

An Analysis of Market and Skill Changes

**The Impact of Globalization on American Jobs
in Selected Industries**

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Synthesis of Lessons Learned Across Industries

Pete Carlson and Mark Troppe

Introduction

To determine the impact that globalization is having on US jobs, we decided to look closely at what's happening in particular industries. Often, patterns show up at the industry level that don't show up when studying at the economy as a whole. We chose a mix of industries – textiles and apparel, auto, health care, biotech, telecommunications, personal computers, software, and entertainment – each of which is affected by and is responding to global forces in different ways. Our research focused on three main questions. What are the key trends shaping where the industry is headed? How are global dynamics changing the competitive landscape? And what are the implications for employment in the US?

We gathered information from a variety of sources. In particular, we benefited from the research that MIT and the Sloan Industry Centers have already done on several of the industries we focused on.

We began our study with the hypothesis that if US firms can be the best in the world in developing new technologies, high value-added goods, and knowledge-based services, they should be able to create new and better jobs to replace the old ones that are disappearing, making it possible for the nation to sustain a high-skill, high-wage, high-employment economy. We found many examples of where that hypothesis holds true for particular firms. But we did not find that it holds true for entire industries.

One reason is because the competitive landscape is changing so rapidly in all of the industries we studied. It's not clear at this point how things are going to sort out globally. Another reason is because US firms are responding to global competition in so many different ways, some of which are actually making innovation more difficult. Where the good jobs end up in the years ahead will largely be determined by what happens in these two very dynamic arenas.

Innovation is Key

In general, our research supports the conclusion drawn by other recent studies that innovation is the key to long-term success in global competition.¹ To be successful in today's world, firms need to focus on what they can do better than anybody else, while constantly identifying new opportunities for products and processes that are difficult for others to replicate. The production of goods and services is becoming increasingly

¹ President's Council of Advisors on Science and Technology, "Sustaining the Nation's Innovation Ecosystems," January 2004; Council on Competitiveness, "Innovate America," December 2004; National Academies, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future," October 2005; MIT Industrial Performance Center, *How We Compete*, January 2006.

fragmented and modular, with operations spread across the globe, performed by whoever can do them the best. That makes it easier for newcomers to get into the game anywhere along the value chain, from anywhere in the world.

The US can't afford to wall itself off from the rest of the world. Economies that were previously closed are now opening up and are rapidly developing their capacity to deliver high-quality, low-cost goods and services. The US stands to gain through access to these new markets abroad and through access to their more affordable goods and services here at home.

We found that innovation is taking place across all the industries we studied. That holds true even in industries we commonly think of as "declining," like textiles and apparel, where firms like Avondale Mills are carving out niches for themselves by developing non-woven textiles and "smart" fabrics. In the personal computer industry, Dell's innovative build-to-order strategy has made it the global leader in sales of notebook and desktop PCs, while Apple has come to dominate the MP3 market with its innovative iPod. In the pharmaceutical industry, four out of five new drugs currently in development in the US are based on biotech discoveries or employ biotech tools, making the US a magnet for foreign investment and R&D in biotech.

The US telecom industry is going through a remarkable transformation, responding to changes in technology and consumer preferences that have led to more customers now using mobile phones than traditional handsets, 40 percent of all communication done by e-mail and instant messaging, and half of all business calls made over the internet. Meanwhile, the digital revolution is blurring traditional industry boundaries, as the chips, software, and network connections traditionally associated with computers are now being built into phones, hand-held devices, and other consumer electronics. Increasingly, these products are defined more by their software, which supports innovation in features and functions, than by their hardware. The digital revolution is also transforming the entertainment industry, which is finding new ways to create and package the content that shows up on screens of all sizes, in theaters and in homes, and on electronic devices of all types.

We looked at how these industries are faring in global competition and found that the US has many advantages when it comes to innovation -- a strong tradition of entrepreneurship, risk-taking, and innovation; the world's biggest market for goods and services; superior access to venture capital and equity funding; the world's best research labs and universities, with strong connections between research institutions and business; the strongest intellectual property protections in the world; and a more flexible, skilled, and mobile workforce than most other countries.

Those factors support a virtuous cycle of innovation that spawns new products and businesses, attracts many of the world's best and brightest individuals to study and work in the US, lures foreign firms to locate their R&D operations here, and attracts more foreign direct investment than any other country except for China. These dynamics keep the US on the cutting edge of new technologies and products, allowing those technologies

and products to become commercialized first in the US, which attracts even more talent and investment.

We concluded that it will take years for developing countries like India and China to put the same kind of social and physical infrastructure in place to sustain the growth of their economies. In addition, studies conducted by McKinsey & Company² have found that, despite the higher number of engineers graduating from schools abroad, only a small fraction of them have the skills required by multinational corporations. That means that many fewer jobs can be off-shored than is commonly presumed. Meanwhile, many US companies are too small to justify the costs involved in off-shoring work. And, many large companies are finding the process too complex to manage. These factors place limits on the amount of work that can be off-shored by US firms, at least for the time being.

Industry Trends

In every industry we studied, the competitive landscape is being radically changed by new technologies and new competition. In some cases, the US is on the cutting edge and leading the way. In others, the US is lagging behind. Here is a summary of what we found.

Auto. US automakers are steadily losing market share to their foreign rivals, which generally have higher quality, higher productivity, lower costs, and more innovative designs. In response, US automakers are relying heavily on discounts to move cars, closing US plants, shifting vehicle production to Mexico and Canada, shifting fixed costs to suppliers, shifting health care and pension costs to employees, importing parts from overseas, and seeking new markets overseas. Meanwhile, foreign automakers are expanding their operations in the US, adding tens of thousands of new assembly jobs, mainly in the South. Foreign automakers are also locating design centers in the US to be close to their customers.

Auto parts suppliers are under intense pressure from automakers and competitors to reduce costs. They are responding by increasing productivity, outsourcing components to even lower-cost second and third tier suppliers, and shifting low-skill assembly work to Mexico and other off-shore locations. So far, the production of capital-intensive and high value-added parts (such as engines, transmissions, and body panels) has remained mainly in the US, largely due to sunk capital costs, lack of capability in low-cost countries, and union resistance to moving those jobs. However, as more and more assembly work shifts to low-cost countries, their infrastructure improves, and union influence weakens here at home, suppliers will likely shift more of their production work to low-cost countries as well.

² Diana Farrell, Martha A. Laboissiere, and Jaeson Rosenfeld, "The Emerging Global Labor Market," McKinsey Global Institute, 2005; Diana Farrell and Jaeson Rosenfeld, "US Offshoring: Rethinking the Response," McKinsey Global Institute, 2005.

Autoworker unions are looking for ways to stem this tide. The UAW has agreed to close unproductive plants, cut jobs, share the cost of health insurance, decrease job classifications, outsource peripheral jobs like janitorial services and material handling, and introduce a two-tier wage system (in the supply sector). But these concessions have not been enough to keep some of the biggest US parts suppliers like Delphi, Dana, Collins & Aikman, Tower Automotive, and Meridian Automotive Systems competitive. All are in bankruptcy, with GM also teetering on the brink.

A growing trend toward building vehicles to order could further disadvantage US automakers. Japanese and European automakers are aggressively preparing to take this next leap forward in flexible manufacturing. For US automakers to do the same, they would need to fundamentally transform the way they design, make, and sell vehicles. And even if they were successful in making those changes, US automakers would still be burdened with higher health care and pension costs than their competitors.

Health Care. US citizens currently spend 53 percent more for their health care than anyone else in the world, a difference that cannot be attributed to higher volume or higher quality of care. To be competitive, US-based companies either need to find ways to offset their higher health care costs, or they need to move jobs off shore to countries where health care costs are lower. The retreat from tightly managed care since the late-1990's has left employers and the government searching for new ways to reduce health care costs. However, most of their efforts have focused on shifting costs, rather than actually reducing them. Employers are trying to shift health costs to employees by reducing prescription drug benefits, increasing co-pays and deductibles, and reducing retiree benefits. The federal government is trying to shift costs to states, which have been cutting back on expenditures and shifting costs to providers, which are required by law to treat the uninsured.

One promising approach to actually reducing the cost of care is to focus on those patients who are the most costly to treat. Roughly 75 percent of all health care spending in the US is for the treatment of chronic diseases. Yet, the main focus of the US health care system is on the treatment of short-term, acute health problems. As a nation, the US emphasizes expensive cures for diseases, rather than cost-effective prevention.

One of the biggest changes taking place in the industry is the rapid growth of freestanding ambulatory care centers and specialty hospitals, driven by advances in medical technology and changes in Medicare payment incentives. These facilities pose a significant threat to traditional hospitals by drawing away doctors, patients, and the most profitable services. As these more modern, more patient-friendly, and potentially more efficient freestanding facilities demonstrate their advantages in quality and cost, they are likely to change the competitive landscape dramatically.

Traditional hospitals are attempting to slow this trend by making it more difficult for freestanding facilities to receive federal funding. In addition to self-interest, hospitals are also concerned that as patients with insurance and the ability to pay seek care at freestanding facilities, hospitals will be less able to cross-subsidize care for the elderly,

disabled, poor, and uninsured, at a time when there are increasing numbers of elderly to serve and likely increases in the ranks of the uninsured, because of rising deductibles and co-insurance payments, or because states have trimmed their Medicaid rolls. If that happens, hospitals will be left with higher-risk patients with more complex medical needs, victims of trauma, and those with little or no health insurance coverage -- and fewer resources to pay for their care – straining both hospital finances and the social fabric.

Biotech. The US established an early lead in biotechnology research and commercialization and has maintained that lead. There are more biotech companies in the US than in any other country, and US biotech firms have higher revenues than those in other countries, in part because of strategic alliances with drug companies in the US. The biotech firms provide a “farm system” for the big drug companies, doing the early research and development, while the big drug companies invest in promising late-stage development and provide the capacity to market and distribute the drug once it has been approved.

A growing number of states are targeting biotech as an economic development opportunity, making significant investments in their universities and research institutions, looking for ways to promote more academic-industry interaction, and finding ways to help companies commercialize the products of their research. The states are also experimenting with ways to help fund the development of these new technologies through tax credits and equity investments, funded in some cases by state pension funds. Finally, state higher education systems are reaching out to biotech companies to better understand their needs, and responding with new curricula at colleges and universities.

US biotech companies are outsourcing clinical trials to other countries, but they are mainly keeping their research and development operations close to home. The early research and development phase requires collaboration across disciplines and tends to flourish when linked to world-class universities. The leading university centers are currently located in the US, particularly in Boston and in the Bay Area. In fact, these centers are magnets for foreign researchers and scientists, and for foreign investment, which is flowing into the US much faster than work is being sent overseas. The US is also attractive because of the availability of private venture capital and the world’s strongest intellectual property protections.

Telecom. The telecommunications industry is one of the fastest growing and fastest changing sectors of the US economy. Over the past decade, wireless service has been growing, while the number of phone lines has been declining, so that the number of wireless customers now exceeds the number of residential wired customers, and the gap is widening. As the market for phone service, both wired and wireless, has gotten more saturated, the focus of competition has shifted to internet access, particularly broadband. The cable companies got a head start in offering high-speed internet access, but the phone companies responded with DSL technology, and more recently with fiber optic cable. While the cable companies appear to have the advantage at the moment in packaging video, high-speed internet access, and voice over internet protocol (VoIP) phone service,

the phone companies are putting their own “triple play” packages together, adding 3G (third generation) technology to make broadband available over cell phones.

