grainger, operates through a network of national, regional, and zone distribution centers and 350 branches nationwide. Customers can place orders for MRO products via phone, fax, EDI or online over the Internet. Orders are available for same day pick-up at the local Grainger branch, or next day delivery. Grainger also provides product and service solutions to customers through its 1,600 person sales force. The MotorBook, now known as the General Catalog, continues to be a primary marketing tool for the company. The 1997 edition of the catalog is over 4,000 pages in length and contains about 80,000 products.

A key element in the growth and success of the company has been the dedication to process improvements and information systems enhancements. Computer systems were first introduced at the branch level in the 1970s. A satellite communications network was implemented in 1989 linking each branch with a network control center, enabling the instantaneous transmittal of information between the branches and distribution centers. This enhancement allows customers to call the nearest branch for complete product availability and pricing information. Today, Grainger customer service agents can check the inventory on-hand in that branch as well as all the other branches and distribution centers across the United States. The customer's order is now handled with one phone call. Having this information online has boosted both the company's service level and asset utilization. In 1997, the company further improved its communications systems with the introduction of a land-based frame relay communications network. Frame relay is faster and more reliable than the satellite system it replaced.

In spring 1995, Grainger launched its Web site, giving small and medium-sized businesses the ability to search and order from its online catalog, check product availability and pricing, and set up rules for who in the company is authorized to make a purchase from the Web site. Customers can identify and select products, check pre-negotiated account prices and determine product availability without leaving their desk, making a phone call, or generating a single piece of paper.

Not only does the site offer customers greater convenience, it also offers greater selection. Through its traditional paper catalog, Grainger has a standard product offering of about 80,000 products. Its Web site has a selection of nearly 200,000 products. In the future, Grainger plans to significantly expand its Internet product offering by partnering with other "best of class" suppliers.

Revenues from the Web site have been growing 100 percent quarter over quarter.

More than 30 percent of Grainger's online sales are to new customers or incremental sales to existing Grainger customers. Because the virtual branch is open 7 days a week, 24 hours a day, customers who would not otherwise be able to order from a Grainger are now able to do so. In fact, more than 50 percent of all orders are placed after 5 PM and before 7 AM when the local branch is closed.

Integrated supply business

In order to serve the needs of very large businesses which are looking to outsource their entire indirect materials management process, the company has developed a separate business unit known as GiSO. Targeting the three components of total cost (process, product and inventory), GiSO employees work on site as advocates for their clients, performing various management services related to indirect materials, including: business process reengineering, inventory management, supply chain management, tool crib management and information management.

By outsourcing these activities to GiSO, businesses have benefitted from total cost savings of over 20 percent, inventory reductions of up to 60 percent, process cycle time improvements of 50-80 percent and the freeing up of their company employees to focus on more core functions of their businesses such as producing automobiles, appliances or computers.

Because GiSO is paid a management fee for the value of services it provides, rather than a mark-up on the product, it is critical for GiSO to minimize any unnecessary inventory and transactions costs. This can prove to be quite a challenge considering the fact that GiSO provides access to over five million products from over 10,000 suppliers. However, through a variety of electronic means, GiSO is able to communicate directly with these suppliers to determine pricing, availability and technical information which it needs to serve its clients.

The Internet, intranet, extranet and private networks will allow GiSO employees to continue to leverage information in the execution of their jobs. This leverage and the elimination of redundant activities in the supply chain have enabled GiSO to grow at more than three times the rate of Grainger's traditional distribution business over the last two years.

GENERAL ELECTRIC

General Electric's material costs increased 16 percent between 1982 and 1992, while GE's pricing remained flat and then started to decline. In response to these cost increases, GE began an all-out effort to improve its purchasing. The company analyzed its procurement process and discovered that its purchasing was inefficient, involved too many transactions and did not leverage GE's overall volumes to get the best price. More than one-quarter of its invoices (1.25 million invoices) had to be reworked because the purchase order, receipt and invoice did not match.

Since the review, GE has taken a number of steps to improve its purchasing, the most recent of which involve the Internet.

Factories at GE's lighting division used to send hundreds of requisitions for quotations (RFQs) to the corporate sourcing department each day for low-value machine parts. For each requisition, the accompanying blueprints had to be requested from storage, retrieved from the vault, transported on site, photocopied, folded, attached to paper requisition forms with quote sheets, stuffed into envelopes and mailed out. This process took at least 7 days and was so complex and time-intensive that the sourcing department normally only sent out bid packages to two to three suppliers at a time.

In 1996, GE Lighting piloted the company's first online procurement system, TPN Post, an extranet developed by GE Information Services. Now, the sourcing department receives the requisitions electronically from its internal customers and can send off a bid package to suppliers around the world via the Internet. The system automatically pulls the correct drawings and attaches them to the electronic requisition forms. Within 2 hours from the time sourcing started the process, suppliers are notified of incoming RFQs by email, fax or EDI and are given 7 days to prepare a bid and send it back out over the Internet to GE Lighting. A bid can be awarded the same day GE receives and evaluates it.[17]

As a result of implementing TPN, GE has realized a number of benefits:

- 60 percent of the staff involved in procurement have been redeployed. The sourcing department has at least 6-8 additional days a month to concentrate on strategic activities rather than the paperwork, photocopying and envelope stuffing it had to do when the process was manual.

- Labor costs involved in procurement declined by 30 percent. At the same time, materials costs declined 5-20 percent due to the ability to reach a wider base of suppliers online.

- It used to take 18-23 days to identify suppliers, prepare a request for bid, negotiate a price and award the contract to a supplier. It now takes 9-11 days.

- With the transaction handled electronically from beginning to end, invoices are automatically reconciled with purchase orders, reflecting any modifications that happen along the way.

- Procurement departments across the world to share information about their best suppliers. In February 1997, GE Lighting found seven new suppliers via the Internet, including one that charged 20 percent less than the next-highest bid.[18]

GE reports that TPN benefits extend beyond its own walls. A computer reseller, Hartford Computer Group, reports that since joining TPN, it has increased exposure across the different GE business units—so much so that its business with the company has grown by over 250 percent. At the same time, TPN has introduced Hartford Computer Group to other potential customers.[19]

As of October 1997, eight divisions of General Electric use TPN for some of their procurement. The company bought more than $1 billion worth of goods and supplies via the Internet during the year. By 2000, the company aims to have all 12 of its business units purchasing its non-production and maintenance, repair and operations materials (MRO) via the Internet, for a total of $5 billion. GE estimates that streamlining these purchases alone could save the company between $500-$700 million annually.[20]

ENDNOTES

1. Forrester Research estimates that Internet commerce between businesses in the U.S. could reach $327 billion by 2002. See: Erwin, Blane et al. “Sizing Intercompany Commerce.” Forrester Research. July 1997.

	1997	1998	1999	2000	2001	2002
Internet commerce (all business-to-business)	$8 B	$17 B	$41 B	$105 B	$183 B	$327 B
Manufacturing	$3 B	$8 B	$17 B	$41 B	$68 B	$116 B
Wholesale/Business Retail	$2 B	$6 B	$18 B	$48 B	$89 B	$168 B
Utilities	$2 B	$2 B	$3 B	$5 B	$7 B	$10 B
Transport	—	—	—	—	—	—
Services	$1 B	$1 B	$3 B	$11 B	$19 B	$33 B

Some business executives and analysts believe that it could be much higher, given the pace at which businesses are adopting the Internet in key business applications. A very recent study by Price Waterhouse, released on March 24, 1998, reported that, “between 1996 and 1997, business-to-business trade doubled every 6 months and this is accelerating to double every 3 to 4 months in 1998. By 2002, the value of goods and services traded via the Internet globally will increase to $434 billion.” See: Retter, Terry and Calyniuk, Mike. *Technology Forecast:1998.* Price Waterhouse. March, 1998.

2. Input, a firm specializing in electronic business market research and consulting services, estimates that the worldwide value of goods and services traded between businesses via EDI over private networks was $162 billion in 1997.

   Torrey Byles, President of Granada Research, an electronic commerce research and consulting firm, estimates that U.S. businesses traded $500 billion via EDI in 1996.

   Input’s figure counts only those transactions where the entire transaction from purchase order to payment, was completed electronically. Byles’ figure includes transactions where the transaction was initiated electronically. Payments may have been received via other means.

3. http://www.tpn.geis.com

4. 1997 survey of purchasing managers by Porter Novelli for W.W. Grainger.

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18. Ibid.

19. GE Information Services. "Extending Business Relationships: TPNPost Case Study - - Hartford Computer Group." http://www.tpn.geis.com. HCG experience related by Ron Brinckerhoff, the GE National Account Manager for Hartford Computer Group.

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APPENDIX 4

DIGITAL DELIVERY OF GOODS AND SERVICES: ANALYSIS AND CASE STUDIES

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DIGITAL DELIVERY OF GOODS AND SERVICES: ANALYSIS AND CASE STUDIES

FIGURES AND TABLES

DIGITAL DELIVERY OF GOODS AND SERVICES

Software, CDs, magazines articles, news broadcasts, stocks, airline tickets and insurance policies are all intangible goods whose value does not rely on a physical form. Much of today's intellectual property is produced, packaged, stored somewhere and then physically delivered to its final destination: a radio station, movie theater, book store or news stand. The technology exists (or soon will) to transfer the content of these products in digital form over the Internet.

Airline tickets and securities are already being bought and delivered electronically in large numbers. Other industries such as consulting services, entertainment, banking and insurance, education and health care face some hurdles but are also beginning to use the Internet to change the way they do business. Over time, the sale and transmission of goods and services electronically is likely to be the largest and most visible driver of the new digital economy.

CONTENT

Nearly 90 percent of people use the Internet to gather news and information and another 80.5 percent use it for research.[1] Many of the Web's most trafficked sites revolve around news, information and entertainment. Time Warner's Pathfinder, Warner Brothers, CNN, C/NET, USA Today, Disney, ABC and HotWired all rank among the top 20 most popular Web sites.[2]

Companies also access the Web's information to keep abreast of news affecting investments, currency obligations, transportation blockages and other events or trends that could affect their business on a daily or long-term basis. Some Web businesses integrate news feeds, stock tickers, trusted third-party company ratings and analyses directly into products and services they offer to their customers online as well as into their internal business processes.

Information Retrieval Services

A trip to the library to find books and articles for a term paper can take hours with limited results. Usually a multi-step process, it starts with a keyword search online to find relevant journal articles or books. Next, the researcher must go to the floor containing the book or periodical and walk past stack after stack to locate it. In the case of periodicals, the researcher might have to page through six months' or a year's worth of publications to find the right month or week that contains the article. If a quick read shows that the article contains interesting information, the next step is to walk to the photocopying machine and make a hard copy.

Information retrieval services such as Dialog Information Services, Lexis-Nexis, Westlaw and others made a business by streamlining this process, pulling together a variety of sources and allowing librarians, law students and businesses to search electronic databases for information online using a dial-up connection.

The Internet offers a range of information retrieval services. The sheer number of Web sites in almost every conceivable industry (companies representing all 4-digit SIC codes except soybean farming can be found on the Net[3]) has driven an industry of "search engines." Instructing people where to find children's clothing, a birthday card, or the Web address for the University of Michigan is the business of Yahoo!, Excite, WebCrawler, Infoseek, Lycos and AltaVista. Directories of individuals and businesses, WhoWhere? and Four11, serve a similar purpose. More than 25 million adults in the U.S. alone use Yahoo![4] to scan the Web for sites selling used cars, magazines covering the entertainment beat, trade associations representing pharmaceutical companies; they can also get stock quotes, read press releases, and find out what is playing at the movie theaters in San Francisco and where to go for dinner or meet up with friends after the movie.

Web-based information retrieval services find and organize content, they shop for the best deals or they "remember" to look out for new merchandise and notify the customer by-email when something becomes available. Some perform the service only when someone requests it; others can be programmed to continue providing the information until the user stops the service. There are sites for people interested in technology with searchable databases crossing a variety of technology magazines. To find the day's or week's stories from the country's leading newspapers on the steps governments are taking to ban human cloning, an Internet user can go to Wired.com's HotBot News service, enter the keyword "cloning" and the "search" button, and links to current stories appear. Jango, a software shopping agent, will search sites for those selling products like decaffeinated Colombian coffee beans and present the array of choices, along with product and price information.

Web Publishing

The distinction between daily newspapers and weekly or monthly magazines blurs online where content is updated as often as 24 hours a day, and editors use color graphics and photos, video and audio and other techniques to attract visitors to their sites. They compete for the same viewers, much more than they would in their print editions.

Book publishing remains apart, as the sheer length of a book does not lend itself to being read from start to finish on a computer screen. However, the book industry has a strong online presence to promote and supplement its traditional retail business.

*Online Newspapers***:** A reader can get news on the Internet, usually free of charge, from any of a couple thousand newspapers from around the world. The Editor & Publisher Company's online newspaper database lists more than 2,700 newspapers have online businesses, of which over 60 percent are U.S.-based.[5]

The top 25 daily newspapers all have Web businesses, featuring the day's stories from the paper, some special Web-only sections, searchable online archives, as well as reviews of books or movies. A few work in partnership with other local businesses to highlight a given city, in addition to the general news. For instance, Boston.com features news from the *Boston Globe*, *Boston Magazine* and other local print and radio channels, classified advertising for cars, homes and job listings in the Boston area, local sports highlights, AND traffic and weather reports. "Cleveland Live" has content sponsored by the *Cleveland Plain Dealer* and other local newspapers, radio and television stations and the Cleveland Orchestra.

The nation's most widely-circulated daily newspaper, the *Wall Street Journal*, launched its Interactive Edition in April 1996. The Interactive Journal's coverage includes politics, economics, technology news, marketing, in-depth sports reporting and features, an extended editorial page, and weather. U.S. readers receive the Journal's national edition, and can also access content from the European and Asian editions online.

The New York Times on the Web offers readers the day's print stories online, along with AP Breaking News and AP radio, 50,000 book reviews dating back to 1980, hosted and unhosted online forums, and "Web specials" covering women's health, sports and special in-depth features (recent features covered the handover of Hong Kong to China and inner-city housing). Readers do not pay anything for general access; small fees are charged for crosswords and archived news stories.

Most online newspapers have yet to turn a profit, but they remain committed to the Internet. Knight-Ridder, a publisher with newspaper holdings across the country, invested $27 million in its 32 Web sites in 1997 while generating just $11 million in revenue. The Tribune Company, owner of the *Chicago Tribune* among many other newspaper and broadcasting businesses, lost about $30 million on its Web activities in 1997 and expects to lose $40 million in 1998.[6] The New York Times Interactive Edition 1997 revenues grew 66 percent over 1996, but the company's online ventures lost between $12-15 million for the year.[7] C/NET's 1997 third quarter revenues, while two-and-one-half times greater than its revenues for the same period in 1996, still did not cover its costs.[8]

Magazines: More than 3,600 magazines can be found on the Internet.[9] All but three of the top 50 magazines in the country (as defined by paid circulation) have an Internet presence in January 1998.[10]

However, what is popular in print is not necessarily popular with Web users. In fact, only 9 of the top 50 magazines show up in Web21's "100 Hot Magazine" sites for the week of September 30, 1997. Today's Web readers appear to be more interested in science, technology and entertainment than do their offline counterparts.

Science Daily Magazine, *Scientific American*, *New Scientist Planet Science*, and the Pharmaceutical Information Network rank among the top 100 Web Magazines.

Ziff-Davis' magazines, *PC Week* and *PC Magazine*, are but two of the attractions in ZDNet's highly trafficked site. Visitors to the site can also purchase products, read product reviews, play games, download software and interact as part of a community of like-minded people. Other popular technology sites include PC World Online, Windows Magazine: PC Tips, News & Reviews, and BYTE.

Like their print editions, Web sites for Reader's Digest and TV Guide attract large audiences. Sites for games (the Imagine Games Network and Online Gaming Review) and music (SonicNet, Dotmusic and Billboard Magazine) are also frequently visited.

Most of today's online content is drawn from content prepared for the print brand. Publishers do not believe this is enough to ensure success with their online audiences. Instead, they believe that content needs to be developed and presented in a format compelling enough to encourage repeat

visits. This means updating the content daily or hourly (rather than weekly or monthly as in print editions) and building a sense of community.[11]

Magazine publishers, like newspapers, are investing more than they earn from their online businesses, perhaps breaking even in 1998 (Figure 1). They continue to experiment with different revenue sources in order to build a solid business model online. Advertising revenues, still very small on the Internet, account for 53 percent of magazines' online revenues, followed by online production services, 22 percent, and subscriptions, 6 percent.[12]

Figure 1. Online Magazine P&L

	1996	1998	2000
Expenses	$2.6 M	$5.2 M	NA
Revenue	$1.5 M	$5.4 M	$15.3 M
Profit	-$1.1 M	$0.2 M	NA

Source: Ernst&Young, MPA survey. Per-publisher averages based on responses from 29 MPA members.

Book publishing: The book industry uses the Internet primarily to market and sell products. The Internet can also be used to make a book's contents interactive and tailored for a user's specific needs.

Amazon.com introduced the idea of a virtual bookstore in the summer of 1995. Today, Barnes & Noble and a host of specialty booksellers offer readers a choice of sites from which to buy books.

Readers can find book reviews in a variety of places: online book stores, newspapers, and online magazines bring readers together to critique and discuss authors and their works. For example, Salon's "Table Talk" invites visitors to join author Carol Shields in the Classics reading group to discuss Jane Austen's *Mansfield Park.*

McGraw-Hill, the leading publisher of K-12 and college textbooks, sees the Internet as an extension of its printed materials. The company has been working with universities to develop an online study resource combining presentation materials, e-mail and discussion groups that students can use to further their study. McGraw-Hill also sees the Internet as a way to provide its scientific and research audiences with more up-to-date articles in its reference publications.