The US is falling behind other nations in the share of the population with broadband access and the speed of those connections. The US is also falling behind in wireless access to the internet. One reason may be the duopoly structure of the industry that limits customer choices to either the local phone company or local cable company, both of which risk undercutting their traditional and most-profitable businesses by offering new services in arenas where they face stiffer competition. Some communities have experimented with providing broadband over power lines, but have run into technical problems that haven’t been completely resolved. Other communities are deploying WiFi and WiMax networks, which are cheaper to install and operate than cable or phone lines. The phone companies are trying to stake a claim to this new technology, while at the same time trying to block internet-based companies like Earthlink, Google, and Yahoo from gaining a foothold in the industry.

As voice and other communication migrate to the internet, it’s getting much harder for traditional providers and for regulators to control the market. New services often come in the form of new software, which can be developed by anyone anywhere and sold over the internet. As a result, there is increasing separation between who owns the telecom infrastructure and who provides the services. Phone companies are considering charging a fee for allowing others to use their networks to access the internet, which could significantly change the competitive landscape if they are successful.

Personal Computers. The personal computer industry has had a global production network almost from its inception. Most PC component production and assembly are now outsourced, with component production located mainly in Asia, and with PC assembly located closer to the customer in North America, Europe, and Asia. With the exception of Apple, US-based PC makers make limited investments in R&D and rely heavily on contract manufacturers and Taiwanese original design manufacturers (ODMs) for product design and development. On the other hand, Chinese PC maker Lenovo is aggressively pursuing innovation through its deal with IBM and through its partnership with Microsoft, Intel, Symantec, and LANDesk to jointly conduct R&D.

Makers of hard disk drives and semiconductors, the main components of a PC, have mainly kept design and development work in house and in the US. In addition, some firms like Intel, which is often on the cutting edge with new technologies, also prefer to keep their production in house to avoid revealing technologies they consider to be a strategic advantage. These high-paying jobs are likely to expand, given the dominance of US-based companies like Seagate, Intel, and AMD in world markets, and the success they are having in bridging into new technologies.

In general, global PC production has been shifting to Taiwan and China, and will likely continue to do so. In addition, the global market has been shifting toward notebook PCs, developing countries, low-end products, and distribution through retail outlets. Those

trends favor PC makers like Lenovo, which is well positioned to expand globally, at the expense of Dell, the current global leader.

The build-to-order business model that Dell exploited to become the industry leader over the past decade may be losing some of its potency. With markets becoming saturated in the US and Western Europe, an estimated 80 percent of new PC sales are expected to come from developing markets like India and China in the next 5 years. Worldwide, retailers currently sell more than 80 percent of PCs, where customers can get assistance from salespeople. That figure is even higher in the fastest growing markets like India and China, where most people live in rural areas, have little knowledge of computers, no credit cards, and are not accustomed to making purchases over the phone or on-line.

Dell and most other PC makers are shifting their focus to high-end products and to emerging products that perform many of the same functions as a PC or can be packaged with the PC as part of a digital home or office. However, they are limited by their over-reliance on others for innovation and by the stiff competition they face from other companies already entrenched in these product markets. Apple is the exception, with their heavy emphasis on innovation and their strategy of linking other companies' products together with Apple's software.

Software. The US leads the world in the development and production of software-related goods and services. Of the top ten software firms in the world, eight are American, earning about one-third of total global sales. Microsoft's revenues alone account for more than 15 percent of the global software market.

In addition to dedicated software firms, firms in many other industries develop software for their own internal use. This is particularly true in banking and finance, telecommunications, retail, and manufacturing, where information technologies now provide critical support to business processes. During the 1990s, firms in these industries began off-shoring business processes, ranging from lower-end data entry, customer support/billing, and call centers (back-office functions) to higher-end management consulting, engineering, and R&D. However, while off-shoring has increased steadily, it remains at low levels, particularly vis-à-vis other phenomena that induce job shifts, such as automation and technological change, job churn, and corporate mergers.

While some US software companies are conducting their design work overseas, the bulk of high-level design work remains concentrated in the US. Microsoft, for instance, still conducts 85 percent of its R&D in the US. Moreover, an increasing number of foreign-owned software companies are locating their design work in the US to be close to customers in the world's largest market and to be situated in clusters with other innovative companies. Most new applications emerge and become standardized first in the U.S. In fact, the global R&D headquarters of several leading Indian software companies are located not in India but in Silicon Valley.

A number of other factors serve to maintain the presence of critical design activity within U.S.-based firms—and, conversely, to limit the potential for U.S. off-shoring of high-

level software jobs. First, the US provides sufficient access to software talent through production of highly skilled labor and, perhaps more significantly, through the attraction of skilled labor from abroad. Second, the US has the world's strongest venture capital market, which firms tend to access more successfully when they have a presence in the country. And third, design work tends to be a proprietary source of competitive advantage. Weak intellectual property laws overseas, especially in India, dampen enthusiasm for outsourcing such work to foreign-owned companies. Fear of security breaches likewise limits global outsourcing. For these reasons, it is likely that the US will remain a leader in software innovation for the foreseeable future.

Entertainment. The US entertainment industry grew out of the old Hollywood studios. Currently, six giant firms – Time Warner, Fox, Viacom, Sony, NBC Universal, and Disney – dominate the industry, owning all six major broadcast networks, sixty-four cable networks, the major radio networks, broadcast rights to all sporting events, and the worldwide distribution of movies. Because the US entertainment market is the largest in the world and distribution channels extend throughout the world, these firms have a tremendous advantage in the global economy.

Over the past decade, the focus of the industry has shifted from the box office to the home, with DVD sales now accounting for half of a film's revenues. In the home, consumers have a growing number of different entertainment products to choose from, delivered on a wide range of new digital technologies. The product growing the fastest in popularity is video games, which now rival feature films in the quality of their graphics, and which now surpass the number of hours people spend going to the movies, watching home video, and reading a book. In addition, consumers are increasingly able to access movies, TV shows, and video games over the internet with a broadband connection, both at home and with wireless devices. The traditional entertainment companies are struggling to maintain their dominance and control in this new environment. But they are facing a stiff challenge from internet and software firms, which have a distinct advantage when it comes to video games.

New computer graphics technology is revolutionizing the industry's production process, creating scenes that don't require locations, sets, props, costumes, directors of photography, stunt people, or even actors. Currently, action movies have more computer-animated scenes than live ones, and larger budgets for computer graphics than for principal photography. Since computer graphics can be done separately, both in time and space, from the actual filming, this work can be done by anyone anywhere in the world. Other countries are investing heavily in building this capacity, and in tax breaks to lure producers to locate work there.

Currently, the industry's financial and creative center remains in Hollywood. However, given the intense pressure to cut costs, and the growing availability of state of the art production and post-production facilities and cheaper skilled labor throughout the world, it is likely that production work will shift to other countries, just as it is now shifting to other states within the US.

Textiles and Apparel. The future for textiles and apparel in the US is not entirely bleak. While it's likely that the more labor intensive functions of sewing and assembling clothing will continue to move offshore, those jobs won't completely disappear in the US. Textile firms that are using new technology, speed, and flexibility to capture a market niche are successfully competing with foreign producers. In the apparel industry, the more creative functions of designing, marketing, packaging and distributing clothing and accessories largely remain in the US.

The trend toward lean retailing offers some promise for keeping jobs in the US, because proximity to the US market is such a distinct advantage in product lines that need to be replenished or updated frequently. An apparel manufacturer providing goods to the US market must weigh the benefits of more proximate, but costly, sources that offer short-cycle local production against lower-cost, off-shore operations that require far longer lead times. As lean retailing becomes even more widespread, the capacity to replenish quickly will become an even bigger factor in the sourcing decisions of major retailers like Wal-Mart, whose choices of suppliers can send ripples through the entire industry.

The lifting of quotas on imports from China at the beginning of 2005 altered the competitive landscape. Imports from China surged during 2005, provoking a strong reaction from US apparel manufacturers. In response, the Bush Administration ordered new limits on Chinese shipments of four categories of clothing, and threatened limits on additional categories. If quotas and tariffs were to completely disappear, it's likely that could shift the balance in retailers' sourcing decisions, and an increasing number of jobs would move to China and, to a lesser extent, other developing countries.

Firm Decisions

Within industries in the US, firms are responding to global competition in many different ways, some of which are actually making innovation more difficult. We found examples in every industry where established firms are seeking to protect themselves from new competitors and new technologies. For example, textile firms are lobbying to extend quotas on imports from China. Phone companies are lobbying state legislatures to block cities from setting up WiFi systems that can provide faster broadband service at lower cost than most DSL lines. Traditional hospitals are trying to block the funding of new specialty hospitals that have the potential to provide more efficient and higher quality care. While these efforts may be in the best interest of the firms involved, they are not in the nation's best interest, which is to keep markets open to innovative products and services, which most often come from new entrants that lack the political clout enjoyed by the established firms.

We found that many US firms, preoccupied with survival, are still outsourcing and off-shoring work solely to save on labor costs, despite ample evidence that this strategy by itself is a dead end. As labor costs rise in one developing country, firms seeking even lower-cost labor find it necessary to keep migrating, which disrupts their operations and adds other costs. Also, repeated studies show that labor costs make up only a small fraction of the total cost of off shoring most goods. As a result, the average reduction in

costs achieved through off shoring is only around 9 percent, even when there is a much bigger gap in labor costs, according to a 2005 survey of more than 5,000 global corporate executives, conducted by Ventero LLC. The key is not whether firms can realize lower costs through outsourcing, but whether they reinvest the savings into core areas of the business as part of a larger strategy that's focused on growth, rather than just survival.

We found that some firms are divesting themselves of their capacity to innovate in an effort to reduce costs and streamline operations. A big reason is the short time horizons of most US firms and investors that pressure managers to focus on near-term results to the detriment of the long-term investments needed for innovation. This is compounded by the lack of tools to account for the kind of intangible assets that support innovation, such as skills and R&D.

Design work is increasingly following production work to contract manufacturers and to other countries. In an effort to cut costs and to focus where they have a competitive advantage, US firms are relying more and more on contract manufacturers to make their products for them. For the same reasons, US firms are also relying more on contract manufacturers to design new features and products for them, since this work is best done in close connection to the manufacturing process. As manufacturing is moving overseas, so is design work. Currently, an estimated 80 percent of design and development work for notebook computers is either done in Taiwan jointly between PC makers and Taiwanese original design manufacturers or by original design manufacturers alone, while only 20 percent is done in house by PC makers themselves. While the firms engaged in this practice may benefit in the short run, they risk losing their capacity to innovate in the long run, while building the capacity of potential competitors.

We found that, with a few notable exceptions, funding for R&D has been shrinking at major US firms, in part due to cost pressures and to the difficulty of measuring the benefits. At the same time, firms have been systematically dismantling the infrastructure that drove innovation in the 1990s. Most corporate R&D functions are now closely tied to existing products, where the returns can be more easily calculated, although experience suggests that it takes excess R&D capacity beyond what's needed for existing products to come up with entirely new technologies and product lines.

We also found evidence that US firms are doing more of their R&D outside the US. With faster growth taking place in markets overseas, R&D staff are being shifted overseas to be in closer contact with customer preferences and market developments – the same reason that so many firms from other countries locate R&D operations in the US. Another reason is because there is a growing supply of talented engineers and scientists in other countries who are willing to work for much less than their counterparts in the US. US firms are more accustomed to buying the skills they need, rather than growing them, so they are more willing to look overseas, especially if that's where they can find the best talent at the lowest cost.

With the US falling behind in broadband speed and deployment, there's the possibility that this trend will accelerate. Broadband is fast becoming the technology platform for

productivity improvements across all sectors of the economy. If other countries continue to advance technologically at a faster pace than the US, then R&D will migrate to those countries, and innovations will be deployed there first. US-based multinational companies that have the capacity to operate on a global scale will be able to shift their R&D operations to where the action is. But smaller US companies, where most of the innovation takes place, will have a hard time following suit.

Implications for Employment

What does all this mean for the US economy, and particularly for the prospects for high-wage employment? Our study suggests that the picture is mixed.

It's clear that some jobs are going to continue to move off shore. Economies in developing countries, such as India and China, are expanding faster than the US economy, and US-based companies will continue to seek access to those markets for growth, as they always have. In addition, low-wage, low-skill production work will continue to migrate overseas, along with service work that involves routine tasks that can be performed in remote locations.

It's less clear what's going to happen to high-wage, high skill work. Those jobs that depend on close customer contact and can't be performed remotely, such as in health care or in R&D for the US market, will remain in the US. In addition, the spread of build-to-order and just-in-time strategies, such as lean retailing, are likely to keep many jobs in the US. But in the final analysis, where the high-skill, high-wage jobs end up in the years ahead will largely be determined by the interaction of the shifting competitive landscape in particular industries, the choices that firms make in how to respond to global competition, and whether the US makes the investments necessary to sustain its superior infrastructure for innovation.

Automotive Industry Trends

Pete Carlson

Introduction

The automotive industry, including both automakers and their suppliers, is the largest manufacturing industry in the US, making up nearly 10 percent of the US economy. The domestic auto industry – the Big 3 and US-based suppliers – makes up 5 percent of all US employment.³ About 500 establishments in the US manufacture motor vehicles -- passenger cars, sport utility vehicles, pickup trucks and vans, heavy-duty trucks, buses, and other special purpose motor vehicles ranging from limousines to garbage trucks. About 7,000 establishments in the industry manufacture motor vehicle parts—including electrical and electronic equipment, gasoline engines and parts, brake systems, seating and interior trim, steering and suspension components, transmission and power train parts, air-conditioners, and motor vehicle stampings, such as fenders, tops, body parts, trim, and molding.⁴

This report describes the market dynamics that are shaping the US auto industry, how automakers and suppliers are responding to them, what impact that is having on employment, and where the industry may be headed.

Market Dynamics

The most striking trend in the US auto industry is the falling market share of US automakers. Since the 1970's, Japanese and European automakers have been steadily increasing their share of sales in the US market, while the share of US automakers has fallen from 82 percent to below 60 percent.⁵ In response to protectionist policies implemented in the 1980's to limit the import of vehicles from Japan, Japanese automakers began building assembly plants in the US. Today, over three-quarters of Japanese vehicles sold in the US are also manufactured in the US by these transplants.⁶

One reason the transplants are gaining ground is higher quality. The J.D. Power and Associates annual study of automakers ranks all of the US automakers below the industry average based on quality problems with new vehicles. In 2005, only GM ranked above average.⁷

³ Richard E. Dauch, "Comment: Adapt or Die," *Automotive News*, March 22, 2004.

⁴ Bureau of Labor Statistics, U.S. Department of Labor, *Career Guide to Industries, 2004-05 Edition*, Motor Vehicle and Parts Manufacturing, on the Internet at <http://www.bls.gov/oco/cg/cgs012.htm> (visited December 28, 2004).

⁵ David Welch, "Commentary: Borrowing from the Future," *Business Week*, January 10, 2005.

⁶ Timothy Sturgeon and Richard Florida, "Globalization, Deverticalization, and Employment in the Motor Vehicle Industry," in Martin Kenney and Richard Florida (editors), *Locating Global Advantage: Industry Dynamics in the International Economy*. Stanford, CA: Stanford University Press. 2004

⁷ "J.D. Power and Associates Reports: Toyota Motor Corporation, General Motors Corporation Garner Most Awards in 2005 Initial Quality Study," May 18, 2005.

2005 Quality Ranking	Automaker	Problems per 100 Vehicles
1	BMW	95
2	Toyota	105
3	Hyundai	110
4	Honda	112
5	General Motors	113
Industry Avg.		118
6	Nissan	120
7	DaimlerChrysler	121
8	Ford	127
9	Mitsubishi	129
10	Subaru	138
11	Kia	140
12	Porsche	147
13	Volkswagen	147
14	Suzuki	151

Another reason the transplants are gaining ground is higher productivity. The 2005 Harbour Report shows that US automakers all trail their Japanese rivals in the number of hours required to produce a vehicle.⁸

2005 Productivity Ranking	Automaker	Hours per Vehicle
1	Toyota	27.90
2	Nissan	29.43
3	Honda	32.02
4	GM	34.33
5	DaimlerChrysler	35.85
6	Ford	36.98

Much of the productivity advantage enjoyed by the Japanese is due to their greater flexibility to produce different models on the same assembly lines and to change over more quickly. Currently, fewer than 40 percent of Chrysler and Ford vehicles are built on flexible assembly lines, compared to 80 percent for Nissan and Toyota.⁹ Flexible production costs 10-15 percent less than traditional production systems, with an additional 50 percent savings in changeover costs. In addition, flexible production allows automakers to offer a wider range of models, more choices within each model, and a fresh look more often.

US automakers are also at a disadvantage when it comes to workforce flexibility. Studies show that US automakers provide less training and give production

⁸ Michael Ellis and Jeffrey McCracken, "Harbour Report: U.S. Automakers Boost Factories' Productivity," *Detroit Free Press*, June 3, 2005.

⁹ Austin Weber, "Automakers Do More with Less: Automotive Manufacturers Face More Challenges and Opportunities than Ever," *Assembly*, September 1, 2004.

workers less responsibility than their global competitors.¹⁰ They also have a higher number of job classifications and more rigid work rules, restricting their ability to move people around to respond flexibly to changes in customer demand. And, until recently, they have had very little flexibility to close plants or lay off employees.

As a result, US automakers have higher fixed costs than their competitors, particularly higher labor costs. While the mostly non-union production and maintenance workers in transplant companies receive hourly pay that is comparable to their union counterparts in US companies (in part to avoid unionization), health care and pension costs run much higher for US automakers. Health care costs alone run \$450 per vehicle more at Chrysler and \$1,200 per vehicle more at General Motors than at the Japanese automakers, where most non-US employees are covered by a national health plan.¹¹ Pension, retiree health and other retiree benefits account for \$631 of every Chrysler vehicle's cost, \$734 per Ford vehicle, and \$1,360 for every GM car or truck. In contrast, pension and retiree benefit costs per vehicle for the U.S. plants of Honda and Toyota, where the average age of the workforce is much lower, are estimated to be \$107 and \$180 respectively.

Because they are limited in their ability to close plants or lay off workers as part of their agreement with the UAW, US automakers need to keep their plants running at 80 percent capacity, at minimum, to cover their costs. They have decided that it's cheaper to just keep making cars, even if they have to pay people to buy them. At the end of 2004, the average sales incentive for GM vehicles was \$4,124, \$3,795 for Chrysler, and \$3,541 for Ford, compared to Toyota's subsidy of \$747.¹² In general, sales discounts are unusual for Japanese automakers, which tend to use them only during economic downturns. US automakers, on the other hand, now rely on them heavily to keep their plants running at high capacity and realize economies of scale. During the summer of 2005, GM, Ford, and Chrysler all offered deep discounts as part of their "employee-pricing" advertising campaigns.

This heavy reliance on discounts to move cars is cutting deeply into profits, making it even more difficult to attract the investment US automakers need to modernize their plants and equipment and introduce more flexible production systems, thereby creating a vicious cycle that is hard to break.¹³

Automaker	2005 Profit/Loss Per Vehicle
General Motors	-\$2,311

¹⁰ Matthias Holweg and Frits K. Pil, *The Second Century: Reconnecting Customer and Value Chain Through Build-to-Order*, The MIT Press, Cambridge, MA, 2004, Chapter 11.

¹¹ David Welch, "Commentary: A Contract the Big Three Can Take to the Bank," *Business Week*, September 29, 2003

¹² Kothandaram Venkatakrishnan, "The Big Three on a Slippery Ground," Frost & Sullivan Market Insight, August 10, 2005; Jeff Plungis, "Automakers Now Discount 90% of Vehicles, See a Paltry 0.8% Rise," American International Auto Dealers Association, December 8, 2004.

¹³ Laura Smith, "What's Bugging the Big 3?" *Quality Digest*, November 9, 2005.

DaimlerChrysler	\$186
Ford	\$620
Honda	\$1,250
Toyota	\$1,488
Nissan	\$1,603

In August 2005, Moody's Corporation cut the credit rating at Ford and General Motors to junk bond status.

Response

US automakers are relying on three main strategies to become more competitive. They are shifting vehicle production to Canada and Mexico, shifting fixed costs to suppliers, and seeking new markets overseas.

US automakers have historically operated production facilities in Canada and Mexico, but they have mainly produced vehicles for sale in those countries, not for sale back into the US. That has changed dramatically over the past decade, beginning even before NAFTA took effect. Vehicle exports from Mexico to the US have gone from \$244 million in 1989 to \$4.6 billion in 1994 to \$13.1 billion in 1998. That trend is continuing. Today, half of the vehicles produced by US automakers in Canada and two-thirds of those produced in Mexico are sold in the US.¹⁴

The advantage of moving production to Mexico is obvious -- lower labor costs. In Canada, where wage rates for production workers are higher than in the US, it's not so obvious. However, overall labor costs are actually lower in Canada due to higher productivity and lower health care costs.

European and Japanese automakers are adopting the same strategy, developing their own regional production networks. In Europe, production is shifting from the traditional high-cost auto centers in the UK and Germany to lower-cost facilities in Spain and, increasingly, Eastern Europe. Although Japanese automakers have typically not produced vehicles in other low-cost countries for sale back in their home market, they too are now adopting a regional strategy. For example, Toyota plans to phase out domestic production of pick-up trucks in 2004 and shift production to Thailand.

The Japanese and European transplants also are pursuing the same regional strategy in North America as the US automakers. Toyota, Honda, and Suzuki have assembly plants in Canada, and Toyota, Honda, Nissan, BMW, Mercedes Benz, and Volkswagen have plants in Mexico.

Another strategy US automakers are using to cut fixed costs is to shift component and subassembly production to suppliers. This simplifies final assembly by cutting down on the number of operations involved, and it

¹⁴ Timothy Sturgeon and Richard Florida, "Globalization and Jobs in the Automotive Industry," MIT IPC Globalization Working Paper 01-003, March 2000.

simplifies purchasing by cutting down on the number of suppliers involved. It also cuts down on the amount of inventory, space, equipment, and number of employees required.

A good example of this strategy in action is the new Chrysler Jeep plant in Toledo, Ohio. Chrysler cut its capital investment by one-third by outsourcing 60 percent of the production responsibility to suppliers, who will own and operate three of the four factories co-located on the same site. One-quarter of the employees directly involved in production of the new Jeep will be on supplier payrolls.¹⁵

US automakers are also trying to cut their fixed costs by simplifying product and process design. They are minimizing the number of different platforms on which their vehicles are built, minimizing the number of unique parts that go into each vehicle, and minimizing the variety of production tools and production processes that they use in their operations. These changes make it easier for different plants to use common parts and processes across all operations around the globe. And they also make it possible to centralize product development, purchasing, and management functions in core locations. In addition, US automakers are also outsourcing some of the product and process design functions to tier-one suppliers.