Television Broadcast/Cable

More than 800 TV stations across the U.S. have Web sites.[13] All the major broadcast networks have Web sites that combine information about TV programming and profiles of the shows' stars, along with special Web services. Viewers can also find their favorite cable channels online. UltimateTV.com lists 151 U.S. cable channels including CNN, fX, HBO, MTV, and the Weather Channel.[14]

The following examples illustrate how broadcast networks and cable channels use the Internet to complement their regular programming as well as introduce new products and services developed exclusively for the Internet:

A January 14, 1998 report on abcnews.com entitled, "Secrets or Lies in Iraq?"—a report on the arms inspection controversy in Iraq—was much more in-depth than a 30- or 60-second television news clip would have been able to accommodate. Visitors to the site could get a quick overview by scanning the Reuters news story on the latest developments involving the American-led U.N. arms inspection team in Iraq. Those wanting to learn more could search the index to all abcnews.com coverage on the subject, read what experts have to say on the subject, or view a chronology tracing events from the Gulf War to the present. Interactive maps showed the build-up of American and Iraqi forces in the region. An interactive guide described the U.S. military bombers, aircraft careers and ships that were deployed for the Gulf War. Or, visitors could listen to audio clips from U.S. Ambassador to the United Nations, Bill Richardson, and Chief U.N. weapons inspector, Richard Butler, or view Peter Jennings' video clip profiling Scott Ritter, the American leading the U.N. arms inspection team in Iraq.

NBC has six online shows adapted from its popular TV programs. Viewers meet the stars, take part in plots and interact with other fans. Its first Internet-only entertainment series, "Second Shift," premiered in February 1997. The online counterpart to NBC's TV series, "Homicide: Life on the Street," Second Shift features a different cast and new plots developed for the online show. Viewers can also get behind-the-scenes interviews with actors from the TV show, read about past episodes and learn about the music played on every show.

CNN's custom news delivers the user's choice of sports scores, stock quotes, local weather and news from CNN and articles from over 100 magazines and news outlets. Instead of jumping from one news site to another looking for the day's articles on the financial crisis in Indonesia or debates on Capitol Hill, CNN's custom news service scans online databases and presents only those articles that the reader indicates as important on the reader's own customized news page.

"Webcasting" gives Internet users the ability to watch their favorite TV programs on their computers. National and local TV and cable stations from the U.S. and around the world offer live and on-demand programming options from "Sesame Street" and "Buffy the Vampire Slayer" to "Court TV" and "Bill Nye the Science Guy".

Radio

To watch television or listen to the radio online, PC owners need a sound card and speakers (available on new PCs) and a special software program. According to RealNetworks, the leader in "streaming media," 30 million copies of RealPlayer (a software program used to play audio and video broadcasts) have already been distributed and they continue to be downloaded at a rate of more than 500,000 copies per week.[15]

Radio stations from around the country broadcast alternative music, the blues, classic rock, classical, contemporary, jazz, country, oldies, top 40 and urban music to Web users. News, sports, traffic, talk radio and weather are also online.

AudioNet calls itself the leader in Internet broadcasting, with live continuous broadcasts of over 175 radio and television stations, play-by-play of thousands of college and professional sporting events, live music, on-demand music from the CD Jukebox (over 1600 full-length CDs), live and on-demand shows and Internet-only Webcasts and live and on-demand corporate and special events.

Yahoo!'s Net Events has links to online radio shows on the air at any given time. One afternoon in January 1998, Yahoo! provided links to 130 different music and talk radio programs.

Business Information

Companies that provide news and information to the business community have their own stand-alone Web sites. They provide information feeds to enhance other companies' online businesses, and they provide feeds into internal business processes through corporate intranets.

Reuters has its own site with online news reports, quote data, market snapshots and other products and services. In addition, Yahoo! readers can keep up-to-date with breaking news provided by Reuters**.** Personal investors on some online brokerage sites may see Reuters' delayed stock quotes, historical pricing charts, and portfolio tracking services.

Small and medium-sized companies use Dun &Bradstreet's (D&B) Web site to access standard business reports including credit and risk management reports for evaluating buyers, purchasing products reports for evaluating sellers, and database marketing reports for evaluating prospective markets. Larger companies also get information feeds directly into their corporate intranets or private networks.

Individuals comparing term life insurance policies on InsWeb's or Quicken InsureMarket's Web sites can see how independent rating firms like Moody's and others rate different insurance carriers and how much business they write.

The securities industry has long subscribed to proprietary newswires and business reports transmitted over private networks. Institutional traders use these services to track stock prices, currency fluctuations, and commodities prices, all in real-time.

DRIVERS OF GROWTH

The movement of information services to the Internet is being driven by consumer demand, more effective distribution and increased advertising on the Internet.

Competition and Consumer Demand

Publishers, networks, radio broadcasters and others have quickly established an Internet presence, some with significant marketing budgets spent on well-placed ads and hot links (buttons or underlined and highlighted text which can be clicked to take the viewer to another site) to "capture eyeballs" (or, in other words, to attract viewers to a site). Those that do not have a presence could potentially lose market share to existing competitors or new ones that connect with this audience first.

The key advantages of Internet-based content from the consumer's point of view are choice and convenience, savings, and timely, personalized news.

The Internet's selection of news and information is so vast, it would be impossible to find its equivalent in any other place due to physical constraints and the costs to carry such a wide inventory. Traditional chain stores tend to stock the publications they can sell to a general audience. Small, specialty shops tend to sell the books, magazines or journals that serve a more targeted community of interest.

The Internet provides the umbrella for both types of stores. Internet users can find obscure or limited circulation journals online along with the top sellers. What is limited to text and perhaps a picture in a print edition may be supplemented with video or audio clips, maps or in-depth background research.

At present, Internet users can access most newspaper, magazine, TV and radio content free of charge. Businesses offering content from trade and technical publications, investment advice and other specialized content targeted to particular audiences may charge a fee or bundle it with other products and services.

Because the online content industry is not yet mature, pricing structures will continue to evolve. Internet businesses may begin to charge for general news and information if they think they can maintain and grow their audience even after they impose a fee.

Timeliness and personalization are two other factors that may influence consumer demand for Internet-based content. Books can take several months or years to go from concept to the shelves in bookstores and libraries. Magazines come out weekly or monthly and newspapers, once a day. Almost as soon as a new story is written and approved, people can start reading it online. With Web news, readers can also choose to skip an article in today's news and still find it again tomorrow, next month, or next year in the site's searchable archives.

Internet users can select only the news, entertainment and information they want and have it "delivered" to their personalized Web page, to an e-mail box, or as a service that the computer defaults to when at rest.

More effective distribution

Distributing newspapers and magazines can cost as much as 30 - 40 percent of the retail price. By contrast, an Internet version of that newspaper or magazine avoids the expense of the trucks that move the papers from the printing plant to the city news stands or the cost of postage to send a magazine to a subscriber across the country. Instead, the publisher's distribution costs include paying off the investment in the Web servers and other technology that makes sure that when someone clicks on the site that it responds quickly.

Unlike newspaper or magazine content that gets used once, content stored digitally can be repackaged and used again. Storing content in a digital library means that it can be used not only on the Internet, it can be called up on TV as a broadcast feed or video-on-demand, made into customized CD-ROMs or electronic games.

Because they focus on a single special interest category, computers, C/NET's different sites can share some of the same services and information. Someone visiting download.com is probably interested in the same set of targeted employment classifieds or software available for downloading as someone visiting computers.com. C/NET selectively uses information in different places throughout its 10 Web sites.

Several cameras record professional sporting events, but very little of the footage is seen by viewers during the game and in after-game analysis. The National Hockey League and IBM have come together in a joint venture called NHL Interactive Cyber Enterprises to bring more of that content to interested fans. The joint venture presents nhl.com, with lead hockey stories, live game radio, video highlights of NHL games, statistics, scores and recaps, schedules, features, a fan forum and a store. A fan interested in how Wayne Gretzky did in the 1998 NHL All-Star Game can call up footage showing his assist in the game-winning goal.

Internet content businesses do not have enough experience behind them to draw conclusions about their eventual cost structures and how they compare to print editions. At a minimum, these businesses require a much lower capital investment than their print counterparts. Some publishers argue that storing and distributing content electronically will cost much less than distributing the print version and their overall costs should therefore be lower. Others are less certain. They think the costs may simply shift from physical printing and distribution to acquiring, operating and maintaining technology and paying a larger share of operating expenses in marketing costs.

Potential loss of existing revenue sources

Though less than $1 billion was spent on advertising on the Internet in 1997,[16] traditional media companies are preparing for the time when existing revenue sources, particularly local business and classified advertising, will in part shift from traditional media to the Internet. Other non-traditional competitors are using the Internet to position themselves to tap into the $175 billion advertising industry.[17]

Companies started using the Internet to advertise in late 1994. Two years later, 46 of Advertising Age's 100 Leading National Advertisers had purchased Web advertising and nearly all had corporate Web sites.[18]

Advertising in 1996 reflected the characteristics of early Web users: tech-savvy, higher income, and male. The top advertisers on the Web were computing products (38 percent), consumer-related goods (20 percent), new media (17 percent), telecommunications (9 percent), and business services (6 percent).[19]

In the space of a year, Internet advertising has begun to reflect the interests of more mainstream audiences. Consumer goods companies' share of spending surpassed that of computer hardware and software companies, with 32 percent and 22 percent of the total advertising dollars, respectively. Financial services had a strong online ad presence in 1997, contributing 20 percent of the total.[20] Yahoo, a leading Internet search engine and one of the top recipients of advertising dollars, confirms the shift: its mix of advertisers went from 85 percent technology companies in 1995 to close to 80 percent consumer brand companies in 1997.[21]

Forrester Research predicts that $1.5 billion in local ad purchases will shift to the Internet in the next three to five years.[22] More than 60 corporations crossing different industries, including online services, broadcast and cable, directory providers, search engines, telephone companies and newspaper networks have announced plans to tap into the $70 billion in local advertising with Internet-based services.[23]

Classified advertising represents 37 percent of a newspaper's total advertising. In order not to lose this revenue, most of the online dailies have at least some portion of their classifieds online.[24]

Knight-Ridder supplements its 32 city newspapers with online city guides called Real Cities. CarHunter and HomeHunter put online the newspapers' already vast database of automotive and real estate classified ads, and combine them with real estate news and information on education and health, schools, parks and recreation and shopping. Cox Enterprises' City Sites center around its newspaper and television holdings. In 1998, the New York Times on the Web plans to launch "New York Today," a guide for Big Apple residents and visitors.[25] The Times Mirror Company, Tribune Company and the Washington Post Company have come together to form a new online company called Classified Ventures. The company's first service, cars.com, will link the online classified ad systems of all its affiliates as well as serve as a national ad management network

facilitating the network-wide placement of sponsoring ads from national and regional advertisers selling vehicles and related products and services.[26]

Software and online service companies like Microsoft, Yahoo, Digital Cities and others are also vying for local advertising dollars. Microsoft's Sidewalk.com has guides to ten cities, listing movie and restaurants, what's going on in arts and music, current events, places to go, local sports, news and tickets. Yahoo has similar metro guides in 12 cities as well as "get local" guides across the U.S. and the world. America Online's Digital City covers movies, dining, real estate, stocks, arts & culture, business & finance, health & fitness, news & media, employment, shopping, travel and sports in 24 cities.

CBS plans to launch a 24-hour online news service, augmented with local news from affiliates (150 affiliates have signed on to participate). CBS will transfer a user who logs onto its Web page directly to the home page of the CBS affiliate in that person's TV viewing area.[27] CBS signed a deal with Classifieds2000 to provide a searchable database of automotive, real estate, computers, personals, employment, and other classifieds on its affiliated and network stations. ABC Television is expected to provide content from ESPNet SportsZone and Disney, with the ability for local affiliates to insert local headlines directing users back to the local site.

CableSoft is developing set-top box technology to allow cable operators to offer interactive "communications neighborhood" channels that include community news, weather, Yellow pages, school menu information, etc. Warner Brothers and Telepictures Distribution (City Web) plan to launch Web sites for local TV affiliates in mid-1998 that will feature a localized version of Lycos' search engine, local information and classified ads/on-air promotion from the TV affiliates, a customized CityWeb browser from Netscape as well as other content.[28]

Directory listings and mapping services like Big Book and InfoSpace partner with newspapers, software companies and others to offer their own city guides. Telephone companies have their own directory listings and mapping services and are partnering with others for real estate listings, restaurant guides, and other local information and services.

At the same time that the competition for a very small pool of advertising dollars on the Internet is intensifying, traditional sources of revenue that media companies rely on may not be available online.

Subscriptions currently generate about 30 percent of a newspaper's and 40-60 percent of a magazine's revenues.[29] Online, newspapers and magazines are weighing the tradeoff between "attracting eyeballs" and charging for their content. To attract advertising dollars, Internet businesses attempt to amass as large an audience as possible, even if that means their businesses operate in the red for a period of time. Imposing a fee to access the content on the site could result in greater revenues in the near term, but it may mean that the ultimate audience size will be limited. So far, most content sites are opting for building audiences rather than imposing subscriptions.

The Wall Street Journal Interactive Edition is one of the notable exceptions. Launched as a free service in April 1996, the site attracted 650,000 nonpaying subscribers. Five months later, the site was relaunched with a subscription fee of $49 per year for non-print subscribers and $29 if the reader also subscribed to the print edition (an additional $175/year). Thirty thousand people subscribed to the relaunched site.[30] As of November 1997, a year and a half after its launch date, the Interactive Edition had 150,000 online subscribers, the largest group of paid subscribers for any online publication.[31]

According to Forrester Research, revenue from online subscriptions will grow from $22 million in 1997 to more than $158 million by 2002.[32]

In addition to traditional advertising and subscriptions revenues, Web publishers anticipate that they will be able to generate a growing amount of revenues by charging transactions fees (also called "commerce" fees). This works as follows: visitors to one site can hot link to another to purchase a CD, book travel, buy stock. The "host" company receives a fee for renting the space on its site, a percentage or flat dollar amount for each lead or purchase that results at the other company, or some combination of the above.

For example, Time Warner's umbrella content site, Pathfinder.com, has a Marketplace with retailers selling books, music, travel, computers and electronics, sporting goods and memorabilia, gardening supplies, vitamins and more. If an article about skiing out West piques a reader's interest to book a flight to Aspen, Travel & Leisure and American Express Travel have an arrangement where readers can make reservations directly from the site.

AOL reported close to $300 million in advertising, merchandising and e-commerce revenue for its 1997 fiscal year which closed June 30. Some exclusive multiyear deals include 1-800-FLOWERS for $25 million, Tel-Save Holdings for $100 million and direct marketer Cendant Corporation (formerly CUC International) for $50 million.[33]

The Future

Forrester Research predicts that online revenue sources from advertising, subscriptions and transactions fees will grow from just over $520 million in 1997 to $8.5 billion within five years. Jupiter Communications projects that online advertising and direct marketing will grow from $1 billion in 1997 to $9 billion by 2002.[34]

The fact that very few consumer-oriented Internet content businesses are making money today does not reveal much about the long-term viability of the industry as a whole. In the early stages of a high-growth market it is often wise to focus on capturing market share rather than making profits. Even the most mature Internet-based content companies have only three to four years of experience. Most date back 18 months to just over two years.

During this early period, companies will experiment with different sales techniques, marketing approaches, and product adaptations to determine the most effective business model. Every couple of months, a visitor to a Web content site may find an entirely new layout, new product additions, technology enhancements, or specialty sections that did not exist before.

The sheer number of Internet content businesses suggests that the Internet will become a significant market. Analysts believe that the revenue streams will soon materialize to support these businesses, with online revenues from advertising, subscriptions and transactions fees growing from just over $1 billion in 1997 to over $8 billion within five years,[35] or close to 5 percent of today's advertising expenditures.

Long-term success for the online content industry is tied to solutions for protecting copyrights and improvements in the Internet infrastructure. Uncertainty about whether digital copies sold over the Internet will be prone to copyright infringement and piracy impedes growth. How quickly the speed and convenience of Internet access for home users improves will also drive the size and growth of the Internet content marketplace.

Technological solutions, including "watermarks" and "digital object identifiers," are being developed to protect copyright. A treaty negotiated at the World Intellectual Property Organization in December of 1996 addresses the question of how copyright should be legally recognized and protected in global Internet commerce. Legislation to ratify this treaty is now pending in the U.S. Congress and in legislative bodies in other countries around the world.

Until users can download a video in a matter of seconds, Web sites will not create many video products to sell online and Web users will prefer to read text, watch television or use their VCR. As broad-band Internet access becomes possible from the home via faster telephone connections, cable, satellite and wireless technologies, the demand for multi-media content will increase. Publishers point out that the lack of portability and difficulty in reading lengthy articles or magazines from cover to cover on a computer limits the potential of the online content market. Their readers like being able to buy a newspaper or a magazine on their way to work and read it on the subway, or get it delivered at home to read when and where they choose.

These limitations may diminish as opportunities to access the Web from other devices increase, whether from a television set, telephone, car console, wearable computer or lightweight, portable screen.

MCGRAW-HILL

McGraw-Hill publishes and distributes $3.5 billion worth of educational materials, financial information and industry and professional publications under 100 different brands and 28 business units.