The third competitive strategy US automakers are employing is to seek new markets overseas. Emerging markets are expected to account for 90 percent of net new sales growth over the next decade.¹⁶ New vehicle sales in China are currently growing at 30 percent a year, making it the third largest car market in the world.

US automakers are now competing with European and Japanese automakers to get a foothold in China, as well as India, Russia, and Brazil. Local content requirements, tariffs, and import restrictions make it necessary to invest in production facilities in these countries, rather than simply export vehicles to them. Assembly capacity in China is expected to double within the next four years, significantly exceeding domestic demand, in keeping with the Chinese government's plan to begin exporting vehicles to other countries.¹⁷ There is intense competition among automakers to get a big piece of this action.

Global automakers have announced that they intend to invest around \$13 billion to boost vehicle production in China to around 6 million cars a year. Currently, one-third of global growth in auto sales is coming from China.¹⁸ However, domestic sales growth in China is expected to slow to around 15 percent a year over the next few years, roughly half of its current rate. That will leave hundreds of thousands, if not millions, of cars looking for a market. General Motors and

¹⁵ Joann Muller, "Saving Chrysler," *Forbes*, August 16, 2004.

¹⁶ American Financial Services Association, "U.S. Auto Sector Outlook," April 2004.

¹⁷ International Metalworkers' Federation, *IMF Auto Report 2004*

¹⁸ Ted C. Fishman, *China Inc* (New York: Scribner, 2005)

Volkswagen are already exporting cars from China to neighboring countries in Asia. There will be increasing pressure to export more.

Independent Chinese automakers are looking at the US market for potential exports, but they still lack the distribution, sales, and maintenance networks they would need to be successful.¹⁹ One possibility is that they will develop alternative distribution networks similar to what they have done with motorcycles and off-road sport bikes, which are sold through Pep Boy's Auto Parts stores. Costco and other big-box stores provide a possible distribution channel for the first wave of Chinese cars, which would likely sell for less than \$10,000.²⁰

US automakers have begun to import Chinese-made parts for use in their North American assembly operations. Lower labor and energy costs make these parts attractive. However, higher costs of raw materials, many of which need to be imported, high transportation costs, and weak protection of intellectual property rights are still major problems.²¹

It will be several years before the infrastructure is in place to support significant export of parts from China. However, US suppliers are expanding their operations there, and investing in infrastructure improvements to support their operations. The biggest US parts makers, Delphi and Visteon, are rapidly expanding their China operations, while shutting their plants in the US.

Elsewhere, US auto industry investments in India and Brazil have been limited up to this point, because there is not enough per capita income in these countries yet to support a profitable automotive industry, and there may not be for another decade.

Employment Effects

The effects of these industry trends on employment are mixed. Unlike manufacturing employment overall, auto industry employment actually grew during the 1990's, despite the loss of jobs at Big 3 assembly plants due to increasing automation and shifting production to Canada and Mexico. The opening of Japanese and European transplants in the US has added tens of thousands of new assembly jobs. But, the biggest contributor to growth in industry employment has been the supply sector.

From the mid-1980's to the mid-1990's, automotive parts suppliers generated nearly three times the number of jobs added by the Japanese transplants, and nearly double the jobs lost by the Big 3 assembly plants. Since the mid-1990's, employment in the supply sector has increased by half again, although some of

¹⁹ Reuters, "China Export Dragon Stirs," September 24, 2004.

²⁰ Fishman, *China Inc.*

²¹ Alysha Webb, "Automotive News China Congress: Cheap Chinese Auto Parts? Maybe Not," *Automotive News*, June 14, 2004

that increase is due to GM and Ford spinning off their parts divisions into independent suppliers, Delphi and Visteon.

The new jobs from transplants are a mixed blessing for autoworkers. The assembly jobs that are disappearing are mainly from the traditional auto centers in the upper mid-west, while the new jobs being created by transplants are mainly down south. One out of five auto assembly jobs are now in the South. In addition, the lost assembly jobs have been mainly unionized, while transplants have located in areas that are mainly non-union, and they have successfully resisted union efforts to organize their facilities.

At the same time, high-paying research, design, engineering, and administrative jobs are still concentrated in the traditional centers. The largest US, European, Scandinavian, and Japanese suppliers have all established their North American headquarters just outside Detroit. This trend should continue as tier-one suppliers take on more of the design work from US automakers, requiring them to be located close to their customers' engineering centers.

The growth of the supply sector is also a mixed blessing for autoworkers. Jobs in supplier plants in the US pay 30-40 percent less than jobs in assembly plants, and that wage gap has been steadily widening for the past three decades. Only around 20 percent of the supply sector is unionized, and although unions have targeted this sector, they have been largely unsuccessful in their organizing efforts, despite occasional help from the Big 3 in twisting the arms of their suppliers.

Suppliers are under intense pressure to reduce costs from automakers and from competition with other suppliers. They are responding by increasing productivity, outsourcing components to even lower-cost suppliers, and shifting low-skill assembly work to Mexico and to other low-cost, off-shore locations. So far, the production of capital-intensive and high value-added parts (such as engines, transmissions, and body panels) has remained mainly in the US, largely due to sunk capital costs, lack of capability in low-cost countries, and union resistance to moving those jobs. However, as more and more assembly work shifts to low-cost countries, their infrastructure improves, and union influence weakens here at home, suppliers will likely shift more of their production work to low-cost countries as well.

Autoworker unions are looking for ways to stem this tide. In its latest round of bargaining with the Big 3, the UAW agreed to close unproductive plants, cut jobs, decrease job classifications, outsource peripheral jobs like janitorial services and material handling, and introduce a two-tier wage system (in the supply sector). The savings from these changes are estimated to be worth around \$300 per vehicle. To put this in perspective, the gap between Chrysler and its Japanese rivals is around \$750 per vehicle.²²

²² Muller, "Saving Chrysler."

But these concessions have not been enough to keep suppliers Visteon and Delphi competitive. Both have been struggling to stay afloat with wages and benefits that are twice what their rivals pay. Earlier this year, Visteon got Ford to agree to reclaim 24 factories and 17,000 employees in North America, so Visteon can focus on its more profitable operations overseas. In October 2005, Delphi declared bankruptcy after failing to wrest major concessions from the UAW in wages, retiree benefits, employee contributions to health care, and pay for laid off workers. These changes would affect 24,000 UAW workers and another 11,000 retirees. If Delphi is successful in using bankruptcy court to restructure their business, they are also likely to end up with a much smaller presence in North America and expanded operations in low-wage countries.²³ These actions make it more likely that GM and Ford will go down the same path.

The UAW also is ambivalent about adopting more flexible forms of work organization. On the one hand, they support giving more autonomy and decision-making authority to their members. At the same time, they worry that self-management and work teams might be so attractive that workers will decide that they don't need a union to represent them. The picture in Europe is very different, mainly because the European unions have had a long-standing interest in "group work," a higher level of political consensus about the possible benefits of new forms of work organization, and more experience working together with management for mutual gain.

Looking Ahead

The competitive strategies being implemented by US automakers, outlined above, are not necessarily being embraced by other automakers around the world. While all automakers are developing regional production networks and trying to gain a foothold in emerging markets, they do not all find that outsourcing production and product design to suppliers, then squeezing them for price reductions, is a desired strategy. Japanese automakers, in particular, are wary of this approach. They favor joint ventures with suppliers, taking a stake in the resulting entity.

That's because the Japanese believe that the winning strategy will be building vehicles to order and delivering them in a matter of days. That's what customers are coming to expect when it comes to other products, such as personal computers. It's just a matter of time before they demand the same thing from automakers.

Building vehicles to order can improve both quality and cost. Currently in the US, half of all customers drive home from the dealer in a car they didn't intend to buy, mainly because they couldn't find exactly what they wanted or weren't willing to wait several weeks or months for it to arrive.²⁴ Any automaker that

²³ David Welch and David Henry, "Spin-Offs that Won't Go Away," *Business Week*, September 19, 2005; David Welch, "Time and Patience Run Out at Delphi," *Business Week*, October 8, 2005; David Welch and David Henry, "Delphi: A Helluva Bargaining Chip," *Business Week*, October 24, 2005.

²⁴ Holweg and Pil, p.2.

can cut delivery time down to a matter of days and give customers exactly what they want will be rewarded with market share.

They will also save money. Studies suggest that automakers could save \$1,200 per vehicle by eliminating the logistics, handling, storing, and insurance costs that are associated with the mismatch between the cars they make and the cars customers really want. In addition, automakers and dealers spend another \$1,000 per vehicle on advertising to move the cars that nobody wants, on top of the thousands per vehicle they spend in financial incentives at the time of sale.²⁵

As Japanese and European automakers aggressively prepare to take this next leap forward in flexible manufacturing, US automakers face a dilemma. They have been closing the gap on costs with their competitors by using the strategies outlined above. However, the strategies that are bringing them success today may make it harder for them to build vehicles to order tomorrow.

In some ways, their approach to cutting costs has made them less flexible. For example, relying on suppliers to design and deliver components and subassemblies could make it harder to make rapid changes in response to shifting customer demand. Playing suppliers off against each other and squeezing them for price reductions could create instability within the supply chain. And outsourcing components to lower-cost suppliers and low-cost countries could add to delays and inventories, making it harder for automakers to respond quickly to changes in incoming orders.

Changing direction at this point would be very difficult. It would require that US automakers wean themselves from the incentives they have come to rely on so heavily to move vehicles off the lot, and that they close plants in the US to eliminate excess capacity. It would require that they work with suppliers as partners, rather than as vendors. In a nutshell, it would require that they transform the way they design, make, and sell vehicles.

To make the leap to build to order, US automakers would face some big hurdles. No matter how they organize production, they would still be burdened with higher health care and pension costs than their competitors. And they would still have to rely on their current plants, equipment, and workforce, all of which are older than those found in their competitor's operations.

The UAW has opened the door to the kind of restructuring that would allow US automakers to compete. It remains to be seen whether it's enough, whether it's in time, and whether the automakers themselves can do what's necessary to reverse the current trends.

²⁵ Holweg and Pil, Chapter 7.

Health Care Industry Trends

Pete Carlson and Ellen Scully-Russ

Introduction

The health care industry employs nearly 8 percent of the US workforce and is growing faster than most other industries. Spending on health care now accounts for more than 16 percent of GDP and continues to rise.¹ The delivery system for health care services includes doctor's offices, ambulatory care facilities, hospitals, rehabilitation centers, nursing and residential care facilities for the elderly and the mentally ill, and home health care providers.

The US health care system is unique among developed nations. Instead of a national insurance program, the US relies heavily on the private sector and has a fragmented system of many different sources of funding and types of coverage. Nearly three-fourths of the population is covered by private health insurance. This includes most of the working-age population and their dependents, covered by employer-provided insurance plans. Employers are not required by law to offer health insurance coverage to employees, but they get a tax break if they do so. The federal Medicare program covers almost all of the elderly and some of the disabled. The federal-state funded Medicaid and State Children's Health Insurance Program (SCHIP) provide a social safety net for the poorest families and for near-poor children. Finally, around 16 percent of the population has no insurance coverage at all.

This report describes key trends in the US health care industry, how the US health care system stacks up against other countries, and what the implications are for jobs in the US.