Just over ten years ago, the financial information services division became the first McGraw-Hill division to distribute its products electronically. Initial sales of digital products barely made a dent in the overall business; up until three years ago, print revenues made up 85 percent of the division's sales. Today, securities brokerages, banks and other financial institutions count on online publications to make their business decisions. Revenues from the online business account for more than 50 percent of total sales.

By contrast, printed materials drive 90 percent of McGraw-Hill's sales to the education market. Information technology's impact on the book publishing business thus far has been in reducing the book publishing cycle by half, from 18 months to 9 months.

The publisher anticipates that electronic distribution and the Internet will play an increasingly important role in core business processes and market positioning in each of the company's divisions.

Before the company even had a presence on the Internet, McGraw-Hill employees accessed the Internet for editorial research. In 1995, the company launched 84 different Web sites with sales and marketing materials for its different brands. At the same time, McGraw-Hill began to post its print products on the Web, with the content from the print edition as the centerpiece. This continued through 1996, when the company decided it needed to develop new products designed to take advantage of the unique capabilities of the Internet.

For the past year, McGraw-Hill has been developing products and services exclusively for the Internet market, spanning consumer, education and business-to-business products. By the spring of 1998, the company plans to launch 62 new products. The following are selected highlights:

Education

The company's higher education division has been working with 25 schools on a supplemental online study resource to run over university intranets. Soon after January 1998, students in participating universities will be able to access online presentation materials, linked with e-mail and discussion group capabilities to help them study outside of the classroom.

Because of the expense and time involved, science and technical reference publications are updated perhaps once every 3 years. Two years before the publication of a new textbook, the editorial publisher begins to gather research for peer review. "New" research is actually more

than a year or two old before it finally reaches the reader. McGraw-Hill's *Harrison's Principles of Internal Medicine Online* will change this. Research will be reviewed on an ongoing basis and posted on the site each week. Still in the development stage, the objective for the online medical journal is to make the latest research available to the medical community as soon as it has been reviewed by their peers.

Financial Services

Standard & Poor's, a McGraw-Hill company, will introduce a Personal Wealth product in early 1998 that integrates financial services tools and information from separate S&P products. For $10 a month, the Personal Wealth adviser will recommend how best to allocate assets based on information the customer provides about his earnings, investment priorities, and current holdings. The service will even provide recommendations for specific stocks or mutual funds that meet the customer's profile. Personal Wealth will have a link to an online broker where its customers can buy or sell investments.

Industry and Professional Publications

McGraw-Hill offers its trade publications to Internet users on a subscription basis. Dodge Dataline Direct delivers construction information. Newsletters and magazines targeted to the aviation industry, including Aviation Week, are also available online. New products and services soon to be announced will draw upon the vast databases of information from the different McGraw-Hill businesses and tailor them to different industry audiences.

Consumer Market

McGraw-Hill introduced Business Week Online back in 1994 to see what lessons it could learn about doing business on the Web. The company has discovered that readers of Business Week Online do not behave as its print readers do. Online users read the front page article and then use the site to research the magazine's archives and special report sections, features not found in the print edition. And, different types of readers - - someone running a small business or a marketing executive in a large multinational corporation - - have different interests. Building on the knowledge, McGraw-Hill intends to introduce new products and services tailored for particular audiences.

Benefits McGraw-Hill expects from the Internet

- *Creating a unified brand*: McGraw-Hill has 100 different brands today, each with its own products, marketing strategy and image. With the Internet, customers will see a unified McGraw-Hill and will be able to get information and products from each of the company's business units, regardless of whether the customer starts at one of the K-12 education sites or Business Week.

- *Additional revenues***:** by storing content electronically, what was once only used in one publication can be repackaged and tailored for use across different McGraw-Hill units.

- *Lower distribution costs***:** McGraw-Hill expects that distributing its content electronically will drive down printing and distribution costs which can be as high as 50 percent of the retail price in some markets.

NEW YORK TIMES

In anticipation of highly profitable classified advertising revenues leaving the print media for the Web, the New York Times Company (along with hundreds of other newspapers) launched its online business in early 1996.

The company's strategy to combat the shift in local advertising is two-fold: the paper has been positioning itself as more of a national paper than a regional paper, drawing a larger share of its revenues from national advertisers. The second part of the still-unfolding strategy is the online business. Right now, the New York Times on the Web offers readers the day's print stories online, along with AP Breaking News and AP radio, 50,000 book reviews dating back to 1980, hosted and unhosted online forums, and "Web specials" covering women's health, sports and special in-depth features (recent features covered the handover of Hong Kong to China and inner-city housing).

The dynamics of the online world are different than print:

- *Low barriers to Web entry results in greater initial competition***:** Because it costs so much to build a printing plant (the company's newest printing plant had a price tag of $350 million), competition in the newspaper business has traditionally been limited. Starting a content business on the Web requires much less capital, resulting in a very competitive market of thousands of different content sites. The Times views this as temporary, however. For those companies competing for the mainstream reader and trying to build a business funded primarily by advertising dollars, the marketing costs to "capture eyeballs" and build a brand will be high. Over time, sites without sufficient funding will find it increasingly difficult to compete online.

- *Different business model***:** In the print business, the New York Times controls the entire chain: they operate the plant, write the stories, sell ads, buy the newsprint, manufacture and distribute the papers. The company considers the development of the content as its expertise, and the rest, a necessary part of doing business. In the online business, the need for the physical plant disappears, freeing the company to focus on its core expertise.

- *Revenue streams***:** The revenue stream for the online business is still evolving. Though small, the main revenue stream comes from advertising. Additional revenues are generated from a subscription fee charged to the international audience, along with fees to print stories from the archives and an annual fee for online crossword puzzles. The company is banking on advertising revenues to ramp up quickly.

- *Business rhythm***:** The print business is well-tuned and predictable. James Terrill, Vice President and Controller of the New York Times, describes its rhythm like this: "Before noon on the day before, we decide the shape of the newspaper. Once you know the advertising spend, you know the size of the paper. The look and feel of the newspaper

does not change—everyone knows the positioning of articles on a page and what should go in each section. Where it goes says, 'this is today's news, this is what's important.' We have to make sure that 365 days of the year, we go through the sequence properly. Once every 20 years we reinvent the newspaper."

Cris Zukowski, director of business operations at New York Times electronic media company paints the contrast : "Our business is a 24x7 operation. It's much more dynamic. The key is to attract viewers and get them to stay, while at the same time deciding what's worthy of the *New York Time's* brand name. We're very informal and have to be because of the speed this market moves at."

- *Cost structure***:** though too early to tell how its cost structure will look once the online business is mature, the New York Times points to significant differences between the print and online businesses. The online business does not have to support the three largest expenses of the print business: the newsprint (the price of which they do not control), physical distribution, and the costs to manufacture and print the paper. Combined, these costs represent 30-40 percent of the total cost structure. The major expenses of the online business are content creation, sales and marketing. The Times points out that marketing expenses are the wild card in the equation. Depending on how the Internet marketplace evolves, marketing expenses could be higher as a percentage of total operating expenses for the online business than for the print business, particularly if users continue to access the Internet via a handful of "start" sites as they do today.

Future plans

The company plans to expand its online site, pulling together specialty sites under the strength of the *New York Times* brand name. With its large base of print subscribers and growing base of registered online users, the company will strive to be the trusted aggregator of news for an expanding audience.

REUTERS

Reuters, a $5 billion global financial news and information company, traces its roots back to 1851, to a small service delivering stock prices by carrier pigeon to clients in London's financial district. The business soon outgrew the carrier pigeon and the company relied on the telegraph and other technology to communicate breaking news from around the globe. By the early 1960's, Reuters' clients received their stock quotes from the new Stockmaster, a computerized quotes display system. Through the early 1990s, many securities brokers and traders relied on Reuters' terminals to keep current on the latest news and analyses that could impact foreign currency, stocks and commodity prices.

Up until recently, Reuters has taken a conservative approach to using the Internet to distribute its products because of technical issues, particularly in Europe. As the Internet's reliability and performance continue to improve, however, Reuters believes that it has the potential to shift the way Reuters does business. Just as the PC eliminated its dedicated terminals in the space of five years, the Internet provides enough compelling reasons for the company and its customers to exchange proprietary networks for the Internet. Reuters' director for European operations, Jean-Claude Marchand, predicted that "all the Reuters' services would be delivered either on the Internet or via Internet-related products within five years."[36]

Between now and then, Reuters anticipates that proprietary networks will be the mainstay for institutional trading. Because program traders and institutions rely on having real-time information delivered without fail to their desks, they will continue to pay a premium for the reliability and predictability of a proprietary network. Businesses geared to the individual investor will gravitate to the Internet, as individual investors will not pay the price premium for network support services and real-time access.

Over time, the premium paid for network reliability and predictability will decline. Instead, the differentiation will come in service, training, proprietary information, and the value of analysis.

Reuters launched an information-only corporate Web site in 1994. Today, Reuters online offers a variety of services designed for the Internet, including:

- *Online news reports tailored for specific audiences*: business news, securities reports, financial markets, breaking news from around the world and a growing number of reports that cover the top 10 stories for a given country.

- *Brokerage products and services*: delayed quote data, historical pricing charts, company news, Market Snapshot and Portfolio Tracker can be plugged into other companies' customized applications. For those that want a turn-key Internet brokerage solution, Reuters provides custom labeling, hosting, maintenance and updating. As of November 1997, 19 online brokerages subscribed to the service. Reuters expects to have 50 customers by spring 1998.

- *Air Cargo Service*: for a monthly subscription fee of $100, Reuters provides buyers and sellers of air cargo space the latest news and information affecting the air cargo world. Airlines, charter companies and forwarders can post available space on their aircraft and shippers can post their needs for cargo space from one location to another. A structured e-mail system provides instant contact between buyers and sellers wishing to make a deal.

- *Media World*: Reuters online community lets media buyers and sellers stay current on the latest advertising, media and brand news from industry sources, view samples and purchasing offerings from vendors of market data and services.

Reuters has announced the creation of a 50^ million global technical center to develop Internet-related products. The company is also investing in pay per view technology and a smart card that will allow Reuters subscribers to access services from anywhere in the world via the Internet.

How the Internet impacts Reuters' business**:**

- *Different pricing model*: subscribers to Reuters newswires over proprietary networks pay a fee per key station. For Internet-based services, customers pay a minimum subscription fee, transaction fees and advertising revenues.

- *Cost structure implications***:** Sales and distribution costs are high in the traditional areas of Reuters business, and do not scale well. To deliver products via a proprietary communications network, the company pays staff and operating expenses associated with purchasing communications capacity, managing the network, and providing network-related customer service and training. As the business shifts to the public Internet over time, Reuters will get out of the business of managing its own network and this could lower costs significantly.

  Sales and marketing operations via the Internet scales much better than in-person sales calls. Replacing paper-based contracts with online credit card sales transmitted via the Internet would free up time for the sales force to focus on customer relations and generating additional business. Over time, Reuters expects to use the Internet to expand its reach into the lower-end of the market.

DUN & BRADSTREET

For over 155 years, Dun & Bradstreet (D&B) has provided information services to assist businesses in buying and selling decisions. Today, D&B is one of the leading providers of business-to-business credit, marketing, purchasing, receivable management and decision-support services worldwide.

Supplementing reports and products available in CD-ROM, proprietary software and via direct electronic feeds, D&B delivers a growing number of its current products via the Internet or via corporate intranets. Responding to customer demand, D&B is also beginning to develop new products and services designed for the Internet.

D&B positions itself as "organizing the business space" on the Internet much as it does in traditional markets. Buyers and sellers need information to validate the identity and legitimacy of a potential business partner. They also need a basic corporate profile to determine credit worthiness, size, geographic presence, management and ownership structure.

D&B's D-U-N-S® Number, a registry for 46 million businesses around the world, is used by governments, standards organizations and industry associations to verify a business's identity online, whether for an Internet or EDI transaction.

Small and medium-sized companies use D&B's Web site most often to access standard business reports including credit and risk management reports for evaluating buyers, purchasing products reports for evaluating sellers, and database marketing reports for evaluating prospective markets.

Larger customers also use D&B's standard reports, but they have begun to request more specialized information and customized solutions their employees can access from corporate intranets and the Internet.

In the past, a buyer of solid wood products would have asked the corporate librarian to print out a supplier evaluation report on each mill being considered for the pine contract for the company's North Carolina furniture factories. Today, the buyer is no longer satisfied with a printed report. Instead, he wants to pull up information about different mills right from his desktop computer, store certain fields of data and compare data across companies to qualify them and look for opportunities to negotiate better prices.

A large telecommunications company in the process of deciding which vendor to lease computer equipment for a year uses D&B's Financial Stress Score, a statistical model that predicts the likelihood of that vendor's business failing in the next 12 months. The D&B information is built right into the workflow. Instead of having to interrupt the process to call up a D&B report, the information is fed directly into a vendor scorecard that the procurement officer uses to evaluate different vendors.

D&B has realized many benefits from the Internet

- *New customers***:** D&B's corporate customers traditionally have consisted of a few key individuals within purchasing, credit and marketing departments who controlled a company's access to D&B reports. With the Internet and corporate intranets, the "gatekeeper" mentality is changing. Customers now request hundreds or thousands of passwords for their employees to access D&B products from the Internet. In fact, D&B has had a 6-11 percent growth in revenues from customers accessing information from the Internet while its traditional business has remained flat.

- *New products and services***:** Driven by requests from its customers, D&B has been working to develop new products and services for customers to integrate into business applications on their corporate intranets. At the same time, D&B is working with Internet companies to provide businesses with D&B's D-U-N-S® Numbers system when they register for a domain name. They also provide their services to certification authorities to validate businesses conducting commerce on the Internet.

- *Deeper integration into clients' business processes*: Clients have asked for new products that allow them to directly incorporate D&B information into key business processes. Because it is easier to change vendors for a standard report than it is to change a business process, D&B is becoming more of a strategic partner than it has been in the past.

- *Lower data acquisition and labor costs***:** Collecting information used to mean maintaining a labor force in different geographical locations who physically visited courthouses and government offices to request and photocopy documents. With automation and electronic feeds for much of its data collection process, D&B has been able to centralize its collection activities and save a considerable amount of money. The Internet will make data acquisition even more efficient. Individual companies will register and update their profiles with D&B online rather than by fax or mail, and a greater share of public information will be transmitted to D&B electronically.

The Future

Going forward, D&B believes that its business will continue to evolve from producing standard reports to providing customized services that rely heavily on collecting, interpreting, storing and presenting information in ways that are meaningful to individual customers. D&B expects that more than half of its business will come through the Internet shortly after the turn of the century.

TRAVEL

Vacationers and business travelers can now find information on the Internet about cities they plan to visit, including driving directions, recommended itineraries, weather patterns and business telephone numbers and addresses. Many hotels have detailed property descriptions, along with photos of the property's grounds, public rooms and bedrooms. Rental cars can be reserved online. Top travel magazines offer online suggestions for the best week-end getaways.

Business travelers increasingly book travel online over corporate intranets. Customized solutions incorporate corporate travel policies, preferred suppliers and negotiated rates, and tools that simplify and streamline expense reporting.

Perhaps the biggest initial travel business being done online is the purchase of airline tickets. Internet-based travel services put the reservations engines that airline customer service representatives and travel agents use at the fingertips of the leisure and business traveler. Customers enter point-to-point destinations, desired travel times and dates, preferred airlines, and other preferences into the reservation system. Moments later, the system delivers a choice of options, along with a secure transactions environment for customers who wish to purchase the ticket online.

In 1996, Internet users booked $276 million online, of which 90 percent of which went to airline tickets. A year later, the figure tripled, to $827 million.[37] By the year 2000, online travel sales could reach $5 billion, or close to 7 percent of U.S. airlines' revenues for passenger air travel.[38]

A snapshot of the top travel sites shows how quickly online travel is growing (Figure 2).

Internet Travel Network became the first Web-based travel service with its launch in May 1995. Within three months' time, it had 70,000 registered users. Less than a year later, the number jumped to 450,000. By the end of 1997, 3 million people had registered on ITN's Web site. Early in 1997, ITN projected it would sell $75 million in travel for the year.[39]

Figure 2. Travel Bookings Take Off

(Bookings/Wk)

	1/96	2/97	7/97	11/97
Travelocity/ EasySABRE	$1 M	$2M	$2M+	$3 M
Expedia	NA	$1 M	$2 M	>$2 M
Preview Travel	NA	$1 M+	$2 M	NA

The SABRE Group's EasySABRE (a PC product also available on the Internet) sold $1 million/week in travel as early as January 1996. In March 1996, the SABRE Group added an Internet-specific site, Travelocity. The two sites booked $100 million in 1996. By November 1997, the two sites' combined weekly business was $3 million.

Microsoft's Expedia, launched in October 1996 was doing $1 million in sales per week in February 1997. By July 1997, its weekly business had doubled. It closed 1997 having booked more than $100 million in travel sales. By January 1998, its sales exceeded $3 million per week.[40]

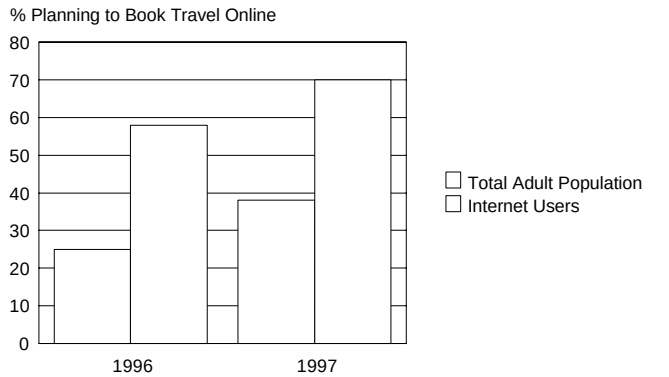
Preview Travel, launched in May 1996, booked $20 million in travel for 1996 and over $80 million for 1997.[41]

Airlines began to experiment with the Internet in 1995, first as a corporate public and investor relations vehicle. They quickly realized that the Internet provided a low-cost way to reach their consumers, and within a year, airlines began to offer fare quotes, flight schedules and other information via the Internet.