Key Trends

Rising costs. The most significant trend in the health care industry today is the rising cost of care. In 2004, employer health insurance costs rose 8 percent, almost three times the rate of inflation.² Since 2000, employee health insurance costs have risen by 36 percent, more than twice the 12.4 percent increase in average earnings.³ During that same period, Medicaid costs have gone up by 63 percent.⁴

Prescription drugs are the fastest growing component of health care costs. Although rising prices are partly responsible, increased utilization is the main driver. Doctors are increasingly relying on prescription drugs to treat their patients. They have a widening

¹ Cynthia Smith, Cathy Cowan, Stephen Heffler, Aaron Catlin, and the national Health Accounts Team, "National Health Spending in 2004: Recent Slowdown Led By Prescription Drug Spending," *Health Affairs*, January/February 2006.

² Marc Kaufman and Rob Stein, "Record Share of Economy Spent on Health Care," *Washington Post*, January 10, 2006.

³ Ceci Connolly, "Higher Costs, Less Care," *The Washington Post*, September 28, 2004.

⁴ Robert Pear, "Health Secretary Calls for Medicaid Changes," *The New York Times*, February 2, 2005.

array of new drugs to choose from, and the growth of direct advertising to consumers has spurred demand. Between 1995 and 2003, the number of prescriptions sold annually rose from 2.1 billion to 3.2 billion.⁵

New medical technologies also account for much of the increase in health care costs. A traditional X-ray machine costs \$175,000, while the current technology, a CAT scanner, costs \$1 million. A traditional cardiac balloon catheter cost \$500, while the latest technology, a treated stent, costs \$5,000.⁶ These expensive new technologies are being used on a broader array of patients. In addition, physicians prefer to prescribe the latest and best tests and devices for their patients.⁷

In the early 1990s, employers responded to rising health care costs by switching to managed care plans that limited patients' choice of physicians and hospitals and that required prior approval for certain high-cost procedures. In 1988, three-quarters of employees were enrolled in conventional fee-for-service plans, while one-quarter were enrolled in either an HMO or a preferred provider organization (PPO). By 1996, only one-quarter of employees were still enrolled in conventional plans, while three-quarters were enrolled in either an HMO or a PPO.⁸

However, in the late 1990s, a backlash from employees, bolstered by a tight labor market, forced employers to choose less restrictive health plans. Physicians and hospitals banded together into networks and used their increased bargaining power to force insurers to loosen controls and negotiate more favorable reimbursement rates. As a result, health care costs, which had leveled off in the mid-1990s, began climbing again in the late 1990s.

The federal government also sought to curb the rising costs of Medicare in the mid-1990s by limiting reimbursements to hospitals. This produced an actual decline in payments of 1.2 percent in 1998, which led to considerable financial instability among hospitals.⁹ A backlash from hospitals forced Congress to partially restore the reductions they had made in reimbursements.

The retreat from tightly managed care has left employers and the government searching for new ways to reduce health care costs. However, most of their efforts have focused on shifting costs, rather than actually reducing them. Employers have been reducing prescription drug benefits, increasing co-pays and deductibles, and reducing retiree benefits to shift costs to employees. The federal government and the states have been

⁵ Elizabeth Querna, "The Druggist is In," *U.S. News & World Report*, January 31, 2005.

⁶ American Hospital Association, "Overview of the U.S. Health Care System," www.hospitalconnect.com/aha/resource_center.

⁷ PriceWaterhouseCoopers, "Cost of Caring: Key Drivers of Growth in Spending on Hospital Care," Prepared for the American Hospital Association and the Federation of American Hospitals, February 19, 2003.

⁸ Marc L. Berk and Alan C. Monheit, "The Concentration of Health Care Expenditures, Revisited," *Health Affairs*, March/April 2001.

⁹ Centers for Medicare and Medicaid Services (CMS), "Health Care Industry Market Update – Acute Care Hospitals," April 29, 2002.

arm wrestling over who's going to take responsibility for rapidly rising Medicaid costs. Meanwhile, many states have been cutting back on Medicaid expenditures, shifting the cost to providers, who are required by law to treat the uninsured.

One promising approach to actually reducing the cost of care is to focus on those patients who are the most costly to treat. Roughly 75 percent of all health care spending in the US is for the treatment of chronic diseases.¹⁰ Yet, the main focus of the US health care system is on the treatment of short-term, acute health problems. As a nation, the US emphasizes expensive cures for diseases, rather than cost-effective prevention. As a result, a recent national study found that patients with chronic diseases typically receive only 56 percent of the recommended care for their condition, based on the best available medical evidence and research.¹¹

Under the current system, chronic care is simply not as profitable as acute care. Insurance plans are more likely to pay more than \$30,000 for an amputation than the \$150 it would take for a diabetic to see a podiatrist to prevent diabetes-associated foot problems.¹² Since the average person changes insurance carriers every six years, and the complications associated with many chronic conditions don't show up for many years, insurance companies are not likely to realize the savings from investments in prevention. Those savings are more likely to be realized by their competitors. Insurance companies are also concerned that if they do a good job of serving the chronically ill, they will attract more of them. That would end up adding risk, and therefore cost.

Some health plans are currently experimenting with wellness or prevention programs, and with disease management programs that focus on the needs of a population of patients who have a specific chronic condition such as asthma or diabetes, where well-established guidelines exist for treatment. To date, evidence of the effectiveness of disease management programs is mixed. Part of the problem may be the turnover within plans, which makes it difficult to capture benefits that only show up over time.

The benefits are more likely to show up among Medicare beneficiaries, who have less turnover and greater need. Nearly 80 percent of all Medicare beneficiaries have at least one chronic condition, and nearly half have three or more chronic conditions. In addition, 5 percent of beneficiaries account for nearly half of the program's total expenditures.¹³ The Centers for Medicare and Medicaid Services (CMS) is currently conducting a large-scale pilot program to improve chronic care.¹⁴ If successful, other health plans could follow suit.

¹⁰ Centers for Disease Control and Prevention, "The Power of Prevention," US Department of Health and Human Services, 2003.

¹¹ Elizabeth A. McGlynn et al., "The Quality of Health Care Delivered to Adults in the United States," *The New England Journal of Medicine*, 2003; 348.

¹² Ian Urbina, "In the Treatment of Diabetes, Success Often Does Not Pay," *New York Times*, January 11, 2006.

¹³ Centers for Medicare and Medicaid, "Health Care Industry Market Update – Managed Care," March 24, 2003

¹⁴ Nora Super, "Medicare's Chronic Care Improvement Program: What is its Potential?" *National Health Policy Forum Issue Brief No. 797*, May 10, 2004.

Changing industry structure. A second major trend is the changing structure of the industry. Three main factors are driving this restructuring. Advances in medical technology have made it possible to perform many procedures in an outpatient setting that previously required hospitalization. Incentives in the Medicare payment system have reduced hospital length of stay, shifted some care to outpatient settings, and shifted other care to skilled nursing facilities. And managed care has reduced unnecessary hospitalizations and hospital days.

Hospitals have seen the biggest changes. Since 1980, hospital inpatient admissions have declined by 14 percent and hospital length of stay has also declined by 14 percent.¹⁵ As a result, the number of hospitals has fallen by 16 percent, and the number of hospital beds per 100,000 in the population has fallen by 34 percent.¹⁶ Hospitals treat patients who are much sicker than in the past, and who are also discharged more quickly than in the past.

Many of the patients being discharged from hospitals are transferred to skilled nursing facilities. Between 1980 and 1997, nursing home care was one of the fastest growing components of the Medicare program, growing at an average annual rate of 30 percent.¹⁷ In 1987 there were a total of 14,050 nursing homes with a total of 1.48 million beds, compared to 16,840 nursing homes with a total of 1.76 million beds in 1996. This represents a growth of almost 20 percent in ten years.

The biggest change in the industry, however, has been the rapid growth of freestanding ambulatory care centers and specialty hospitals. These facilities include heart hospitals, orthopedic hospitals, surgical hospitals and ambulatory surgery centers, cancer hospitals and centers, dialysis clinics, pain centers, imaging centers, mammography centers, and providers of many other specialty services. Their number is increasing rapidly. The number of Medicare-certified ambulatory surgery centers doubled in the past decade, and now exceeds the number of hospital-owned outpatient surgery departments with which they compete.¹⁸ The number of specialty hospitals has tripled.¹⁹ And the compound annual growth rate of ambulatory surgeries performed in freestanding centers or physician offices is three times the rate for hospital-based, out-patient surgeries.²⁰

This rapid growth is due to several factors. Advances in anesthesia and in surgical equipment and techniques (such as arthroscopic surgery) now make it possible to perform a wider range of procedures on an out-patient basis. Reimbursement rates for these procedures are relatively favorable, particularly for cardiovascular and orthopedic

¹⁵ Gloria J. Bazzoli, Linda R. Brewster, Gigi Liu, and Sylvia Kuo, "Does U.S. Hospital Capacity Need to be Expanded?" *Health Affairs*, November/December 2003.

¹⁶ American Hospital Association, "TrendWatch – Chartbook 2004," www.hospitalconnect.com.

¹⁷ Centers for Medicare and Medicaid Services, "Health Care Industry Market Update – Nursing Facilities," May 20, 2003.

¹⁸ Lawrence P. Casalino, Kelly J. Devers, and Linda R. Brewster, "Focused Factories? Physician-Owned Specialty Facilities," *Health Affairs*, November/December 2003.

¹⁹ John K. Inglehart, "The Emergence of Physician-Owned Specialty Hospitals," *The New England Journal of Medicine*, January 6, 2005.

²⁰ VHA, "The Doctor is Out: Physician Competitors in the Marketplace," *VHA Research Series*, 2003.

surgery. Physicians, who have chafed at the restrictions placed on them by hospitals and insurers, are able to gain more control over their practice, and they are also able to share in the profits. On average, physician ownership exceeds 50 percent at the specialty hospitals in which they have a share.²¹

These freestanding outpatient facilities pose a significant challenge to hospitals by drawing away doctors, patients, and hospitals' most profitable services. Cardiology services alone can account for one-quarter of hospital admissions and one-third of hospital revenue.²² Orthopedic procedures are also one of a hospital's most profitable services. These are the two services most often found in specialty hospitals.

There is another trend reinforcing the shift to freestanding outpatient facilities. During the 1990s, managed care gave physicians an incentive to band together into large medical groups to build a large patient base and to gain negotiating leverage with health plans. They tended to be multi-specialty groups in which primary-care physicians played a central role in referring patients. However, as health plans have retreated from managed care, primary-care physicians are no longer the gatekeepers, and there is less need for physicians from different specialties to be linked to each other.

As a result, and in parallel with the growth of specialty hospitals, there has been a shift toward single-specialty medical groups since the late 1990s.²³ These medical groups can pool their resources to invest in the latest technologies, establish their own freestanding facilities, negotiate favorable terms with health plans, and avoid much of the administrative and regulatory complexity associated with hospitals. Since a high volume of patients has been shown to lead to higher quality and lower costs,²⁴ this combination of single-specialty medical groups and specialty hospitals has the potential to achieve the same kind of advantages that have accrued to "category killers" in other industries.

There is evidence that freestanding outpatient facilities treat patients with better insurance coverage, lower risk, and less complex medical needs than those who receive treatment at hospitals.²⁵ There is also evidence that patients prefer the convenience, ambience, and efficiency of these freestanding facilities, and that staff prefer the regular hours and better work environment. If those trends continue, it is likely that the market will be increasingly segmented, and hospitals will be left with higher-risk patients with more complex medical needs, victims of trauma, and those with little or no health insurance coverage.

²¹ Inglehart.

²² Kelly J. Devers, Linda R. Brewster, and Paul B. Ginsburg, "Specialty Hospitals: Focused Factories or Cream Skimmers?" *Issue Brief*, Center for Studying Health System Change, April 2003.

²³ Lawrence P. Casalino, Hoangmai Pham, and Gloria Bazzoli, "Growth of Single-Specialty Medical Groups," *Health Affairs*, March/April 2004.

²⁴ John D. Birkmeyer, et al., "Surgeon Volume and Operative Mortality in the United States," *The New England Journal of Medicine*, November 27, 2003.

²⁵ Ariel, Winter, "Comparing the Mix of Patients in Various Outpatient Surgery Settings," *Health Affairs*, November/December 2003.

Hospitals are attempting to avoid this fate by making it more difficult for new freestanding facilities to enter the market. In 2003, the hospital industry convinced Congress to impose an 18-month moratorium on new physician-owned specialty hospitals, citing potential conflict of interest from self-referrals. When that moratorium expired in June of 2005, CMS extended it for 6 months to review its procedures for enrolling specialty hospitals in the Medicare program. To hedge their bets, hospitals are also financing their own freestanding facilities.

Pressure to Improve Quality. Another major industry trend is increasing pressure to improve the quality of care. Both external pressures and internal enablers have caused the industry to seek new ways to improve organizational performance and health outcomes. This trend has implications for the practice of medicine and the roles payers, practitioners and consumers play in the delivery of health care.

One strategy to improve quality is to require health care providers to measure and report on the quality of care they provide. A number of national organizations, including the National Committee for Quality Assurance (NCQA), the Joint Commission on Accrediting Healthcare Organizations (JCAHO), the Centers for Medicare and Medicaid Services (CMS), and the National Quality Forum (NQF), have developed measures of health care quality for use by health plans, hospitals, nursing homes, home health agencies, and clinicians. CMS has launched websites that contain quality information voluntarily reported by hospitals and nursing homes. Federal legislation in 2005 established a system of voluntary reporting of medical errors by hospitals. Some states have gone even further to make such reporting mandatory.

This system of tracking quality and making the results available to consumers is intended to introduce competition into the health care system. Proponents believe that as consumers become more informed about care options, quality, and costs, providers will face pressure to adopt new competitive practices based on improved care and customer satisfaction. With better information, patients are likely to take better care of themselves and cooperate more with treatment plans. But they also may demand a greater say in their care and increased access to clinicians and to treatments, which may increase costs.

Another strategy to improve quality reinforces reporting by also rewarding higher quality care. CMS and other payers are experimenting with new pay for performance schemes that offer financial incentives to providers to improve their quality outcomes on 10 clinical measures for Medicare patients. Those hospitals in the top 20 percent get a bonus, while those hospitals in the bottom 20 percent will get a 0.4 percent reduction in their annual Medicare fee schedule update. CMS is building similar systems for nursing homes and for physicians.

A number of private organizations have adopted similar pay-for-performance schemes. Two insurers, WellPoint Inc. and United Health Group, have begun rating hospitals and rewarding high-quality care. For example, if the hospital scores high on quality for bypass operations, it gets a bonus of 1 to 4 percent on top of its fixed fee for the

procedure.²⁶ The Leapfrog group, a coalition of employers and other organizations who buy health care, also rewards hospitals for improvements in quality. The organization surveys hospitals on a variety of quality measures and makes the results available to employer members, who share them with their employees. These groups, along with many others, have now joined together in the Bridges to Excellence Coalition to push for the expansion of pay for performance programs.

A third strategy to improve quality is to adopt information technologies. Health care is the one of the most, if not the most, complex sectors of the economy.²⁷ The industry's fragmentation not only contributes to redundancy and waste, it also makes it extremely difficult to build the infrastructure needed to improve quality and performance. Because patient information usually resides in different places, clinicians often do not have full knowledge of their patients' medical history, condition, or current treatments. For example, most doctors have no idea what the average blood pressure is of their cardiac patients. In fact, many do not know how many heart patients they have or how many have been prescribed a particular drug.²⁸ This type of customer and product information is routinely available in other industries, where it is used to support decision-making and quality improvements, but not in health care.

Many errors and costly redundancies could be avoided if the industry improved the way it managed and shared patient information. In a 1990 cross sector survey of American industries, health care ranked 38th out of 53 in its investments in information technology.²⁹ However, in 2004, the American Health Information Management Association found that 40 percent of the respondents to their annual survey were engaged in the implementation of new information systems, and only 10 percent said they had no foreseeable plans to upgrade their systems. National policy is pushing the industry in this direction.³⁰ The US Department of Health and Human Services has established the Office of the National Coordinator for Health Information Technology to support the widespread adoption of health information management systems within 10 years.³¹ Dr. David J. Brailer, the head of that office, predicts that tech investments could lead to \$140 billion a year in cost savings by 2014, or an estimated 6 percent of health-care spending in that year.³²

A final strategy for improving quality is to establish standards and care protocols based on advanced medical knowledge and best practices for patients with common conditions. This information would aid clinicians in the development of diagnosis and treatment

²⁶ The Digital Hospital. (2005, March 28, 2005). *Business Week*.

²⁷ *Crossing the Quality Chasm: A New Health Care System for the 21st Century*. (2001). Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine.

²⁸ The Tech Guru: Dr. Gerald Burns, A former trauma surgeon champions life saving data. (2005, March 28, 2005). *Business Week*.

²⁹ Wasting Disease. (2005, July 15, 2004). *The Economist*.

³⁰ Zender, A. (2005). *Ready for the EHR? A New Survey Measures EHR Implementation and Individual Readiness*. Retrieved April 4, 2005, from www.ahima.org

³¹ *Health IT Strategic Framework*. (2004). Washington, DC: Office of the Coordinator for Health Information Technology.

³² Timothy J. Mullaney and Arlene Weintraub, "The Digital Hospital, *Business Week*, March 28, 2005.

plans, and ensure far more consistency in care and outcomes.³³ New technology-enabled decision-support systems could provide doctors and other clinicians with access to this information at the point of practice, further ensuring the dissemination of best practices throughout the industry.

New decision support systems based on standardized protocols could clearly make a big difference in the quality of care. However, the acceptance of these innovations by the medical community has been slow.³⁴ Studies show that it takes an average of 17 years for new medical knowledge to be incorporated into practice, and even then, much of the new knowledge fails to reach, or is never adopted by, many clinicians. One reason is because standardized protocols run counter to the culture of medicine that is highly individualistic and perpetuates a craft-based occupational model. Most doctors and other clinicians are trained to draw upon their years of education and clinical experience in the delivery of care, and therefore resist a more standardized approach to care. However, if clinicians are unable to access and use today's knowledge and technologies, they will be even less prepared to integrate more advanced knowledge and technologies that will surely come in the years ahead.³⁵

Aging Population. A much-cited trend these days is the aging of the population. By 2025, 18.5 percent of the population will be age 65 or over, compared to 12.4 percent in 2000. That represents an 80 percent increase in the actual number of elderly Americans.³⁶ Many observers have concluded that this trend will significantly increase the demand for health care services.

There are predictions that, as demand increases, there will be shortages of doctors, nurses, and pharmacists. The number of doctors entering practice has been around 20,000 a year for the past two decades. However, studies suggest that the medical needs of an aging population will require anywhere from 50,000 to 200,000 more than the number currently in the pipeline by 2020.³⁷ A shortage of nurses already exists and is expected to get worse over the next decade as Baby Boomers retire.³⁸ The biggest bottleneck is a shortage of faculty in nursing schools to train new nurses. In addition, more than 40 percent of nurses currently working in hospitals report high levels of dissatisfaction and burnout. Pharmacists, too, are currently in short supply, at a time when the number of prescriptions to be filled is rising rapidly.³⁹ The new Medicare prescription drug benefit is likely to add to this burden. However, following a decline in

³³ *Crossing the Quality Chasm: A New Health Care System for the 21st Century.* (2001). Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine.

³⁴ Reed, M. C., & Grossman, J. M. (2004). *Limited Information Technology for Patient Care in Physician Offices* (No. NO. 89). Washington, DC: Center for Studying Health Systems Change.

³⁵ *Crossing the Quality Chasm: A New Health Care System for the 21st Century.*

³⁶ Laura B. Benko, "Boomer Bust?" *Modern Healthcare*, July 28, 2003.

³⁷ Myrle Croasdale, "Physician Work Force Estimates Far Apart," *AMNews*, June 20, 2005.

³⁸ American Association of Colleges of Nursing, "Nursing Shortage Fact Sheet," www.aacn.nche.edu, accessed 12/6/05.

³⁹ American Foundation for Pharmaceutical Education, "Facts at a Glance: The Pharmacist Shortage," www.afpenet.org, accessed 12/6/05.

the late 1990s, the number of applications to pharmacy schools is now increasing once again.

There is some evidence to support the conclusion that an aging population will put a significant strain on the current system. Historical data show that as people age, their use of medical services increases. Research by the Center for Studying Health System Change found that per-person spending on health care increased by an average \$40 a year for individuals between 18 and 50 years old. Between ages 50 and 64, however, spending accelerated, increasing by an average of \$152 a year.⁴⁰ Average per-person spending on health care for individuals 65 and over is three times the spending for individuals ages 34 to 44.⁴¹

Many hospitals are responding to the aging of the population by building new facilities and expanding existing ones. In particular, they are investing in new units to treat heart, joint, and cancer patients, because these conditions are common among the elderly.

However, it's unclear whether the expected influx of hospital patients will actually materialize. It's likely that a growing proportion of patients will receive care at freestanding surgery centers and ambulatory care centers to take advantage of the greater efficiency and convenience these facilities offer. And it's also likely that advances in genomics and preventive care will moderate the effects of aging, offsetting much of the demand for traditional hospital services.

New medicines are on the horizon to combat traditional age-related conditions. New anti-osteoporosis drugs are in development to prevent broken bones. New cholesterol-lowering drugs called statins are demonstrating effectiveness in preventing Alzheimer's disease and in reducing the incidence of cardiovascular disease. Other drugs are targeting specific types of cancer. And genetic research is under way to develop products that would slow aging, prolong youthfulness, and forestall age-related ailments.

Chronic disability rates among the elderly have been falling since 1982. The percentage of the elderly with debilitating conditions fell by 1.6 percent annually between 1982 and 1994. Since then, it has fallen by 2.6 percent annually. If that decline continues, there will be 40 percent fewer elderly with disabilities in 2027 than without these improvements. Cancer rates have also been falling by 1 percent annually since 1992.⁴²

Some of these gains can be attributed to better health education and preventive medicine. For instance, smoking rates have dropped significantly over the past several decades due to greater public awareness about the health risks. That greatly reduces the incidence of emphysema and cancers associated with smoking. As a result, the elderly are much healthier today than in the past, and that trend is accelerating.

⁴⁰ Bradley C. Strunk and Paul B. Ginsburg, "Aging Plays Limited Role in Health Care Cost Trends," Center for Studying Health System Change, *Data Bulletin* No. 23, September 2002.

⁴¹ Uwe Reinhardt, "Does the Aging of the Population Really Drive the Demand for Health Care?" *Health Affairs*, November/December 2003.

⁴² Laura B. Benko, "Boomer Bust?"