Today, the major U.S. airlines let customers purchase tickets via the Internet, in addition to information about fares and flight schedules. Some sites also include their frequent flyer membership programs, allowing current members to check their status and new members to enroll. Special e-mail services notify customers of fare discounts.

Even in its infancy, electronic commerce is expected to have a quick and measurable impact on the travel industry—most visibly in the migration of bookings to online travel sites and travel suppliers' own sites. A growing number of leisure travelers use the Internet to make their travel plans and bookings. Airlines benefit from significant potential savings, driven by lower online commissions (or no commissions if booked directly with airline), lower customer service costs, and lower ticketing costs as more online customers accept electronic tickets. Some airlines are also now using the Internet to improve capacity utilization.

Figure 3. Growing Number of People Plan to Book Travel Online



Source: "Travelers Use of the Internet."
Travel Industry Association of America. November 1997

Growing consumer demand

According to a survey released in November 1997 by the Travel Industry Association of America,

13.8 million Americans use the Internet to plan their trips and 6.3 million make reservations on the Internet. And, the acceptance is growing. In 1996, 10 percent of Internet users used the Internet to make travel plans and purchases. Nearly 70 percent say they plan to do so in 1998. Acceptance is not limited to today's Internet audience. Thirty-eight percent of all adults said they would consider using the Internet for their travel in the next year (Figure 3).

Lower sales and marketing costs:

Airlines are pursuing various strategies to drive their distribution costs down: lowering travel agent commissions, selling through the Internet and offering more electronic ticketing opportunities. Through technology and the Internet, airlines expect to cut sales and marketing costs by 20-30 percent over the next three years.[42]

At $12 billion, sales and marketing costs comprised of travel agent commissions, marketing and advertising expenses, labor costs and other expenses for airline reservations agents, are airlines' second largest operating expense.[43]

Figure 4. Cost to Process Airline Tickets

$8.00: Travel agent books, using computer reservation system
$6.00: Travel agent books direct with airline
$1.00: Customer books "electronic ticket" direct with airline

Source: Air Transport Association of America. Phone conversation 11/20/97.

How a ticket is sold, through an agent or by the airline directly, and whether the ticket is paper or electronic, can mean the difference between paying $8 or $1 to process a ticket (Figure 4).

Today, 80 percent of tickets are sold through travel agents, most who book through a computer reservation system (CRS). Bookings made direct with airlines (typically through a toll-free number) account for the remaining 20 percent.

Until 1995, the airlines paid travel agents 10 percent of the ticket price for domestic and international flights they ticketed. An additional 3 percent went to agents who steered business in an individual airline's direction. In February 1995, the airlines capped agent commissions for domestic travel bookings at $25 for one-way tickets and $50 for round-trip tickets. According to Salomon Brothers, this move saved the airlines $500 million in 1995.[44]

In late September 1997, the airlines lowered the commission structure again, to 8 percent for both domestic and international flights, maintaining the $50 cap per round-trip domestic ticket. Delta and United Airlines have been reported as saying this will save them up to $100 million annually.[45]

Travel agents have fought the cuts in commissions, arguing that the lower commission structure does not cover their costs. So far, airlines have not backed down.

In 1996, Southwest Airlines became the first major U.S. airline to let passengers buy tickets directly on its Internet site, completely bypassing the agent and the commission. A new breed of travel services started to emerge - - online travel sites sponsored by airlines themselves, "virtual" travel agents like Microsoft's Expedia.com and SABRE's Travelocity.com, and travel agents' own sites. Whether customers purchase tickets on an airline's site or through online travel agents, the airlines get a break. They save money if their own travel reservations centers do not have to be involved in the purchase, and the commissions they pay to online agents are about half what they pay to traditional agents (Figure 5).

Figure 5. Commission Structure: Travel Agent Versus Online Travel

	Travel Agent	Online Travel*
Commission %:	8%	5%
Cap on one-way:	$25	$10-15
Cap on round trip:	$50	$25

*Airlines do not pay a uniform fee or commission for travel booked online. For instance, American pays $15/ticket, United pays $10/ticket, Continental and Northwest pay 5% with a maximum of $25 for domestic trips.

Doing away with printed tickets—the paper, the machines to print the tickets, and the labor involved—would also reduce airlines' sales and marketing expenses. Instead of getting a physical ticket in the mail, customers with electronic tickets receive a reservation or locator number that they give to the airline representative at the airport gate as proof of purchase.

Southwest Airlines started the push into "ticketless travel" in 1994. By 1997, more than half of Southwest's customers fly without printed tickets.

U.S. Airways and American Airlines began issuing electronic tickets later than Southwest and have a smaller base of customers using them - - about 15-17 percent of U.S. Air's customers and 10 percent of American's.[46]

While the airlines' ability to move customers away from paper tickets to electronic tickets does not depend on the Internet, it's proving useful to airlines as a way to get more of their customers to use electronic tickets. Internet customers reserve their ticket, select a seat and give their credit card information online. Using an electronic ticket is a natural extension of the process.

Airlines have been encouraging their Internet customers to use electronic tickets by offering frequent flyer miles for travel booked online with an electronic ticket. Northwest Airlines has been offering its WorldPerks members who purchase via its Web site an additional 1,000 frequent flyer miles for using an electronic ticket. Travelocity started offering electronic tickets on 10 major airlines late September 1997. Without the use of any special incentives, Travelocity now tickets 40 percent of its business electronically.

Opportunity for New Revenue

Yield management, or, in other words, allocating how many tickets should be sold at different fares for a given flight in a given market, is a key driver of airline profitability. For each flight, an airline has to sell about two-thirds of all the seats in order to cover the fuel, the pilots' and flight attendants' salaries and the other costs of operating that flight. On average, airlines sell about 70 percent of the seats.

According to the Air Transport Association of America, airlines' yield management has been steadily improving over the years, through a combination of cautious investment in new aircraft and investments in information technology. Today, sophisticated computer programs can pretty accurately gauge demand for a particular flight at a particular time at particular seat prices.

No matter how precise an airline's forecasting, however, seats still go unsold on some flights. Auctioning airline seats to the highest bidder and offering special "cyberfares" for leisure travel are two techniques made possible by the Internet to sell seats at the last minute.

Knowing that the Thanksgiving holiday period was usually slow for trans-Pacific travel, Cathay Pacific tried an experiment using its Web site. Between October 13 and October 26, 1995, the airline auctioned off 50 business class seats for a round-trip flight between Los Angeles and Hong Kong. Bidding started at $25 for these $2,882 round-trip seats and increased at increments of $25. Cathay received 2,400 bids for the 50 seats. All 50 seats were sold at an approximately $1,500 each. The result of the gamble was $75,000 in incremental revenue.[47]

Salomon Brothers recently projected that airlines could realize substantial improvements in profitability by more widely using an auction system.[48]

The Future

Selling travel online appears to have few constraints to growth, perhaps because the computer infrastructure at the airlines and car rental companies has been in place for years. Its growth will depend on the speed at which the Web audience grows and bandwidth to the home increases. Analysts predict rapid growth in travel services, from less than $1 billion in 1997 to close to $8 billion within five years.

AMERICAN AIRLINES

In May 1995, American Airlines launched its Web site for public and investor relations. Less than six months later, American's passengers could use the site to access basic customer service information, including flight schedules, fares and flight status. By June 1996, passengers could buy tickets online, either through American's "AAccess" Web site or through a PC software dial-up program.

American's site really took off in February 1997. The day after a pilot strike was averted, American announced a fare sale. In every announcement, the company posted its Web site. When passengers realized they could avoid the long holds on the 800 number by going onto American's Web site and booking the reservation themselves, the site's numbers surged: for every one person who had accessed the site before, nine people did so during the fare sale. As of November 1997, American had approximately 500,000 registered online users. Online revenues already in the "millions of dollars" every month were growing 22 percent month over month.

Reservations center savings

Over half of the phone calls to American's reservations centers are requests for flight information, not to book reservations. Answering these questions via the Internet allows American to provide its online customers with a higher level of customer service and, at the same time, saves the airlines money. Similarly, flights that are booked online are cheaper to process than flights booked through their reservations center or through travel agents and CRS systems.

American estimates that about 20 percent of the flight information queries answered via the Internet would have otherwise been calls to their reservations center. Because the online volume is still very small relative to the airline's total call volume, American has not yet experienced significant savings.

American anticipates that in 1998, its online ticketing and customer service volumes will be large enough to have an impact on their overall costs.

Savings on ticket processing

Roughly 10 percent of American's customers fly with electronic tickets. With online customers, the average is closer to 70 percent. As online volumes grow, the airline expects that more of its ticketing will be done electronically, driving down its ticket processing costs.

Potential for increased revenue

In spite of its reputation as leading the industry in yield management, American still ends up with unsold seats in some markets. Before the Internet, the airline did not have a profitable way to market these seats at the last minute.

Today, every Monday or Tuesday, American looks at its yield management results and picks out low-performing markets. Mid-week, over one million "NetSAAver" subscribers get an e-mail from American listing rock-bottom fares for certain markets for travel that weekend. The NetSAAver program has generated tens of millions of incremental dollars for the airline since its launch in March 1996.

In 1998, American plans to link its AAccess Web site to its frequent flyer database. Each time a frequent flyer logs onto the site, the site will know which cities that customer most frequently travels between, whether his preference is for coach, business or first class travel, how many points he has earned toward a free flight or upgrade, and a host of other preferences. Matching that customer's profile to its internal information about available seats in different markets will give American the ability to personalize fares, suggest promotions and travel packages that suit that customer. In the end, American hopes to benefit from new revenue opportunities.

THE SABRE GROUP

Back in the 1930s, making a reservation on an American Airlines flight meant calling a reservation agent, who would telephone the central number at American where seat inventory was maintained. After checking the seat inventory against the request, the travel agent would get a teletype response. Through the 1940s, reservations were recorded manually with a pencil on different colored index cards and arranged in a "lazy Susan." Flights were controlled by half a dozen employees sitting around a table spinning the lazy Susan for index cards that would correspond to particular flights. By counting the pencil marks on each card, a clerk at the reservations center could give a "yes" or "no" to a request for a seat. To complete a booking for a round-trip reservation from New York to Buffalo required 12 different people performing more than a dozen separate steps during a three-hour period—longer than the flight itself.

Through the 1940s and the 1950s, the system became more sophisticated, and American's first truly electronic reservations systems, SABRE (Semi-Automated Business Research Environment) emerged in 1959. By 1964, the telecommunications network extended across North America. In May 1976, the first SABRE unit was installed in a travel agency. By the end of the 1970s, more than 1,000 travel agency customers were linked.[49]

The SABRE Group is now a publicly traded company (82 percent of the equity is controlled by the AMR Corporation) with sales of just under $1.8 billion. Today's SABRE system processes $66 billion in travel sales and serves a network of travel agents in more than 105 countries, hoteliers, car rental companies, travel suppliers and consumers who use SABRE to reserve and book travel with almost every major airline, 39,000 hotel properties, 50 car rental companies, railroads, tour operators, and a host of other travel products and services around the world.

The SABRE Group's electronic commerce strategy straddles four customer groups: travel agents, airlines, businesses and individuals.

Planet SABRE, the SABRE Group's PC-based travel agent reservations system, gives travel agents a direct connection to the Internet so that they can benefit from the vast amount of information published on the Web. SABRE Web Reservations is another product that provides links to the SABRE system so that travel agents in North America, Europe, Australia, Latin America, the Caribbean and Mexico can offer their customers planning and booking services directly from the agent's Web site.

The SABRE Group operates Web sites for major airline carriers, including American Airlines and Japan Airlines.

Corporations can choose from full-service travel products running over Lotus Notes, Windows and corporate intranets, or customized tools to assist with business travel planning and reservations. SABRE Business Travel solutions (SABRE BTS) provides a live connection to the SABRE system that incorporate corporate travel policies and rules, along with expense reporting

packages. About 30 corporations use the full-service solution, and nearly 100 corporations use elements of the product in their own travel systems.

The SABRE Group has two Internet sites for individual travelers—easySABRE and the better-known Travelocity.

Launched in March of 1996, Travelocity provides one-stop online leisure travel services backed up by the SABRE transaction and reservations engine. Travelers can book flights, cruises, hotels and rental cars, and can also access interactive street maps, photos, video clips, driving directions, travel guides, and weather forecasts. For customers searching for the lowest fares on a particular itinerary, Travelocity's "3 best itineraries" service prioritizes flights based on price. On selected flights, Travelocity customers can view the airplane seat plan, see what seats are free, and select a seat.

Personalized touches are also available. If a flight is canceled or delayed, Travelocity will page or e-mail the customer to let him know. Travelocity will monitor fares in certain markets and will notify interested customers by e-mail when the fares have changed. And, AT&T PocketNet customers in need of travel updates on the road can access real-time arrival, departure, gate information as well as flight schedules through their cellular phones.

EasySABRE and Travelocity together booked about $100 million in travel reservations in 1996; in February 1998 they reached the $4 million/week mark. Two years after its launch, Travelocity has 2 million registered members.

RETAIL BANKING

Consumers use the Internet to get up-to-the-minute balance information on their checking, savings, certificates of deposit and credit cards accounts. They can use online services to see whether checks have cleared, verify deposits, and transfer funds from one account to another. Those who wish to have the bank pay their bills can go online to set up one-time or repeat payments and the bank will automatically make the payment and debit the appropriate customer account.

In addition to basic banking services, customers banking via the Web can learn about and apply for credit cards, mortgage and home equity loans, automotive and education loans, as well as personal lines of credit. They can also get quotes on insurance policies and review mutual fund performance and download prospectuses.

About 4.5 million households were banking online in 1997 through a dial-up connection direct to their bank or through the Internet. By 2000, between 10-16 million households are expected to do their banking online.[50]

Many banks have Web sites, but most are information-only today. Before the decade is out, banks increasingly plan to give their customers the ability to do most of their banking transactions on the Web.

Most of the top 100 banks in the U.S. have a Web site. However, Online Banking Report classifies 24 of them as "True Internet Banks"—banks that let their customers review balances, transfer funds and pay bills directly from their Web sites.[51]

According to a 1996 Booz-Allen & Hamilton survey of North American financial institutions with Web sites, 80 percent of respondents planned to allow their customers to conduct most traditional banking transactions over the Internet within 3 years.[52]

Having a Web presence is by no means limited to the nation's largest banks. In Online Banking's list of 133 "true Internet" banks, 109 do not make the list of top 100 U.S. banks ranked by assets.[53]

Even community banks are seeing what PC banking and the Web can do for them. According to a late 1996 survey of community banks, only 1 percent offered PC banking, but an additional 25 percent of them planned to do so. Fifteen percent had a home page on the Internet, with another 30 percent saying they planned to have one soon.[54]

The State National Bank of Big Spring, Texas, a locally owned bank managing about $131 million in assets, launched its Web site in January 1997 to better serve its customers who preferred to

bank online. Customers can see full statement details, pay bills, transfer funds as well as order checks, set up direct deposit authorizations and stop payments on checks. The bank is happy with the success of its site, which gets about 2,000 hits per day. New features such as showing images of checks a customer has written and notifying them by e-mail of any account problems (for instance, if your balance falls below a certain level) are soon to be added.[55]

Beneficial National Bank, a wholly-owned subsidiary of a $17 billion bank holding company, became the first bank in the U.S. to introduce the two-minute consumer loan on the Web in late 1996. As of mid-May 1997, about $4 million in loan checks had been cut for successful applicants for unsecured consumer term loans between $1,000 and $10,000. Beneficial bases the interest rate and maximum loan amount on the applicant's credit score. It issues a preliminary loan decision while the consumer is online, and approved applications are automatically routed to a human analyst for further verification. If the approval holds, the loan check is mailed the next business day.[56]

Credit unions are beginning to develop Web presences. As of September 1997, 811 credit unions had Web sites, with about half offering online loan and membership applications. Credit unions operating "cyberbanks" generally have assets of around $100 million. That spans a group from Star One Federal Credit Union with $1.3 billion in assets and 52,000 members to the much smaller Valley Community Credit Union in Nampa, Idaho, with $4.2 million in assets and 2,100 members. Interactive services like credit/debit card applications, mortgages, auto and personal loans, and check viewing and reordering continue to be added.[57]

A few new banks have been created especially for the Internet. Security First Network Bank (SNFB) became the world's first Internet bank in October 1995 and Atlanta Internet Bank followed a little over a year later. The core of the business for both of these banks is remote banking, with the Internet as the center and telephone and ATM access as supplemental services. Two more all-Internet banks are expected to open soon: Georgia-based Rockdale National Bank and Houston-based CompuBank.[58]

In addition to what they are doing on their own, banks and non-financial companies are coming together to create technical standards for communicating and building out the necessary networks to speed the development of online banking.

Integrion Financial Network, an alliance of 18 banks, Visa USA and IBM, intends to seamlessly connect all the devices a consumer might use for banking—telephone, PC, the Web, screen phone or Personal Digital Assistant—to a bank's back-end computer systems. Consumers should be able to access balances, account histories, transfer funds, get transaction information and pay their bills from any of these devices. In time, these capabilities will be enhanced to include bill presentment, stock quotes, interactive loans and other applications. The basic platform is operational; a process is now underway to customize the product at participating banks through 1998. NationsBank and BancOne were the first two banks to go online with Integrion in mid-1997. The participants in Integrion will use a common messaging standard called the Gold Standard.