Better health makes it possible for the elderly to live longer and more independently. The ability to live independently, along with changing preferences among the elderly, is driving demand for home health services. During the 1990s, services delivered at home to recovering, disabled, chronically or terminally ill persons was one of the fastest growing expenditures in Medicare.⁴³ A study by JPMorgan projects that the industry will continue to grow at an annual rate of 5 to 10 percent.

In addition, an increasing number of the elderly are choosing hospice care at home, rather than living out their last days in an acute-care institution. Since Medicare first offered the hospice benefit in 1982, the number of providers has grown from 31 to 3,100.⁴⁴ Although the Medicare reimbursement rates for hospitals and nursing homes were cut in the 1990s, the rates for hospice service were increased, making it a more attractive option. Since Medicare beneficiaries incur around 28 percent of their total medical costs in their last year of life, and half of that in the last two months of life, a continuing shift to less-expensive hospice care could deliver significant cost savings, as well as better quality at the end of life.

Outsourcing. A final trend worth mentioning is outsourcing by health care institutions, mainly hospitals. While hospitals have been slower than most other industries to adopt outsourcing, the practice is growing, driven mainly by the pressure to cut costs.⁴⁵ The most common functions affected are information technology, finance, and support areas like food service, housekeeping, and laundry. Clinical functions are the least affected.

Although the off-shoring of some medical services, along with “medical tourism,” has received a lot of attention in the press, these practices are very limited and represent just a tiny fraction of all the work that has moved overseas in recent years.⁴⁶ Some hospitals rely on radiologists in Australia, India, Israel, and Switzerland to read and interpret scans from their patients in the US, but this practice is mainly being driven by the exploding demand for the use of new imaging technologies and the corresponding shortage of trained radiologists in the US.⁴⁷ There’s evidence that the supply of radiologists is catching up the rising demand.⁴⁸ Meanwhile, Medical tourism is constrained by insurance coverage, which rarely extends to voluntary procedures performed in other countries.

It is likely that the outsourcing trend will continue in health care. Information technology functions, in particular, are likely to be outsourced as hospitals face mounting pressure to adopt new clinical information systems and computerized physician order entry systems

⁴³ Centers for Medicare and Medicaid Services, “Health Care Industry Market Update – Home Health,” September 22, 2003.

⁴⁴ Julie Piotrowski, “The Business of Care for the Dying,” *Modern Healthcare*, November 4, 2002.

⁴⁵ VHA, “Hospitals Increasingly Outsourcing Key Functions,” Press Release, February 4, 2000.

⁴⁶ Susanna Moon, “2004 Outsourcing Survey: Outsiders Moving In,” *Modern Healthcare*, September 27, 2004.

⁴⁷ The Associated Press, “Some U.S. Hospitals Outsourcing Work,” December 6, 2004.

⁴⁸ Radiological Society of North America, “Radiologist Shortage Over? Survey Says Yes,” www.rsna.org, accessed 12/6/05.

to promote patient safety. Currently, most hospitals lack the expertise in-house to deploy these systems, and they will need to turn to outside vendors and partners for help.

However, hospitals face a number of constraints on their outsourcing activities. One is the threat that they might lose their non-profit status if they outsource too many of their functions to for-profit entities. In 2004, a medical center in Illinois was stripped of its non-profit status and received a \$1.1 million local property tax bill after a review board determined that it relied too heavily on for-profit entities to provide hospital services.⁴⁹ Congress is also gearing up to take a look at this issue.

Another constraint is concern about privacy issues. The Health Insurance Portability and Accountability Act (HIPAA) places strict limits on the use of patient information, provides a mechanism for individuals to file complaints, and imposes civil penalties on institutions or individuals that violate its provisions. Outsourcing work that involves sensitive patient information could make patients uneasy and increase the risk of legal action.

Finally, outsourcing clinical functions could undermine hospital efforts to improve the quality of care. The fragmentation of hospital operations is currently one of the biggest obstacles to improving the quality of care. Further fragmentation through outsourcing could increase the number of hand-offs and increase the likelihood of errors.

International Comparisons

Although the cost of care is on the rise in all OECD countries, the U.S. system is by far the most expensive in the world. US citizens spend 53 percent more for their health care than anyone else in the world.⁵⁰ This difference cannot be attributed to higher volume or higher quality of care. On most measures of healthcare usage, the U.S. falls below the OECD median. The U.S. trails other OECD countries on outcome measures like life expectancy and infant mortality, occupying the bottom quartile of industrialized countries.⁵¹

In cross-country comparisons of patients with common conditions, the U.S. healthcare system lags other OECD countries. Several countries are equally successful in reducing overall mortality, and some even achieve better results with younger patients.⁵² In addition, the U.S. system lags in basic quality measures like citizen satisfaction. In international surveys of citizen satisfaction with their healthcare systems, Canada and European nations consistently earn higher marks than the U.S.⁵³ Patient-reported

⁴⁹ Michael Romano, "Outsourcing Everything," *Modern Healthcare*, April 5, 2004.

⁵⁰ Gerard F. Anderson, Peter S. Hussey, Bianca K. Frogner and Hugh R. Waters, "Health Spending in the United States and the Rest of the Industrialized World," *Health Affairs*, July/August 2005.

⁵¹ Anderson, G. F., Uwe, E. R., Hussey, P. S., & Petrosyan, V. (2003). The Prices, Stupid: Why The United States Is So Different From Other Countries. *Health Affairs*, 22(3).

⁵² Doctuer, E., Suppanz, H., & Woo, J. (2003). *The US Health System: An Assessment and Prospective Directives for Reform* (No. 350): OECD.

⁵³ Anderson, G. F., Uwe, E. R., Hussey, P. S., & Petrosyan, V. (2003). The Prices, Stupid: Why The United States Is So Different From Other Countries. *Health Affairs*, 22(3).

medication errors, medical mistakes, or lab errors in the US are the highest among the advanced industrialized countries.⁵⁴ And half of sick adults in the US report that they didn't visit a doctor, get the recommended treatment, or fill a prescription because of the cost, a rate nearly double the next-highest country.

The higher costs Americans pay for health services can be attributed to a number of factors. First, the inputs of care, like salaries, medical equipment, pharmaceuticals, and other supplies, are more expensive in the U.S. than in other countries. The buying power of the U.S. healthcare system is weak by international standards. In other parts of the world, like Canada, Europe, and Japan, the government controls the financing and, in the case of England, the provision of health care. The monopolistic powers of these national systems enable them to extract bigger discounts from providers of health services and products. Prescription drugs, for example, are generally much cheaper in other industrialized countries than they are in the United States.⁵⁵ And the cost of a procedure in Canada is one-third the cost for the same procedure in the U.S.⁵⁶

Second, the average hospital stay, although shorter than most OECD countries, is typically more labor intensive in the United States.⁵⁷ And third, the fragmented structure of the US health care system creates a costly administrative burden that far exceeds what other nations must bear. The multiple payer system in the US is inherently more expensive than the single payer systems found in other industrialized countries. Each insurer in the US must maintain its own claims processing facilities, which increases overhead costs. Providers must deal with multiple insurance products, and keep track of different eligibility requirements, co-payments, referral networks, and approval requirements. To manage this complexity, U.S. providers must maintain complicated billing, cost accounting, and internal auditing systems.⁵⁸ As a result, administrative overhead accounts for as much as 31 percent of healthcare expenditures in the U.S., as opposed to just 16.7 percent in Canada.

Implications for Employment

The high cost of health care in the U.S. relative to other industrialized nations has serious implications for the U.S. economy. To be competitive, US-based companies either need to find ways to offset their higher health care costs, or they need to find ways to move jobs off shore to countries where health care costs are lower.

⁵⁴ Cathy Schoen, Robin Osborn, Phuong Trang Huynh, Michelle Doty, Kinga Zapert, Jordon Peugh, and Karen Davis, "Taking the Pulse of Health Care Systems: Experiences of Patients with Health Problems in Six Countries," *Health Affairs* Web Exclusive, November 3, 2005.

⁵⁵ The Health of Nations. (2004, July 15, 2004). *The Economist*.

⁵⁶ Anderson, G. F., Uwe, E. R., Hussey, P. S., & Petrosyan, V. (2003). The Prices, Stupid: Why The United States Is So Different From Other Countries. *Health Affairs*, 22(3).

⁵⁷ Reinhardt, U. E., Hussey, P. S., & Anderson, G. F. (2004). U.S. Health Care Spending in an International Context. *Health Affairs*, 23(3), 10 - 26.

⁵⁸ Woolhandler, S., M.D., M.P.H., Campbell, T., M.H.A., & Himmelstein, D. U., M.D. (2003). Costs of Health Care Administration in the United States and Canada. *New England Journal of Medicine*, 349(8), 768-775.

Health care costs for current and retired workers add as much as \$1,500 to the cost of every car or truck produced by Big Three automakers in the US.⁵⁹ By comparison, Toyota spent \$186 on health and pension costs on every car built globally in 2003. That figure fell by 3 percent from the previous year, while health care costs for the Big Three rose by 16 percent. US automakers have been shifting production to Canada, where health care coverage for auto workers and their families is less than one-fifth the cost in the US, yielding a \$4 per hour wage advantage.⁶⁰ In general, benefit costs account for 28.8 percent of compensation for private sector production workers in the US, compared to 17.0 percent in Japan, 16.6 percent in Canada, and 17.6 percent in the UK. Three-fourths of the difference is due directly to the different health care system in the US.⁶¹

The good news for the US is that, beyond the cost differential, the health care systems in all industrialized countries face many of the same problems. The cost of health care spending per person is rising in all industrialized nations at a relatively similar rate. All industrialized countries have been slow to invest in information technology that can reduce errors and improve quality and efficiency, and they have been slow to adopt evidence-based standards and protocols. Access to care is also a common problem. In some countries, like Canada and England, wait time for services are very high, whereas America's mixed funding arrangement leaves 44 million people without healthcare.⁶²

It's possible that adopting a single-payer system in the US could close much of the gap with other countries. Eliminating the fragmentation created by the current system could reap huge savings by reducing administrative costs and by making it possible to negotiate lower prices for drugs and other medical supplies and devices. It could also speed the introduction of information technology, which could further reduce paperwork, increase efficiency, and improve quality of care. But this solution is unlikely in the current political environment.

Focusing more on chronic conditions could also reap huge benefits. As mentioned above, chronic conditions are the leading cause of illness, disability, and death in the US, and account for the bulk of health care spending. By organizing care delivery along the lines of specific conditions, such as diabetes, cancer, and cardiovascular disease, it would be possible to bring together the best available medical evidence, the necessary practitioners and equipment, and the patients who need treatment. Since most patients respond to similar treatments, it would also be possible to standardize care delivery into routine protocols. That would pave the way for introducing methods to improve quality and efficiency that have proven effective in other industries, but have so far had limited impact in the current fragmented environment.

However, focusing more attention on managing chronic conditions could have a profound impact on hospitals, which have come to rely on the income from treating the effects of chronic illness. Hospitals are already under considerable pressure to cut costs, and they

⁵⁹ John D. Stoll, "The Health Care Crisis," *Ward's Auto World*, February 1, 2005.

⁶⁰ Kirstin Downey, "A Heftier Dose to Swallow," *The Washington Post*, March 6, 2004.

⁶¹ Labor Research Association, "The Auto Industry Crisis is a Health Care Crisis," 2005.

⁶² The Health of Nations. (2004, July 15, 2004). *The Economist*.

are under siege from the growing ranks of freestanding facilities. As the more modern, more patient-friendly, and potentially more efficient freestanding facilities demonstrate an advantage in quality and cost in a market where these factors are becoming increasingly transparent, they are likely to attract growing numbers of patients and change the competitive landscape dramatically.