Intuit, CheckFree and Microsoft are working with other banks and financial institutions on a standard messaging initiative called the Open Financial Exchange. Participating institutions will use the OFX standard for basic banking transactions, bill payment and presentment and investing.

The two groups have publicly committed to making the Gold Standard and the OFX standard compatible and interoperable. Lines are already blurring—a recent 10-year agreement was reached between Integrion and CheckFree, where CheckFree will handle all bill payment for the network.

DRIVERS OF GROWTH

The growth of Internet banking is driven by banks' interest in lowering costs to serve their customers, new competitive pressures and growing consumer acceptance.

Lower operating costs

Banks have vast networks of distribution. In virtually every neighborhood, there's a branch bank, an ATM, or, increasingly, a mini-branch in the grocery store. Banks supplement these physical locations with toll-free numbers, and, more recently, online banking services.

Banks are seeking to reduce operating expenses and to gain competitive advantage by increasing consumer convenience.

James Culberson, President of the American Bankers Association, notes, "transactions through bank branches will decline by nearly one-third by 1998. Already, nearly half of all banking transactions today no longer involve human interaction."[59]

Grocery store banking is on an upswing. These small branches offer the human touch to those customers who want it, they are inexpensive to build—they cost $175,000 to build versus $1-$2 million for a traditional branch bank—and they get a regular flow of customer traffic—an average grocery store gets 12,000-15,000 shoppers who visit 2.5 times a week. In 1986, there were less than 400 grocery stores with in-store banks. Ten years later, 4,400 grocery stores had in-store banks.[60]

Phone banking, also popular, is predicted to increase 50 percent between 1996 and 1998.[61]

The largest banks have started pushing PC banking as a way to reach customers who prefer to do business with them electronically. Eighty-one of the top 150 U.S. banks offer some type of PC banking service, up from 57 in 1996.[62]

Banks see the Internet as one more remote service they can offer to customers who want to bank that way. It has not yet reached a critical mass to impact their operating costs, but expectations of the "early adopters" is that it will.

Based on early 1996 work, Booz-Allen estimates the cost to create a fully functioning Internet banking site—one where customers can check balances online, transfer funds between accounts, pay bills online—to be between $1-$2 million (excluding regulatory capital), or about as much as it would cost to set up a traditional branch.[63] IBM suggests that the price tag is significantly higher: anywhere from $2 million - $10 million, depending on how much work there is to integrate the bank's back-end systems to their Web site.

For banks that outsource online banking to third parties, less expensive solutions are available. Basic online banking solutions created for banks with assets in the $100 million range are available for $20,000-$22,000, with ongoing charges of $1 per user per month for banks that offer bill payment services. For that investment, banks can offer their customers a secure transaction environment where they can view account balances, download data into personal financial management software, pay bills, order checks and stop payments.[64]

Online banking services are much less expensive to offer to customers than any other form of banking. Booz-Allen & Hamilton estimates that it costs about a penny to conduct a banking transaction using the Internet and more than one dollar if it's handled by a teller at a branch bank.[65]

A branch bank can serve as many customers as it has staff to handle. On the Internet, once the site is up and running (assuming it is robust enough to handle the demand), it can handle as few as one customer inquiry to hundreds of thousands a day without additional expense.

Although too early for banks to determine what kind of impact the Internet will have on their overall business, Wells Fargo expects to generate significant cost savings as more than one million of its customers move from higher-cost channels like the branch to lower-cost channels like the Internet by the end of the year 2000.

New Services

Today's online banking allows customers to conduct basic transactions such as checking account balances, transferring funds, and updating customer account information. In the future, banking on the Web has the potential to be much easier and convenient than banking by ATM, by phone or visiting a branch bank. One example is online bill payment.

The ability to pay bills electronically has been around for nearly two decades, but it has really begun to catch on in the past two years, as banks have begun aggressively marketing their home banking products.

In 1995, CheckFree had less than 400,000 electronic bill pay customers. Two years later, the company has 2 million customers, or about 50 percent of the overall market. At present, half of CheckFree's electronically initiated payments are still paid with paper. This is because only a slim percentage of its billers have electronic connections with CheckFree (1,000 out of 3 million

billers). With the goal of increasing the number of billers electronically connected to CheckFree, the company introduced an Internet-based bill presentment and payment service in March 1997.[66]

Another initiative aimed at increasing the electronic connections between billers and payors is MSFDC, a collaborative effort by Microsoft and First Data Corporation. MSFDC has developed a software product that connects the biller, the payee and the bank via the Internet. The company expects the service will attract large companies initially, and smaller companies will follow later.[67]

Figure 6. Online Bill Payment Can Save Billions of Dollars

(Cost to process each bill)

	Today	Online
Cost to biller	$1.65 - $2.70	$0.60 - $1.00
Cost to customer	$0.42	$0
Cost to bank	$0.15 - $0.20	$0.05 - $0.10
Total system cost*	$38 B - $57 B	$11 B- $18.7 B

Potential savings: $19.3 B - $46 B

Source: IBM preliminary estimates.
*Total system cost is determined by multiplying the processing cost by 17 billion checks.

According to a preliminary analysis by IBM, it costs a biller between $1.65-$2.70 each time he sends out a bill - - $0.65-$1.50 to prepare and send out each bill and another $1.00-$1.20 to process the payment once it is received. To pay the bill, his customer writes a paper check, puts it in an envelope and sends it back to the merchant. This costs about $0.42. Then, the bank gets involved, sorting the checks and stamping them, debiting the customer's account and then crediting the merchant's account. This costs about $0.15-$0.20 per bill. In total, simply processing the physical bills and checks costs $38 - $56 billion for the 17 billion bills that flow through the system (Figure 6).

Using the Internet for bill presentment and payment could dramatically reduce the amount of paper-based processing, resulting in potential savings of up to $19 - $46 billion each year.[68]

Changing customer demands and competitive pressures

Personal assets have flowed dramatically out of banks and into asset management firms. In 1976, banks held 25 percent of the $2 trillion market of invested household assets. Today, their share has been cut nearly in half, to just 13 percent.[69]

In order to better compete for consumers' assets, banks have expanded the variety of products and services they offer. In addition to credit card and lending products, some bank Web sites market insurance products, mutual funds, and may offer financial advice. In these instances, the customer

clicks on a button that links the bank's site to another legal entity affiliated with the bank. The appropriate statements of disclosure notify the customer that the products are not FDIC-insured, nor are they obligations of or guaranteed by the bank.

For instance, NationsBank presents retail customers with credit card services, home equity and mortgage lending from its Mortgage Corporation, insurance from a variety of outside carriers, investment services such as mutual funds distributed by Stephens Inc., military banking and PC banking services. Bank of America offers retail customers basic banking products and services, along with mutual funds and other investment products through BA Investment Services. Visitors to the Fleet Financial Group's home page may enter the site through one of several centers: banking, investment, business, mortgage, or borrowing. Through its recent acquisition of Quick & Reilly, Fleet's banking customers now have an online service to trade and track stocks, options, mutual funds and bonds.

The Web customer does not focus on the boundaries between the different companies providing the services; he sees a one-stop shop for financial services. By combining the bank's offering with online financial management tools like Intuit's Quicken or Microsoft's Money, the Web customer can do his budgeting, pay their bills and manage their assets without leaving a Web site.

Consumer Acceptance

Banks are finding that just because they offer a new service does not mean that customers react in the way that the banks would like (that is, move from a higher-cost distribution channel to a lower-cost one); instead, they actually transact more with the bank. According to a senior official at BankBoston, "instead of just going to a branch four times a month, now they go to the branch twice but also go to the ATM six times, call the phone center twice and do PC banking maybe three nights a week."[70]

Banks have begun aggressively marketing lower-cost delivery channels (ATMs, phone banking, online banking) to encourage customers to change their behavior. Sixty percent of them offer lower monthly fees for customers who use low-cost delivery systems.[71] For example, Florida's Barnett Bank announced a $4 a month fee discount to any customers who banked by ATM, phone or online.[72]

Some banks prefer the "stick" to the "carrot" approach. First Chicago NBD is one example. Back in 1995, the bank made a bold move for the industry. After discovering that its most profitable customers "went for self-service" and that tellers were the most expensive way for the bank to service checking accounts, the bank repriced First Chicago's check and savings accounts and started charging for teller services. Other banks considered the move "PR suicide." The approach seems to have generated positive results for First Chicago. The bank reportedly lost less than 1 percent of customers (not the 10 percent others had predicted)—despite some other Chicago-area banks advertising against First Chicago. Branch personnel decreased by 30 percent and ATM

activity "skyrocketed," growing 100 percent in 3 months. NBD announced plans to follow First Chicago's example and will begin instituting teller fees in 1998.[73]

How quickly people will take to doing more of their banking transactions online will depend on their comfort with technology, how much the bank promotes it, whether they feel that online banking offers an advantage in terms of convenience, additional services, or price, and how easy it is to do it.

Figure 7. Reasons for Banking Online

Convenience of day or night access:	93.4%
Getting up-to-date information:	94.7%
Helps balance accounts more easily:	94.1%
Integration with Quicken:	85.9%

May 1997 survey by Genesis Associates of Intuit's online banking customers. Figures reflect % of people who felt the benefit mentioned was important in their decision to bank online.

Intuit, one of the leaders in online banking, sees its online banking service beginning to take off. In the fall of 1995, the company introduced online banking. As of July 1997, over 800,000 of their customers use the service. In fact, more than 25 percent of these customers switched financial institutions in order to be able to use online banking with Intuit's Quicken product.

When asked why they bank online, Intuit's customers cited convenience, keeping up to date with/balancing their accounts, and the integration with Quicken (Figure 7).

The number one reason given by customers who were not banking online was that their financial institution did not offer the service. Banking fees and security concerns were also raised (Figure 8).

Intuit discovered that the people they surveyed often did not know how much their financial institutions charged for online banking. They just assumed the fees were high. (In fact, many online banking services are free.)

Figure 8. Reasons for Not Banking Online

Financial institution doesn't offer it:	60.9%
Haven't gotten around to it:	13.1%
Too expensive:	12.1%
Security concerns:	5.8%

May 1997 survey by Genesis Associates. Figures reflect % of people who felt the reason mentioned was important in their decision not to bank online.

Security, also cited as a concern, ranked lower on the list, with fewer than 6 percent raising it as a concern. Intuit reports that other research it has conducted revealed that security had been a concern of more than three-quarters of its current online banking customers before they started using the service. Once they started using the service, however, the concern faded—98 percent of them reported being comfortable with the online security.

Eighty-eight percent of current PC bankers said they plan to do more online banking in the next 3 years, according to a 1997 survey of consumers by Dove Associates. More than 60 percent of people who did not bank online thought they would begin doing so within that time period.[74]

The Future

Online banking today merely duplicates what can be done through other channels. The market is expected to grow at the point when online services provide an advantage to traditional channels. The ability to pay bills electronically may be enough of a time savings to customer to encourage more of them to bank online. Others may be drawn in by personalized advice and information, online trading services, or the convenience of accessing and seeing their up-to-the-minute account balances and activity presented in a single place.

The more consumers become aware of the benefits of online banking, and the more they understand about how it works, the more people will use it. Many consumers do not know that their financial institution provides online banking,[75] how much it costs, and what precautions are being made to ensure secure transactions. According to the Yankee Group, over 47 percent of all PC households are not aware that their banks offer online services.[76] The greater the consumer awareness, the faster online banking will grow.

Some believe that banks have been waiting until a single standard was created before investing in online banking solutions. The public commitment of the two primary standards for Internet financial transactions—OFX and Integrion's Gold Standard—to be interoperable will likely spur more financial institutions to act.

WELLS FARGO ONLINE BUSINESS

Wells Fargo, one of the nation's largest banks, has physical locations in 10 states and manages roughly $109 billion in assets.

To meet changing customer preferences and to lower operating costs, the bank has introduced new distribution channels for retail banking:

- *Telephone banking*: more than 400,000 customers call Wells Fargo's toll-free number each day. The company estimates that for every 2 million transactions moved from a branch to a telephone operator saves $15 million, or $7.50 per transaction.[77]

- *Grocery store branches*: Wells has closed many traditional full-service branches in favor of smaller, less-expensive grocery store branches.

- *Online banking*: for customers who prefer the convenience of in-home banking, Wells started offering PC banking services in 1989. Its initial launch with Prodigy and a proprietary direct dial-up offering generated little interest. The addition of Microsoft Money, Intuit's Quicken and its own Web site in 1995 really kicked off Wells' online banking business. By December 1997, over 430,000 customers were online with Wells.

Back in 1992 and 1993, Wells began the information systems work it would eventually use to provide the backbone of its Web and online banking services. Up until that point, data about a customer's checking account, savings account and other accounts had been stored and reported separately. Most customers received one statement for checking, another for savings, and so on. In the mid-1990s, Wells invested in a new object-oriented infrastructure supplied on a TCP/IP network that would poll the bank's different computer systems in real-time and build a complete customer profile. Today, the bank can see a customer's entire relationship with the bank and the customer receives a consolidated statement across all of the accounts he maintains with the bank.

In developing its online banking strategy, the bank surveyed its customers and determined that they not only wanted to conduct basic banking transactions, they also wanted a core financial services product for record keeping, taxes and budgeting. Wells therefore developed a solution incorporating Microsoft Money and Intuit's Quicken software packages.

Wells also decided to experiment with the Internet. The bank launched an information-only Web site in December 1994. By May 1995, Wells became the first bank to offer its customers access to account balances online.

Today, customers can access account balances and transaction history, transfer funds between accounts, pay all of their bills, apply for new accounts, and order travelers checks, cashiers checks and foreign currency online. Internet banking is free.[78] Bill paying services cost $5 per month, with the fee waived for Internet customers with balances of $5,000 or greater.

Wells recently announced its plans for an integrated bill presentment and payment pilot with MSFDC in early 1998, with the aim of rolling it out to customers within the year. The new offering will be free of charge.

Small business banking

Wells began offering Internet payment services to businesses in late 1996. Its product targeted at the small business market, Business Gateway, sells for $14.94 and includes a $5 monthly fee. Developed to work over corporate intranets, authorized users can transfer funds between accounts, access balances and transactions details, and send e-mail to Wells. As of November 1997, about 1,200 of Wells' total base of 80,000 merchants accepted payments on the Internet.

The bank is also exploring options to let small merchants view their card-related activity and transfer funds from the acquiring account to their checking accounts on the Internet.[79]

Benefits of online banking

- *More profitable customers*: According to the bank, customers who bank online today have higher balances and are more profitable than customers using traditional channels.

- *Better customer retention*: Banking experts say it costs twice as much to acquire a new bank customer as it does to retain an existing one. Wells has been able to keep online customers at higher rates than their other customers.[80]

- *Lower costs***:** By the end of 2000, Wells expects to have more than 1 million online customers. As its customers move from high-cost channels like the branch to low-cost channels like the Internet, Wells expects to recognize significant savings per transaction.

- *Real-time response***:** The Internet gives the bank real-time feedback of what works and what does not. Making a change in the way a product is presented on the Internet does not require creating new written pamphlets and distributing them. New text can be communicated to thousands of people within the time it takes to get the wording onto the Web site. And, the site can be tailored to meet the needs of the individual banking at the time. Such flexibility and customization is not possible in other distribution channels.

- *One-to-one marketing***:** Wells has integrated the data from its different databases, and therefore has a customer's profile when he visits the bank's Web site. Wells can match the profile to products and services it currently offers or can offer via a third party. Over time, Wells plans to use the Web to target offers to individual customers. At this early stage, the bank has only just begun to explore its potential.

INSURANCE

Individuals can find information about and purchase an array of insurance policies from insurance carriers, banks, securities brokerages, real estate companies and automobile marketplaces on the Internet.

In early 1997, 81 percent of leading insurers had at least one Web site. All planned to have one within a year. Most of these sites provide sales and marketing information, along with basic tools to help customers determine their insurance needs. In order to receive a quote or purchase a policy, however, customers must have contact with an offline agent. To do more than that, insurers would need to link their Web sites to the computer systems that drive their business. Only 10 percent of insurers have these needed links.[81]

Internet customers may also shop for insurance through bank Web sites. NationsBank and Chase Manhattan have insurance affiliates that market term life policies underwritten by insurance companies. Customers on the NationsBank site can receive real-time, online quotes and have the possibility to begin the application process online; Chase customers complete an online questionnaire requesting a quote and a representative either calls or sends an e-mail to the customer within 2-3 business days.

Charles Schwab's online securities brokerage not only enables investors to buy and sell stocks online, it also distributes term life insurance underwritten and issued by Zurich Life Insurance Company of America and universal life policies underwritten by Great-West Life & Annuity Insurance. Investors using Quote.com's Web site, an all-purpose financial market data site, with quotes on stocks, options, commodity futures, mutual funds and other financial news and information can also enter an insurance center and receive online quotes for life insurance and annuities.

InsWeb, an Internet-based insurance marketplace offers online quotes or contact information from 10 carriers selling auto insurance, 3 carriers selling term life insurance, and a few carriers selling health, professional liability and disability income insurance. The level of automation varies by type of policy and insurance carrier. For instance, Nationwide Insurance gives online automobile insurance quotes to potential customers in California. AIG, American Express Property & Casualty and TIG Insurance have customers complete a basic questionnaire online but then send their automobile insurance quotes via e-mail. Zurich Kemper and Lincoln Benefit Life offer online quotes for term life. Interested customers can request an application and be contacted by a representative.

Insurance policies are also sold when buying a car or a shopping for a home online. Auto-by-Tel new and used car shoppers can purchase auto insurance through a direct link to AIG Auto

Insurance. Although not yet widely in practice, some full-service real estate Web sites, including Newhomesale.com, have links to agents selling homeowners' insurance. Over time, as the practice of offering consumers one-stop shopping for new vehicles and homes expands, more sites are expected to offer insurance as part of the complete package.

By 2001, about $1.1 billion in premiums will be generated via the Internet, the vast majority from automobile insurance (Figure 9).[82]

Figure 9. Personal Insurance Premiums to Surpass $1 billion by 2001

	1997	2001
Auto	$21 M	$850 M
Term Life	$17 M	$108 M
Homeowner	$1.1 M	$152 M
Total	$39.1 M	$1.1 B

Source: Forrester Research

DRIVERS OF GROWTH

The insurance industry will begin to use the Internet in order to lower distribution costs, meet challenges posed by new competition and deregulation, and to meet changing customer preferences.

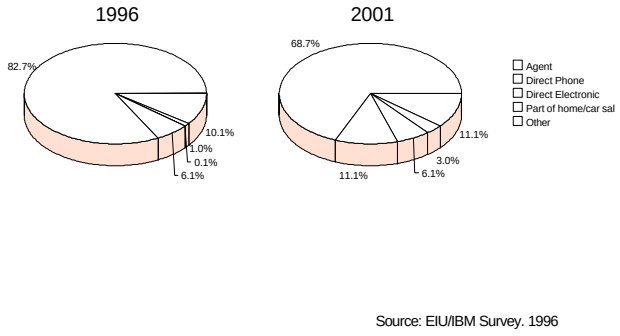
Lowering distribution costs

Core property and casualty (P&C) and life insurance businesses have experienced little to no growth over the last several years and their operating cost structures have not improved.[83] Life and P&C insurers have long used agents and brokers to sell their products. In the case of life insurance, this selling system is characterized by productivity that has not improved in 20 years: an agent still sells one policy per week. Low productivity translates into distribution costs as high as 33 percent or more of the product's price.[84]

According to an Economist Intelligence Unit Ltd. (EIU)/IBM survey of insurance executives, less than one-third of insurers report being "highly confident" or "confident" that their current product distribution methods are the right ones. More than a third are "less than confident" or "not confident at all" about it. In the next 5 years, they plan to make some changes. Direct sales by phone and the Internet will increase from just over 6 percent today to 17 percent in 5 years (Figure 10).[85]

Selling and servicing policies via the Internet has the potential to greatly reduce sales and distribution costs. Booz-Allen & Hamilton estimates that P&C, health and life insurers selling and providing customer service over the Internet will have a cost advantage of as much as 58-71 percent versus those using agents and telephone call centers.[86]

Figure 10. Insurers Expect to Sell More Policies by Phone and Internet in 2001



Source: EIU/IBM Survey. 1996

Online, the customer does much of the work himself. Through policy information and online financial tools, he can determine which policy is right for his needs. He then completes an application and may purchase the policy online. The Internet could also be used to handle customer service, billing and payment functions. The more of these functions available online, the more the insurer can ultimately save.

For a direct online sale by the carrier, the agent commission is avoided. If the sale is through an online agent, the commission is cut by more than half.

Application and underwriting processes involve many time-consuming, manual steps that could be made more efficient by electronic communications. Electronic linkages with third parties such as the Department of Motor Vehicles, medical technicians, hospitals and others should minimize time and labor involved in the application and underwriting process.

The process of servicing the policy can also be streamlined through the Internet. Basic customer service functions can be put online such as giving customers the ability to update their own customer profiles, locate service providers, or track the status of a claim. Even billing and payment processing will be done more efficiently as customers have the ability to transfer funds electronically from a bank account when a premium payment is due or a deductible must be paid. Most of these services are not yet available online, but are expected to be offered soon.

New competition/changing relationships

Banks and securities brokerages are getting into the business of selling insurance in their aim to be the one-stop shop for consumers' financial services needs.

In the mid- to late-1980s, banks began offering annuities and other insurance products to stanch the flow of deposit dollars to insurance companies and brokerage firms.[87] Some banks have taken this online.

According to Ernst & Young, insurers do not want banks underwriting insurance, but a growing number of them do not mind banks distributing insurance products for a few key reasons: 1) the banks' branch network would allow them to reach virtually every neighborhood in the U.S.; 2) unlike insurers' databases which record information by policy rather than by customer, banks' sophisticated customer databases give them tools to match customers' needs with products; 3) consumer surveys show that the general public tends to be more trusting of, and therefore more receptive to, bankers than insurance agents.

Securities brokerages have also started selling insurance products through traditional offline brokers and, more recently, through their online services.

Whether through alliances with insurers or in direct competition with them for business, how aggressively banks and securities brokerages enter the insurance business will have an impact on the existing insurance industry. It's likely to have an impact on their online strategies as well: Banks are moving more quickly than insurance companies to embrace new technology: by year-end 1997, 80 percent of the top 20 banks will offer electronic transaction processing, 45 percent will offer Internet transaction processing. Only 15 percent of the top insurers plan to do so.[88]

New Sales Opportunities

Surveys of consumers reveal that a vast, under-served middle market of potential insurance buyers hasn't been reached by traditional insurance sales methods.[89] Because of the time they have to invest to sign up a new customer and because their compensation is based on the size of the premium, agents tend to focus on clients they believe will buy larger policies. Penetration among customer segments that buy smaller policies is therefore lower.

The low cost of sales and marketing through the Internet has the potential to extend insurers' reach into previously under-served customer segments.

Changing customer preferences

Insurance executives expect their customers' insurance needs and expectations to change significantly in the next five years. Today, they believe that only 2 percent of their customers prefer the Internet to an agent when purchasing auto and term life policies. In five years' time, more than 40 percent believe their customers will prefer using the Internet to purchase these policies.[90]

Customers will want to go online to get product information and quotes, pay premiums, compare prices, access and update their policy information, access their claims status, and get advice from financial service experts.

Most insurers feel comfortable giving product information online and already do, or plan to do so. However, fewer than half plan to provide the other services online, and just over 30 percent plan to let their customers buy a policy online.[91]

Customers will increasingly view insurance as part of an overall financial portfolio, not as a distinct product. Like banks and securities brokerages, insurers are expanding their product lines. As an example, Prudential's Web site combines insurance, retirement planning, education funding, health care, investing, real estate, banking services, estate planning under one umbrella called "personal investments and insurance."

The Future

In spite of their belief that the Internet will be a driving force of change in their industry and their belief that it is a good sales channel for simple products like term life, home owner and car insurance, most insurers remain cautious in their use of the Internet.

That caution is fueled by a requirement to invest in integrating their Web sites with the computer systems that drive their business. Very few have made the necessary investments.

Their caution is fueled by a perceived conflict with their existing sales channel. Insurers worry about how their own agents and independent agents will respond if they move aggressively to offer online transactions over the Internet. If the independent agents feel threatened, they might drive business to other insurers.

State regulations also contribute to the caution. Existing state regulations that add cost to online insurance businesses could inhibit the growth of online insurance. These include: a requirement to be licensed in every state in which the on-line company conducts business; a requirement for a "wet" (paper-based) signature in addition to the on-line signature; a requirement in some states to employ local agents to solicit business; and a requirement to register all new products and product changes with each state insurance commissioner.

If the market for online insurance is large enough, competition from other industries may drive the speed at which it develops. If customers increasingly look for one-stop shopping for their financial service needs, businesses like securities brokerages and banks that offer insurance sales online may pressure traditional insurers to follow suit.

QUICKEN INSUREMARKET

The Quicken® InsureMarket® service, owned and operated by Interactive Insurance Service Corp. (IIS), a wholly owned subsidiary of Intuit Inc., began operations on the Internet in October 1996. In Quicken InsureMarket's first 12 months of operation, $500 million in life insurance coverage was sold through the term life marketplace. Today, Quicken InsureMarket customers across the United States can shop for life insurance, auto insurance, homeowners insurance, disability income or long-term care insurance.

As with other Web sites, the site visitor chooses where to begin. The "Insurance Planner" is a logical first step for someone wishing to get a general assessment of his insurance needs. Upon completing a basic questionnaire about age, income, family situation, health, home ownership and existing insurance coverage, a software program processes the information and, in moments, presents the site visitor with a prioritized list of his insurance needs.

Site visitors in the market for life insurance can learn about the differences between term life, variable, universal or universal variable policies by answering a few simple questions. If a site visitor decides he is interested in purchasing a policy, he can then contact an agent, and, in the case of term life insurance, get personalized quotes or apply for a term life policy online.

Clicking on the "Easy Quote" button is like entering a "store" for term life insurance. Information the site visitor supplies—zip code, age, health, income, family status, and desired insurance coverage—can generate personalized quotes from up to seven carriers (from among Zurich Direct, John Hancock Marketplace, Prudential, Transamerica Occidental Life, Lincoln Benefit Life, Ohio National and Travelers Life) and up to four agent contact options (Prudential, State Farm, Met Life and AllState). The system randomly generates the order of the insurance carriers providing quotes and agent referrals the site visitor sees so as not to give an advantage of the best "shelf space" to any one carrier. A visitor's zip code is used as a filter so that information is provided only from carriers licensed and willing to sell insurance in that state. The visitor can also access a Web page with detailed information about the policy and the carrier, including how independent sources such as A.M. Best, Moody's, Standard and Poor's and Duff & Phelps rate the carrier, how many years it's been in business, total assets and the amount of insurance in force.

Depending on the carrier the customer chooses, the application process and method of payment differs. One carrier's highly automated application process permits the customer to begin the application on line, schedule an appointment for a medical exam, and submit the first installment of the premium on-line either by credit card or using a billing option. The policy is often received by the customer as quickly as four to six weeks after the exam. For the other carriers, a representative from the carrier contacts the customer to complete the application and schedule the medical exam.

Quicken InsureMarket site visitors can also access information about other types of insurance and be put in touch with agents to apply for and purchase policies. For instance, a visitor can go into

the "home insurance basics" area online to learn about homeowner's, renter's and condo or co-op owner's insurance policies, coverages, features about the home or apartment that affect the rate of the premium, and steps that can be taken to lower the premium. The auto insurance marketplace provides that information and also pulls together information from sources including the Federal Bureau of Investigation, the Insurance Research Council and others to advise the visitor about his level of risk for injury, theft, and accidents, given where he lives and what kind of car he drives. At the beginning of 1998, Quicken InsureMarket offered online auto insurance quotes and transactions in one state and referrals to insurance agents in fifty states. Over the upcoming months, Quicken InsureMarket will expand this service to customers in additional states.

Benefits to Business

Insurance carriers that offer their term life products today via the Quicken InsureMarket Web site benefit from real-time sales and lead generation, enhanced customer service through the company's toll-free number, and direct marketing links to Quicken.com with its tens of millions of site visitors monthly. Insurance carriers can potentially save hundreds of dollars for each policy sold online.

Internet Distribution Costs 50-100% Less Than Selling Through Traditional Agents

Traditional agent fee:	$400-700
InsureMarket fee:	$200-350
Savings:	$200-350/policy

Source: InsureMarket estimates, based on figures for term life policy of $400,000 with $700 annual premium

Benefits to Consumers

Quicken InsureMarket offers one-stop shopping for insurance products and information. A visitor to the site can compare policies, receive real-time quotes and purchase online or through an insurance agent.

Consumers may benefit from lower prices than they might have found elsewhere, simply because of the ability to comparison shop on InsureMarket's site. As online competition increases and the share of the insurance company's online business grows, and as consumers are able to more easily compare insurance prices, insurance prices for consumers are likely to come down.

Future plans

IIS launched its Quicken InsureMarket auto insurance service in early 1998 and plans to enhance it over the upcoming months. IIS also plans to add home, annuities, long-term care, disability and business insurance marketplaces to the Web site.

Quicken InsureMarket anticipates that more of its existing and future insurance carrier partners will enable customers to purchase policies online. Quicken InsureMarket will help streamline the application process by knitting together the customer, the carrier and the third-party sources necessary for completing the application process. For instance, instead of having to make a separate call to schedule a medical exam, the customer may be linked directly to a local paramedic, find a convenient time and schedule the appointment online. Similarly, a customer applying for auto insurance may not have to wait until his driving record is pulled from the Department of Motor Vehicles (DMV). With an online link to a DMV's records, the carrier will have that information in close to real time so that the application can be processed more quickly.

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Media	$0.9B	$1.9B	$3B	$4.4B	$5.8B	$7.7B
Direct mkting	$0.1B	$0.2B	$0.4B	$0.6B	$0.9B	$1.3B

Total	$1B	$2.1B	$3.3B	$5B	$6.7B	$9B

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FORRESTER	NA	$654 M	$1.5 B	$2.8 B	$4.7 B	$7.4 B	NA
ROBERTSON STEPHENS	$150 M	$500 M	$1 B	$1.6 B	$2.6 B	NA	NA

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APPENDIX 5

RETAIL OF TANGIBLE GOODS: ANALYSIS AND CASE STUDIES

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RETAIL OF TANGIBLE GOODS: ANALYSIS AND CASE STUDIES

FIGURES

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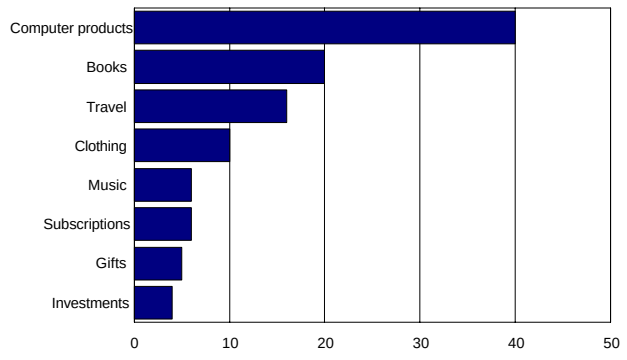
In 1994 and 1995, very few retailers were present on the Internet. Large information technology companies including IBM, MCI, and media giant Time Warner, established "cybermalls" early on and attempted to rent virtual space to interested retailers. Start-ups like Amazon.com, CDNow and N2K, Peapod, and Virtual Vineyards saw an opportunity to become the first Internet retailers in their specialty market segments of books, music, groceries and wine. These new Internet-only businesses had a head start of one to two years during which they invested heavily to build a brand image and gain market share before super retailers like Walmart, Barnes and Noble, the Gap, and J.C. Penney equipped their Web sites with a sales capability.

Today, even though Internet retail still represents but a small fraction of total retail, Internet consumers have a wide variety of shopping alternatives and products from which to choose. They can access sites that specialize in books, computer goods, groceries, music, magazines, hosiery, sporting goods, candles, flowers, and a range of other products. These sites may be sponsored by well-known store-based retailers, manufacturers, media companies, or wholesalers; they may be hosted by information technology companies present only on the Internet or via a toll-free telephone number.

Figure 1. What Do People Buy on the Net?



Source: Forrester Research

With sales topping $850 million in 1997, PC hardware and software is the largest specialty retailing area on the Internet.[1] Consumers can shop for desktop computers, notebooks, software and accessories direct from the manufacturer, via a reseller, well-known retailers with large store networks and new retailers with a presence limited to the Internet. Egghead.com, a $361 million computer reseller,[2] began offering hardware and software products from its Web site in February 1996; nine months later, consumers could directly download selected software products to their PCs. In January 1998, Egghead announced that it would close its network of retail stores and stake its future on Internet commerce.

Books and music are other large categories of Internet commerce (Figure 1). Amazon.com closed 1997 with sales of $148 million. Barnes and Noble reports that its Web-based business, launched in mid-May 1997, generated about $14 million during its first nine months of business. The company expects its 1998 sales to exceed $100 million.[3]

N2K and CDNow, two of the largest music sites, posted $6.5 million and $9.5 million in net revenues respectively for the first nine months of 1997. N2K's full-year 1996 revenues were just under $1.7 million; CDNow's were $6.3 million.[4]

Gifts and flowers are other important Internet retail categories. 1-800-FLOWERS had online sales of $30 million during 1997, for 10 percent of the company's total revenues. Garden Escape, a Web site selling plants, gardening supplies, tools and equipment, reports that its sales have been growing 30-40 percent every month since its fall 1995 launch.

Hallmark, the world's leading creator and marketer of greeting cards and personal expression products, recently launched its site in December 1997, offering more than 1,100 cards and 100 multimedia/animated greeting cards, gifts, and other services.

Super retailers like Walmart and direct marketer, Cendant Corporation (formerly CUC International), present consumers with one-stop shopping under one roof. Both companies' Web sites offer a vast selection of products across different product categories. As in its stores, shopping at Walmart.com is free of charge, and consumers can choose to make single or bulk purchases. Shoppers at Cendant's netMarket pay a $69 annual membership fee in order to purchase from their selection of over 1 million products.[5]

Not only have specialty and mass-market retailers established Web presences; businesses that do not traditionally compete for consumer retail spending have also established consumer-oriented Web sites.

Online service providers like America Online (AOL) and Earthlink Network, search engines like Yahoo! and Excite, and content businesses like Time Warner's Pathfinder bring together leading retailers for one-stop shopping, commonly organized by product type (books, computers, consumer electronics, furniture, etc.) and type of retailer (department store, mass merchandiser). In order to participate, retailers pay these companies some combination of rent, transaction and advertising fees.

For instance, tenants that qualify as "anchors" (a concept akin to department stores in shopping malls) on AOL's Shopping Channel pay for prominent placement in the Shopping Channel and advertising rotations to AOL's more than 11 million members. AOL also has exclusive advertising partnerships with retailers such as Barnes & Noble and the Cendant Corporation. For tens of millions of dollars over a multiyear period, AOL reserves the shopping space in particular product categories for these partners, advertises and markets their products on AOL's online service and/or aol.com, and participates with them in joint technical development and research.

Excite and Yahoo! hope to make the shopping experience more convenient for the consumer by providing intelligent software agents that scan the product databases of participating retailers and present only those that carry a particular product. The agent saves the consumer the time and effort he otherwise would have spent "visiting" each Web site in search of the product. The agent also presents price and delivery information that allows the consumer to comparison shop, weighing price, brand and availability when making the decision to purchase.

Internet consumers can participate in virtual auctions at sites like Onsale and First Auction. These sites combine entertainment and shopping, with real-time auctions that take place 24 hours a day, each one lasting for a few hours. Bidders compete with each other for a limited number of products, bidding the price up at set increments. In the past, the products offered at auction sites were limited to computer products and consumer electronics; today, bidders can also take home golf clubs, jewelry, clothing and a variety of other products.

Even buying a car—more of an investment than a typical retail purchase—is possible through a number of auto marketplaces, online classified sites, and manufacturers' own sites. Web shoppers can view pictures of different car models and read extensive information on the car's features, performance and reviews. Financing and insurance options are also available online. The existing distribution system and franchising laws require that a licensed dealer closes the transaction, so today's Internet-based businesses have direct links to dealership sites or send leads to dealerships who follow up with interested customers.

JD Power & Associates estimates that about 10 percent of all new car and truck buyers used the Internet as part of their shopping process in 1996. By 2000, at least 21 percent of all new car and truck buyers will use the Internet.[6]

The National Automobile Dealers Association (NADA), which represents more than 20,000 car dealers nationwide, reports that more than half of new-car dealerships have a Web site. Forty percent of the remainder plan to launch one within six months. Dealers with Web sites sell five cars a month on average over the Internet—double the number a year ago. Consumers use the sites to access vehicle inventory information, schedule sales appointments, order new and used cars, and apply for financing (Figure 2).[7]

Figure 2. What Consumers Can Do at Auto Dealers' Web Sites*

Access vehicle inventory	>50%
Schedule sales appointment	28%
Order new and used cars	22%
Apply for financing	26%

*Chart represents percent of dealer sites offering a given feature.
Source: National Automobile Dealers Association, October 1997

The largest volume of car sales is being driven by car marketplaces, like Auto-by-Tel, AutoVantage, AutoWeb and CarPoint. These services charge participating dealerships fees for listing their cars on the service.

Auto-By-Tel works with 2,700 dealers nationwide and refers more than 100,000 purchase requests to them each month. The company currently generates over $500 million in vehicle sales per month, or $6 billion on an annualized basis.

AutoVantage, owned by the Cendant Corporation, reports that it works with 1,000 dealerships nationwide and refers 30,000 customers to them each month.[8]

AutoWeb, a service based in Santa Clara, CA, has a network of 1,200 dealers in the U.S. and Canada and refers 110,000 purchase requests per month, up from 15,000 per month a year ago. In November 1997, the company announced its one millionth purchase request.[9]

Analysts estimate Internet retail at between $1.3 - $4 billion for 1997, a fraction of the $2.5 trillion consumer retail market. By the year 2000, U.S. online consumer retail could be as little as $7 billion or as high $37 billion.[10] If mail order sales are used as an indication of the potential for Internet retailing, as some suggest, the figure could reach $115 billion in five to eight years.[11] Some who offer this comparison to mail order believe that the Internet has three advantages over that channel. It offers consumers a more complete assortment, better and more complete information, and over the long term, better prices.

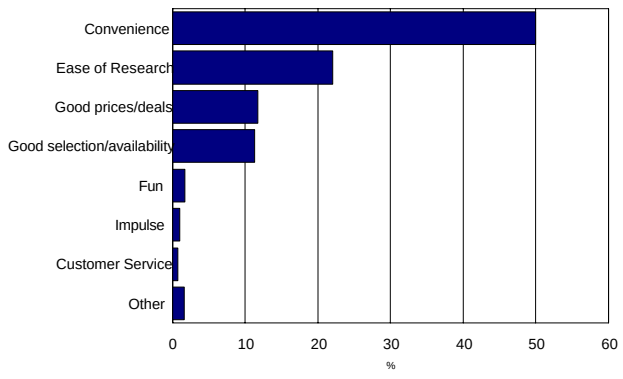
The growth of online consumer retail is being driven by cost savings, the ability to customize marketing, and increased consumer demand.

Consumer Demand

According to a Fall 1997 survey conducted by CommerceNet and Nielsen, 10 million people in the U.S. and Canada have used the Internet to make a purchase. This represents almost a doubling from their survey conducted six months earlier, when they found 5.6 million purchasers among the Internet users in North America.[12]

A larger number of people use the Internet to shop before making a purchase offline. A recent study by Ernst & Young shows that 64 percent of Internet users research products online and then buy them at stores or by telephone.[13]

Figure 3. Reasons Why People Shop Online



Source: Forrester Research

AOL reports that 79 percent of its members have window-shopped for products and services online. Forty-two percent have made purchases online at some point.[14]

When asked why they use the Internet to make a purchase, Internet users cite convenience. (In fact, 40 percent of the transactions made with retailers on AOL are made during hours when traditional malls are closed.[15]) Ease of research and good prices rank a distant second and third in the order of reasons given (Figure 3).[16]

Lower Operating Costs

Virtual stores report lower operating costs than their physical counterparts. They typically limit their operations to advertising and marketing, site content, establishing relationships with manufacturers or distributors, accounting functions and customer service. Rent and depreciation, store personnel, utilities and other expenses of a physical store infrastructure are almost entirely avoided. Internet-only stores may not even take possession of the goods, leaving fulfillment activities—warehousing and distribution functions—to third parties. More than one-fourth of Web sellers currently outsource these functions.[17]

NECX Direct, an online computer products store, is linked electronically to two distributors, Ingram and Merisel, which ship orders directly from their warehouses. Ordering, payment, invoicing and inventory management are handled electronically. It cost NECX Direct about $1 million to establish its Web site. The online division operates with a staff of 40 employees, including a Webmaster and developers, networking staff, graphics designers, telephone sales and support personnel, merchandisers, buyers and management. The company reports that its online operating model is cheaper than traditional mediums because fewer people are involved in each transaction.[18]

Comparing Amazon.com to a large traditional bookseller illustrates some key differences in an Internet-versus-physical-store business model. During the fall of 1997, Amazon's gross margin (retail sales minus cost of goods sold) was 19.5 percent of retail sales compared to this retailer's 36.7 percent.[19] The traditional retailer purchases its books from publishers and benefits from discounts due to its large sales volume. Up until very recently, Amazon purchased its books almost exclusively from wholesalers, paying markups the traditional retailer largely avoids. Aggressive price discounting online further erodes the gross margin of the online retailer. Amazon has recently begun to purchase more titles directly from publishers to reduce its purchasing cost.

As a virtual retailer, Amazon has no physical store infrastructure. Rent and depreciation represent less than 4 percent of Amazon's sales compared to 13 percent for the traditional retailer, and its labor costs are lower as a percentage of sales. Amazon has less capital tied up in inventory: its books turn 20-40 times per year versus two to two-and-a-half times per year for the traditional retailer. On the other hand, Amazon's advertising and marketing costs have been high relative to

its sales volume. In a new and rapidly growing market, it is not unusual for companies to invest heavily to build a brand and capture market share. Over time, as sales volumes increase, advertising and marketing expenses decline as a percent of sales.

Distribution requirements differ greatly for traditional store retailers and companies selling through the Internet. Large store retailers purchase large quantities of a single item and deliver them in pallet (large) quantities to a warehouse or directly to a store. Rarely do they deliver goods one-by-one to a customer's home or office. Internet retailers, on the other hand, require a distribution system that moves goods from a manufacturer or a warehouse to a customer's home, typically within a week or less.

Just as in mail order purchases, the Internet customer typically pays the full charge for the home delivery service. Depending on the method of shipment, home delivery can add significantly to the price of the product.[20] The high cost of delivery will likely have an influence on the way customers shop: rather than purchasing one item at a time, they will bundle several items in a single purchase to save on delivery charges. Over time, delivery charges will decrease as the volume of Internet retail increases. Like their larger store-based counterparts, Internet businesses will benefit from the economies of shipping larger quantities to a given geographic area and then distributing them locally, and likely pass these savings on to their consumers.

Direct marketers that sell via the Internet report lower operating costs versus their telephone and catalog sales operations. The Cendant Corporation reports that it loses $9 per new member in its telesales operation during the first year of membership when it factors in the sales and marketing expenses to acquire that new member. Because of its lower sales and marketing costs to acquire new Internet members, Cendant makes a profit of $10 for each new member in the first year. By the second year of membership, Cendant makes $30 per member in telesales and $40 per Internet member.

One-to-one Marketing

A shopkeeper in a small store may remember the purchases of his regular customers. A salesperson in a large store with customer traffic that changes daily has a very difficult time keeping track of a customer's purchases to be able to make individual recommendations.

Though not yet widely in practice, the Internet offers the opportunity to profitably market directly to narrow bands of customers, and even to market to customers one-by-one. Software programs detect when an individual customer enters a Web site, greeting the customer by name, much as a neighborhood shopkeeper might recognize a regular customer. Querying one or more databases reveals that the customer has recently purchased a pair of blue jeans and an Extra-large sweater or books on the topic of travel in Italy. On the Internet, the store might prompt the customer to purchase another sweater in a similar style or a shirt to go underneath the sweater. It might notify the customer when new travel books have been published, or suggest books on Renaissance art.

Researchers are working to develop software agents that learn the behaviors and preferences of individuals. As these technologies become more sophisticated, Internet businesses are likely to employ them to assist in one-to-one marketing.

If Web users become convinced that businesses will protect their privacy at the same time they make targeted offers, one-to-one marketing will become commonplace.

The Future

The retail sale of tangible goods on the Internet is likely to grow more slowly than business-to-business Internet commerce or commerce of goods and services that can be delivered digitally. How quickly it evolves will depend on consumers' trust of the medium, the sophistication and efficiency of distribution, and the speed at which the Internet becomes a mass market.

The most frequent complaint from online shoppers is that finding and buying things on the Internet is slow and complex. Some of that is due to delays in accessing information because of slow modems. Some of it is due to sites that are poorly organized, making it difficult to find things.[21] As bandwidth to the home increases, delays should be minimized. Search and categorization tools currently being developed should make navigating the Internet easier and more intuitive for users.

The tools are not yet in place to authenticate Internet businesses or to safeguard privacy. Leading Internet retailers worry that bad actors may lead to a backlash against the industry. Without authentication tools, a site can claim to be a retailer, but not be legitimate. A site may abuse a customer's privacy by collecting and sharing information without the individual's knowledge or consent. Or, a retailer might sell a customer a product but provide inadequate customer service.

As digital signature and certification authorities become widespread, and as privacy guidelines are more widely adopted, consumers will have better information and more control over where they shop. Industry groups like shop.org, launched in 1996 by leading Internet retailers, and others, have been formed to establish and promote good business practices for Internet retailers to ensure consumers have a problem-free online shopping experience.

Some consumers still fear giving their credit card online. Ernst & Young discovered that 68 percent of consumers who have yet to make a Web purchase say they are uncomfortable sending their credit-card numbers across the Internet. To address these concerns, a new industry in security services has been developing. Ernst & Young estimates that the market for firewalls and encryption was approximately $1 billion in 1996 and is projected to grow to $5 billion by 2000.[22]

Industry efforts to improve security through encryption like Secure Sockets Layer (SSL) and the newer Secure Electronic Transaction (SET) appear to be making an impact. 1-800-Flowers reports that fewer than one-third of its customers worry about credit card security, compared to

almost 75 percent last year.[23]

The growth of Internet retail will also depend on how quickly retailers and manufacturers establish a presence on the Web. Most of them have a Web presence, but it tends to be limited to information about the company and store locations. Only 12 percent of retailers and 9 percent of manufacturers currently sell via the Internet.[24] Few have the experience or the infrastructure to deliver orders directly to end customers. In addition, selling online is likely to have an impact on their existing store sales and, in the case of manufacturers, their relationships with wholesalers and retailers.

Web sites marketing cars describe the uncertainty of the legal and regulatory environment as another potential inhibitor to the growth of Internet commerce. If a state interprets the business model of an online auto marketplace as functioning like a brokerage, the marketplace will have to become licensed in every state and modify its business practices, or shut down in that state. If, on the other hand, a state interprets the business as an advertiser or marketer, the licensing requirements would not apply. How and whether an auto site can offer financing and insurance also centers around how states interpret their role.

Online auction sites raise other regulatory questions. Many states have statutes governing offline auctions, requiring professional licensing of auctioneers and registration of the auction with local authorities. In many states, municipalities are also authorized to regulate and/or license auctions. Online auctions differ from physical auctions in that bids placed in an online auction may come in from many different states, not just a single location. In addition, the frequency of online auctions (sites operate 24 hours a day and new auctions begin as frequently as every few minutes), for example, would prohibit the business from registering each auction with local authorities.

Most of these concerns are expected to be addressed as the market develops. Some will be addressed by technological advances; others by competitive dynamics and government action.

AMAZON.COM

From little more than a concept two and a half years ago, Amazon.com has grown to a $148 million business with customers in more than 150 countries, attracting them with a choice of 2.5 million titles, discounts of up to 40 percent, and search tools and book reviews that Amazon hopes make buying a book that much easier. By the end of 1997, over 1.5 million customers had shopped at Amazon.

Amazon is not a traditional bookseller. It has no physical stores, so it does not support the cost of the space and the labor to staff the stores. Moreover, because it is not constrained by physical space, Amazon offers a selection of books much greater than any single traditional bookstore. Amazon tries to find its customers any book a customer might request, whether in print or out of print, promising to get the book for them within a couple of days (for those in print) or as quickly as they can find it (for those out of print).

At the same time, Amazon shares typical retailers' goals of attracting and keeping customers. As a young company, Amazon spends heavily on advertising and marketing to build its brand name. It draws visitors to the store through advertising, both on the Web and off. But getting someone into the store is only part of the battle. Amazon believes that making the shopping experience as intuitive and enjoyable as possible is what turns the visitor into a customer. Amazon's sophisticated online search tools let the visitor quickly navigate the vast selection of books to find a specific author and title; they also let visitors take their time to browse through subject areas. Brief descriptions and book reviews give additional information a potential buyer might need to make a purchase. These tools, combined with a very simple and quick check-out process, help convert window shoppers into customers. Amazon recorded its millionth customer in October, 1997 then attracted another 500,000 by the time the year drew to a close. And customers appear to be satisfied with the experience: 58 percent of Amazon's orders come from repeat customers.

Because a customer does not walk into the store, pick up the book and carry it home, Amazon has more work to do once the sale is made to get the book to the customer's home or office. In its early days, Amazon relied almost exclusively on large book wholesalers like Ingram and Baker and Taylor for its inventory. Amazon's Seattle warehouse stocked only a couple thousand titles. As the company has grown larger, its strategy for order fulfillment is changing. To drive down cost and to meet its corporate goal of shipping 95 percent of its orders the same day, Amazon has begun to increase the inventory it keeps on hand. Rather than pay the additional markups that the wholesalers charge, Amazon now purchases some of its titles directly from publishers and stocks them in an expanded Seattle warehouse and a second warehouse in Delaware. At the close of 1997, Amazon's warehouses stocked more than 700,000 books, including partially filled orders.

Amazon believes that it has an inherent cost advantage versus traditional book sellers. Because Amazon does not support a physical store infrastructure, it benefits from lower rent and depreciation and lower labor costs relative to traditional booksellers. For instance, rent and depreciation represent less than 4 percent of Amazon's sales and 13 percent of the sales of a large

store-based retailer.[25] Amazon quotes sales/operating employee of over $300,000 versus $100,000 for the traditional retailer.

Amazon has less capital tied up in inventory. Its books currently turn between 20-40 times per year versus two to two-and-one-half times for the traditional bookseller.[26] As Amazon continues to stock more titles in its own warehouses, its inventory turns are likely to fall, but the company believes they will still be far higher than those of store-based retailers.

When it does not stock a book, Amazon receives payment for its goods before it has to pay its vendors. Rather than paying interest on money tied up in inventory, Amazon earns interest on its own sales. Other booksellers have money tied up for the books that stock their stores and warehouses and do not receive payment until the books are sold. Then, they receive payment from customers once the books are sold.

At this early stage of its operating history, Amazon has not yet made a profit.

Through 1997, it purchased most of its books through wholesalers, paying markups that traditional booksellers avoid by buying direct from the publisher. At the same time, online booksellers have been engaged in aggressive price discounting. These two factors contribute to a gross margin that is lower than that of its larger competitors.[27] And, in order to build its brand name, Amazon's expenses in advertising and marketing are a high share of its total cost structure.

Amazon has been taking steps to buy more of its books directly from publishers in order to improve its gross margins. As volumes increase, Amazon expects its advertising and marketing expenses to decline as a percentage of sales.

AUTO-BY-TEL

Auto-by-Tel launched its Web site in March 1995. During its first nine months of operation, the company processed a total of 43,000 purchase requests, and 70 percent of these requests resulted in sales at participating dealerships. In 1996, Auto-by-Tel received 345,000 purchase requests, for more than $1.8 billion in auto sales.[28] As of the end of November 1997, the Web site is generating $500 million a month in auto sales (or $6 billion on an annualized basis) and processes over 100,000 purchase requests each month. Over 1.3 million car buyers have shopped at Auto-by-Tel.

Auto-by-Tel shoppers can access model and pricing information, including dealer invoice pricing and manufacturer rebate information on all new and used cars from 2,700 dealers it has accredited across the country. Along with a picture of the car and brief descriptions, the customer can access new-car and used-car pricing from third party sources like AutoSite, Edmund's, CarCenter and Kelley Blue Book.

After deciding which car to buy, the customer enters the zip code where he or she lives and the make and model of the car desired. A screen pops up requesting which color exterior and interior is preferred, the type of transmission, how many cylinders, and if it is available in both door model options, to choose between a 2-door or 4-door model. Then, the customer completes a new car purchase request, selecting the manufacturer options to include on the car: radio, power windows, anti-lock brakes, sunroof, etc. With these selections and some contact information for the customer, the request goes to the Auto-by-Tel dealer closest to the customer's home. Within 24 hours, the dealer contacts the customer with a no haggle price.

For customers wishing to obtain financing, Auto-by-Tel provides rate information compiled by Bank Rate Monitor on different financing rates available in the city where the customer lives. Options are explained by the dealer and all the paperwork is prepared before the customer arrives to complete the transaction and pick up the car. Auto insurance quotes from AIG are also available online or by calling an AIG representative. The customer is also asked whether or not he wishes to acquire service agreements or after-market products available from their dealer. If interested, the customer can compare retail list prices and special Auto-by-Tel prices for each.

Auto-by-Tel charges the dealer a sign-up fee and flat monthly fee, ranging from $995 to $2,500, regardless of how many customers it sends to the dealer. For the fee, dealers are connected to Auto-by-Tel's proprietary server-based dealer communication network. In addition, Auto-by-Tel provides dealers with training for servicing Internet customers. The company has found that Internet customers expect a higher degree of professionalism and knowledge from the sales representative than a customer walking in to the showroom.

The National Automotive Dealers Association estimates that it costs the average dealer $101,500 to sell 100 cars, or about $1000 per car. With Auto-by-Tel, a dealer can sell 100 cars for $20,000, for a savings of $800 per car. Because Internet customers have access to both

manufacturers' suggested retail price and the dealers' cost, the company expects that the gross margins for Auto-by-Tel sales at participating dealers are likely to be lower than for their showroom sales. But, because their costs are so much lower, they can afford to pass some of these savings to customers in the form of lower prices.

Auto-by-Tel just expanded its site to include a used car service. Customers can search a database of 20,000 certified used cars, and see the condition of the car through digital photographs available online. The site was launched in June 1997. In January 1998, Auto-by-Tel received 600,000 inquiries against the database for that month alone.

CENDANT CORPORATION - NETMARKET

Cendant Corporation is a $5.3 billion consumer goods and business services company with more than 66.5 million members worldwide. It is a membership-based company which allows its members to shop by computer, bypassing retail stores.

After a couple of false starts in the early 1970s and 1980s trying to create a market for online retail before there were PCs in the home, Cendant's (formerly CUC International) business started to take off with phone and catalog sales.[29] The concept was simple: Cendant planned to link manufacturers with their end consumers, skipping the steps in-between. Cendant would work both ends, getting enough manufacturers to work with them to build an attractive product selection and signing up enough customers so that they could negotiate the best prices with the manufacturers. Cendant would do the advertising and marketing, take the orders and pass them through to their suppliers. Customers would get the product at wholesale and pay shipping charges to get it delivered to their home. Revenues to Cendant would come in the form of membership fees. By 1993, the concept had blossomed into a $2 billion business.[30]

Cendant experimented with America Online (AOL) initially, then launched its own site called Shoppers Advantage in the fall of 1995. Without doing major promotions of its online presence, it sold $400 million worth of products in 1996. More recently, Cendant has partnered with AOL and now offers numerous co-branded sites to AOL members. Cendant also launched its own site, netMarket, in July of 1997.

For $1.00, visitors to netMarket can become trial members for a three-month period and have access to over 1 million products and services with a 2-year extended warranty. Products cover approximately 20 percent of an average family's shopping needs, from cars to electronics and cameras, books, appliances, luggage, perfume, flowers and gifts, computer hardware and software, video games, and a variety of other goods and services. After the trial period expires, the annual interactive membership fee of $69 applies.

Cendant projects it will have facilitated the sale of more than $1.2 billion over the Internet during 1997. Each month, it adds 100,000 new interactive members.

Cendant's business model relies almost entirely on membership fees. The company reports that because it does not make its money on transactions, it sells products to retail customers at, or near, wholesale prices. If customers feel they are getting a value, Cendant figures they will buy a membership. And, once customers have paid their annual fee, they have a reason to check out what Cendant has to offer. The cycle continues.

Before the decade comes to a close, Cendant plans to offer a product selection to cover 95 percent of the products a typical household would buy.

Benefits of the Internet

As Cendant already operates without the confines of physical stores, it has the ability to offer a huge array of products, even through its telesales and catalog business. The Internet takes that to a next step. The benefits the Internet provides beyond that are:

- *Lower operating costs***:** As a direct marketing company, Cendant does not incur many of the costs of a traditional retailer. The company reports that its margins are therefore 8 to 10 times higher. The Internet only improves the situation. In its telesales operation, Cendant loses $9 per new member during the first year of their membership. On the Internet, they make $10. By the second year, Cendant makes money either way: $30 per member in telesales, $40 over the Internet.

- *Higher average purchase***:** Because it is easier to sell something visually than it is to do verbally, Cendant's online customers tend to buy up to three times as much as its telesale customers.

INTERNET SHOPPING NETWORK/FIRST AUCTION

A wholly-owned subsidiary of the Home Shopping Network, the Internet Shopping Network (ISN) presents two different retail models to Web users: the Computer Superstore—a virtual superstore selling 40,000 computer-related products and First Auction—a site that conducts real-time auctions of computer, consumer electronics and general merchandise. Both sites operate 24 hours a day, 7 days a week.

Combined, the two sites had sales of $15 million in 1997. Based on the pace that sales increased through the year, ISN anticipates that 1998 sales could reach $38 million.

Computer Superstore

To fit the online marketplace in its infancy—early Web "surfers" were high-tech, higher-income and predominantly male—ISN launched a business selling computer hardware and software. Computer products appealed to the early Web audience and had a track record with telephone and catalog sales that demonstrated that people would buy them on specification—sight unseen.

Marketing and technology drive this Internet-only business. Customers are attracted to the site by well-placed advertising, an extensive product mix and low prices. Computers behind the scenes receive customer orders from the Web site, process them and pass them along to a distributor. The distributor picks the item from its inventory, packages it, and FedEx ships it directly to the customer's home.

The Computer Superstore reports having a lower cost structure than traditional retailers because it doesn't support the costs of operating a physical store infrastructure, with the corresponding rent, labor, utilities and inventory costs. Nor does it incur the costs of warehousing and shipping. Reduced costs flow to lower prices to the customer.

The company provides the following example of the retail price and margins of three different selling vehicles for a well-known hand-held electronic personal organizer:

ISN Sells for Less Than Traditional Retailers

	ISN	Mail order	Store
Retail price	$260	$275	$292
Cost	$234	$234	$234
Margin	$26 (10%)	$41 (15%)	$58 (20%)

At the close of 1997, The Computer Superstore site had 175,000 members and attracted 25,000 visitors every day.

First Auction

ISN thinks the auction model will sweep the Web, appealing to Internet users who are adventurous, looking to be entertained, and seeking a bargain. Auctions take advantage of the interactive nature of the Web, allowing people from all over the country to bid against each other in real-time. They "transform a traditional shopping experience into an entertainment experience." First Auction plays to the entertainment element, starting many of its bids at $1.00, well below a product's cost. Bidders respond, competing with each other to take possession of whatever items First Auction is offering at the moment—whether golf clubs, CD players, television sets, jewelry or something else that's caught the bidder's eye.

The site auctions off over 5,000 items a week. Products, along with their picture, specifications and starting price, appear at the top of the First Auction home page. To place a bid, visitors must register with the site—providing name, address, email, phone number and credit card information (which is encrypted to ensure security). The Bid page shows how many units are up for bid, the starting bid, bid increments, the top bids so far, and the start and end time for the auction. The new bidder enters a bid, upping the price by the preset increment. This bid is posted on the Bid page under an alias. At the close of the auction, the bidders with the highest bids "win." (In almost all cases, more than one unit of a product is offered for bid.)

First Auction changes its auction items based on its inventory. It buys end of life, close-out merchandise at large discounts from distributors with inventories they cannot move through traditional channels. By getting the product at a low price, First Auction can offer a very low starting bid (often below cost). The difference between this model and the virtual superstore model is that First Auction takes possession of the merchandise, warehouses it and is responsible for getting it to the customer. Still, with the discounts they get and the volume of traffic they anticipate, ISN believes that First Auction can make money and customers can get bargains.

Launched in July 1997, First Auction's membership roster approached 100,000 people by the end of 1997, and 30,000 people visited the site each day.

1-800-FLOWERS INTERACTIVE SERVICES DIVISION

1-800-FLOWERS goes to market in three ways: through its own flower shops and partners in major cities across the country, by telephone order, and online sales through America Online, Microsoft Network and the Web. In total, 1-800-FLOWERS fulfills about 9 million purchases per year through these three channels.

The company started a telephone order center ten years ago before it was common for consumers to purchase goods over the phone. It has continued that tradition with its online business, starting an online service on CompuServe back in 1992. The company supplemented this arrangement with partnerships with Bloomberg Financial Services, AOL, Microsoft, AT&T WorldNet, Earth Link Network, Switchboard and two dozen other companies, as well as launching its own Web site.

By 1996, 1-800-FLOWERS' stand-alone Web site was its fastest growing business sector.[31] In 1997, the online business contributed 10 percent of the company's $300 million in revenues.

The company sees the following benefits in its online business:

- *New sales opportunities*: 1-800-FLOWERS' Web site reaches an international group of customers it had not reached in the past. About 15-20 percent of the online business comes from outside the U.S., much of it from Americans working overseas who send flowers to their friends or family back home.[32]

- *Lower operating costs***:** Although its online business generates just 10 percent of 1-800-FLOWERS' total revenues, it contributed nearly as much profit to the overall business as the company's store-based operation, which generated twice as much revenues.[33] 1-800-FLOWERS passes on some of these savings to its online customers who pay service fees 35 percent lower than the service fees charged for phone orders.

- *Targeted marketing***:** 1-800-FLOWERS offers incentives for customers to share personal information that will help them better target offers. Customers that register with the company's Web site benefit from a service that reminds them of special occasions such as birthdays and anniversaries. The company also plans to offer local neighborhood specials based upon the zip code in customers' billing addresses.

ENDNOTES

1. Delhagen, Kate. “Retail Revs Up.” Forrester Research. October 1997.

2. 10-K filing. SEC. June 27, 1997.

3. “Barnes & Noble Post $100 M in Online Sales.” *CRW Business Desk*. January 16, 1998. http://www.techweb.cmp.com/crw/news98/b&n0116.lhtml

4. Company filings with SEC.

5. Visitors to netMarket can get a trial membership for $1 for the first three months. After that, the $69 annual fee applies.

6. December 1997 phone interview with John Osborn, JD Power and Associates.

7. “Half of New-car Dealerships Market Sales, Services on Internet.” National Association of Automobile Dealers. October 1997. http://www.nadanet.com/news/internet.htm

8. Richtel, Matt. “Net-Savvy Shoppers Driving Off with Bargains.” CyberTimes. The New York Times on the Web. November 8, 1997.

9. AutoWeb press releases: “Autoweb.com Announces Automotive Industry and Electronic Commerce Milestone.” November 12, 1997 and “Dealerships nationwide profit by “revving-up” alternative channel.” February 1, 1997. http://www.autoweb.com/press/nov12-97.htm and http://www.autoweb.com/press/feb1-97.htm

10. INTERNET RETAIL PROJECTIONS, 1997-2002*

	1997E	1998E	1999E	2000E	2001E	2002E
Forrester Research	$1.8 B	$3.3 B	$6.1 B	$7.3 B	$9.9 B	
RobertsonStephens	$1.3 B	$2.7 B	$5.1 B	$7.4 B		
IDC	$4.3 B			$37 B		$60.2 B

*This table reflects U.S. consumer retail, excluding auto and travel except where noted.

Forrester’s figure includes PC hardware/software, entertainment, books and music, gifts/flowers/greetings, apparel/footwear, food and beverages, jewelry, consumer electronics, sporting goods, toys and hobbies, health/beauty/drugs, tools and gardening, home furnishings, other. Forrester normally includes travel in its overall retail spending

estimates. See: Delhagen, Kate et al, "Retail Revs Up." Forrester Research, Vol. 4, No. 6, October 1997.

Robertson Stephens includes computer hardware/software, other sales, gifts/flowers, books, apparel, music, e-services, food/drink. RobertsonStephens normally includes travel and auto in its overall retail spending estimates. See: Benjamin, Keith E. et al. "Digital Media Overview." Robertson Stephens & Company. August 26, 1997.

IDC's figures include include **all** goods and services purchased by U.S. consumers, excluding funds transfers and stock trades. This estimate includes a much larger array of products and services than the Forrester and Robertson Stephens estimates. Source: IDC phone conversation, February 1998.

11. Meeker, Mary and Pearson, Sharon. *Morgan Stanley U.S. Investment Research: Internet Retail.* Morgan Stanley. May 28, 1997. pp.4-2+. The report estimates that mail order spending in the U.S. ranged from $71 - $155 B in 1996, for an average of $113 billion for the year. It posits that Internet retailing's growth may occur three to five times faster than mail order did, given the growth in the number of Internet users and the ease and efficiency of ordering from the Internet. Based on these assumptions, Morgan Stanley estimates that Internet retailing could reach $115 billion in five to eight years.

12. CommerceNet/Nielsen Spring and Fall 1997 Surveys. Spring survey polled 6600 representative households in the U.S. and Canada between December 1996/January 1997. Fall survey polled 9,000 representative households in the U.S. and Canada. http://www.commerce.net/news/press/121197.html and http://www.commerce.net/neilsen/press_97.html

13. "Internet Shopping." Ernst & Young, LLP. January 1998. Ernst & Young surveyed over 850 consumers and 150 companies about their present and future plans for the Web.

14. America Online.

15. America Online.

16. Delhagen, Kate et al. "Retail Revs Up." Forrester Research. Vol. 4, No. 6. October 1997. Forrester surveyed 300 consumers who had made an online purchase in the last 12 months. When asked to rank what they liked best about online purchasing, 50 percent of the respondents cited convenience, 22 percent cited ease of research and 11.7 percent cited good prices/deals.

    Ernst & Young's survey of 850 consumers revealed similar patterns. Fifty-three percent of current Web purchasers cited convenience, 46 percent cited choice/variety and 45 percent said to save money.

17. "Internet Shopping." Ernst & Young, LLP. January 1998.

18. Goff, Leslie. "Online computer store forecasts growth." *Interactive Age Digital*. 1997. http://techweb.cmp.com/ia/iad_web/networth/ccstudy/necx.html

19. SEC filings.

20. At CDNow, a consumer purchasing a CD that costs $12.58 pays an additional $2.99 for standard delivery, raising the price to $15.57, or an additional 24 percent. In this example, delivery is within 3-8 business days. CDNow has a maximum delivery charge of $4.97.

    Amazon.com charges $3.00 per shipment and $0.95 per book for standard delivery (within 3-7 business days). For a book with a retail price of $16.77, delivery of $3.95 raises the total price to $20.72, or an additional 24 percent. Overnight delivery costs a premium: $8.00 per shipment and $2.95 per book. That $16.77 book would cost $27.72, or an additional 65 percent. Given the high delivery charges per single unit, it's likely that consumers will combine purchases.

21. Hansell, Saul. "Money Starts to Show in Internet Shopping." New York Times on the Web. December 1, 1997.

22. "Internet Shopping." Ernst & Young, LLP. January 1998.

23. "1-800-FLOWERS announces key findings in on-line purchase habits..." 1-800-FLOWERS press release. December 23, 1997.

24. "Internet Shopping." Ernst & Young, LLP. January 1998.

25. Comparison of SEC 10-Q filings.

26. Discussions with Amazon management.

27. Amazon points out that pricing at traditional bookstores is significantly higher than for all online bookstores. Thus, gross margin is on the order of 1,000 basis points lower for booksellers' online operations versus their store operations.

28. Silverman, Robert. "Web ads pay off for autos: Auto-By-Tel signs ad pact with AOL, search engines..." *Inside Media*. Vol. 8, No.11. p. 28. May 29, 1996. Note: the actual quote from the article was: "Auto-by-Tel's 1,400 member car dealer network estimates that nearly 300,000 new car buyers will tender purchase requests via the service this year, resulting in a potential of $1.8 billion in sales." In fact, according to documents filed with the SEC and Auto-By-Tel's own press releases, Auto-By-Tel generated 345,000 purchase requests for 1996.

29. Schwartz, Evan. "It's!Not!Retail!" *Wired*. November 1997.

30. Ibid.

31. Tadjer, Rivka. “Many Ways to Go Online - - Can a service provider be your quick ticket to online brand-name recognition?” *CommunicationsWeek*. July 28, 1997. http://www.techweb.com/se/directlink.cgi?CWK1997072850065

32. Goth, Nikki C. “Sweet Smell of Success.” H!TS supplement, Red Herring online. Spring 1997. http://www.herring/com/hits/03/800.html

33. Ibid.

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