This trend could lead to a two-tiered health system in the US. As patients with insurance and the ability to pay seek care at freestanding facilities, hospitals will be less able to cross-subsidize care for the elderly, disabled, poor, and uninsured, at a time when there are increasing numbers of elderly to serve and likely increases in the ranks of the uninsured, because they are unable to afford rising deductibles and co-insurance payments, or because states have trimmed their Medicaid rolls.⁶³ How the nation chooses to respond to this challenge will have a profound impact on the ability of all American businesses to compete in the global economy.

⁶³ Stuart H. Altman, David Shactman, and Efrat Eilat, “Could U.S. Hospitals Go the Way of U.S. Airlines?” *Health Affairs*, January/February 2006.

Biotechnology Industry Trends

Pete Carlson

Introduction

The biotechnology industry is not defined by its products, but by the technologies employed in making them. Those technologies involve the use of biological processes to solve problems or to make useful products. Biotechnologies are primarily employed in the medical and pharmaceutical industries, but they are also used to increase crop yields, clean up hazardous waste, and increase the efficiency of industrial processes. Biotech firms span more than 60 industrial classifications, giving the industry influence far beyond the firms narrowly defined as “biotech,” which vary greatly in size and scope, ranging from small, mainly R&D operations to large, diversified companies with established production and distribution systems.

In 2004, the latest year for which figures are available, there were 1,444 US firms narrowly defined as engaged in biotechnology, employing close to 200,000 people. Other estimates, using a broader definition of “biotech,” put employment as high as 885,000.¹ Biotech jobs pay roughly \$26,600 more than the overall national average private sector wage. Biotech firms are very research-intensive, spending roughly a third of their budgets on R&D, compared to the US corporate average of around 4 percent.²

Currently, 40 states are targeting biotech for development. Twelve states -- California, Illinois, Indiana, Iowa, Massachusetts, Minnesota, New Jersey, North Carolina, Pennsylvania, South Carolina, Tennessee and Virginia -- have a significant number of people employed in biotech. The heaviest concentrations of biotech firms are clustered around Boston, Massachusetts, the Bay Area in California, and Research Triangle Park in North Carolina.

This report describes the market dynamics that are shaping the biotechnology industry, how firms are responding to them, what impact that is having on employment, and where the industry may be headed.

Market Dynamics

The manipulation of biological processes has been going on for thousands of years, from the fermenting of grains and fruits to create alcoholic beverages up through the discovery of penicillin in the 1920s. The latest wave of discovery, the biotech revolution that began in the 1980s, is marked by advances in molecular biology, genomics, and computing

¹ Biotechnology Industry Organization (BIO) website; Battelle Technology Partnership Practice and SSTI, “Laboratories of Innovation: State Bioscience Initiatives 2004,” Report Prepared for the Biotechnology Industry Organization, June 2004.

² “A Survey of the Use of Biotechnology in U.S. Industry,” U.S. Department of Commerce, Technology Administration, Bureau of Industry and Security, October 2003.

power that have made it possible to sequence the human genome, develop more targeted medicines, grow high-yield/high-nutrition crops, and grow artificial organs and tissues for transplant surgery. These developments attracted public attention and fueled growth in the industry throughout the 1990s.

When the dot.com bubble burst in the late 1990s, the spotlight shifted to biotech as the next hot investment prospect. Many fund managers shifted their money into biotech stocks because they believed that the health care industry was recession-proof. Excitement over the mapping of the human genome bid up biotech stocks to record highs, as investors concluded that this scientific breakthrough heralded a new era in medicine. The boom peaked in 2000 with 68 initial public offerings, and record levels of venture capital.

However, a string of high-profile product failures and the securities scandal at ImClone Systems undermined the industry's credibility. Investors also began to realize that it would be years, if ever, before these companies would bring products to market. Biotech financing fell 76 percent from 2000 to 2001.³ Stock prices for such high-fliers as Human Genome Sciences, Celera Genomics, and InforMax fell by as much as 95 percent, making it hard for them to raise money. Venture capital, a key source of funding for biotech firms, also fell dramatically after 2000, although funding has increased somewhat in the past couple of years.

Biotech firms depend heavily on capital markets to fund the long-term investments needed to bring products to market. Very few firms generate enough revenue to fund their own research. On average, it takes \$802 million and over 14 years to develop and bring a new drug to market in the US.⁴ Few investors are patient enough to wait that long to see if their investments will pay off. Venture capitalists in the US now tend to fund only the late stages of drug development – at the time when data are available indicating the safety and efficacy of a product, when regulatory approval of the product can be gauged, and when marketing of the product appears feasible.

The lack of funding available for research and development has led many biotech firms to seek partners willing to provide financing for the long product development cycle. Many are turning to the big pharmaceutical companies. Currently, nearly two-thirds of the funding for biotech research and development comes from the pharmaceutical industry, while over one-quarter comes from government sources, and less than 4 percent comes from universities.⁵ However, the pharmaceutical companies are reluctant to get involved until late in Phase II, so biotech firms still have few sources of funding to help them cross the “valley of death” from the early work in the lab to Phase II trials of the product.

Many pharmaceutical companies see biotechnologies as a solution for their own problems. For the past decade, drug companies have been able to ride a wave of multi-million dollar blockbuster drugs such as Prozac, Lipitor, and Viagra. These blockbuster

³ Terence Chea, “Biotech Industry Digs In,” *Washington Post*, June 26, 2002, p. E01.

⁴ Bryan Bergeron and Paul Chan, *Biotech Industry* (Hoboken, NJ: John Wiley & Sons, Inc. 2004), p 71.

⁵ National Science Foundation.

drugs drove worldwide sales growth from \$22 billion in 1980 to \$149 billion in 2000. Drug industry earnings rose an average of 15 percent a year throughout the 1990s.⁶ But between 2002 and 2006, patents have expired on 35 drugs with aggregate sales of more than \$73 billion a year, while only 14 potential blockbuster drugs are in the pipeline to be launched through 2006.⁷

At the same time, the pharmaceutical industry is coming under increasing pressure to reduce drug costs. Managed care organizations are stepping up their efforts to negotiate more favorable prices, and there is growing political pressure on drug companies to lower prices. One approach to containing the high cost of drug development has been to reduce delays in the FDA's approval process. Over the past couple years under a new administrator, the FDA has streamlined the drug approval process, cutting a year or two off the 10-15 year development process. A shorter approval process is worth several billion dollars, but there are limits to the amount of time that clinical trials can be shortened. Patients must still be followed for many months or years to determine the safety and efficacy of drugs and other regulated products.

The biotech industry offers pharmaceutical companies an alternative to blockbuster drugs, focusing instead on targeted drugs aimed at a relatively small number of patients with a specific form of a disease. So the market for a particular drug tends to be limited. However, because the drugs are targeted and often customized to a particular patient, they can produce dramatic results. In the history of the pharmaceutical industry, only about 500 disease-causing functions in cells or viruses have been found. But with the growing understanding of how DNA works, the number of potential new targets could grow into the thousands.⁸

The costs associated with a targeted approach to drug development are much lower than with blockbuster drugs. For one thing, there's no need for massive advertising campaigns, or for a standing army of sales representatives to cover the universe of doctors' offices. Trying to wring more sales out of a dwindling number of patented blockbuster drugs, the pharmaceutical industry currently spends more than \$3 billion a year on ads aimed directly at consumers.

Pharmaceutical companies are starting to cash in on the potential of offering more drugs at lower cost by partnering with biotech firms. The biotech firms provide a "farm system" for the big drug companies, doing the early research and development, while the big drug companies invest in promising late-stage development and provide the capacity to market and distribute the drug once it has been approved. In 2004, biotech firms produced two-thirds of the drugs in clinical trials, but spent only 3 percent of the total \$40 billion that drug companies spent on R&D,⁹ because much of their late stage financing came from the big drug companies.

⁶ Brian O'Reilly, "There's Still Gold in Them Thar Pills," *Fortune*, July 9, 2001.

⁷ David Stipp, "How Genentech Got It," *Fortune*, May 27, 2003.

⁸ O'Reilly, "There's Still Gold in Them Thar Pills."

⁹ Arlene Weintraub, John Carey, Kerry Capell, and Michael Arndt, "Biotech, Finally," *Business Week*, June 13, 2005.

The big drug companies aren't likely to abandon their reliance on blockbuster drugs any time soon, especially since they still account for half of the market growth, and there are still a number of potential blockbusters in the pipeline.¹⁰ Biotech products still only represent about 10 percent of the pharmaceutical market. But, the growing number of partnerships with biotech firms to develop targeted drugs suggests a new business model that could become dominant in the pharmaceutical industry over time.

Agricultural Biotech. The use of biotechnologies in agriculture has grown rapidly over the past decade in the US. The rate at which traditional crops have been replaced by genetically modified versions rose from 4 percent in 1996 to 45 percent in 2004 for corn. The rate for soybeans rose from 9 percent in 1996 to 85 percent in 2004. And the rate for cotton rose from 17 percent in 1996 to 76 percent in 2004.¹¹

Proponents claim that the replacement of traditional crops with genetically modified versions has enhanced nutrition, increased resistance to pests, pesticides, and herbicides, and extended product shelf life. These benefits could have a significant impact on the economy, since only 24 plants supply nearly all of our food derived from plants, while eight plants supply more than 85 percent of our diet.¹²

Numerous studies have shown widespread improvements in profits and in management capacity from adopting biotech varieties of plants. For example, a study conducted by Louisiana State University and Auburn University found that farmers growing genetically modified cotton saved 2.4 million gallons of fuel, 93 million gallons of water, and 41,000 10-hour days by avoiding the need to spray pesticides on their crops.¹³ Estimates vary by crop and area, but average profits rose by \$15 per acre for soybeans, by \$55 per acre for corn, and by several hundred dollars per acre for cotton.¹⁴ Another study by the National Center for Food and Agricultural Policy found that biotech crops increase grower incomes in the US by \$1.9 billion and crop yields by 5.3 billion pounds, while reducing pesticide use by 46.4 million pounds.¹⁵

Prior to the 1980s, most of the R&D in plant biotech was publicly funded, mainly through land grant universities, in part because it took 20-30 years for those investments to pay off. However, advances in molecular biology have made it possible to compress the time needed to enhance the characteristics of a plant from a few decades to a matter of years. Lured by a quicker return on investments, private R&D now significantly exceeds public investments. Although there are hundreds of companies invested in some

¹⁰ John Simons, "Blockbusters to the Rescue," *Fortune*, January 23, 2006.

¹¹ C. Ford Runge and Barry Ryan, "The Economic Status and Performance of Plant Biotechnology in 2003: Adoption, Research, and Development in the United States," a study prepared for the Council for Biotechnology Information, Washington, DC, December 11, 2003; Biotechnology Industry Association, "James Greenwood Assumes BIO Presidency as Industry Has Banner Year," News Release, January 1, 2005.

¹² Bergeron and Chan, p.92.

¹³ Bergeron and Chan, p. 97.

¹⁴ Runge and Ryan.

¹⁵ Biotechnology Industry Organization, News Release, January 1, 2005.

aspect of plant biotech, six companies lead that sector – Syngenta, Bayer, Monsanto, DuPont/Pioneer Hi-Bred, Dow, and BASF.

Global Competition

The US established an early lead in biotechnology research and commercialization and has maintained that lead. There are more biotech companies in the US than in any other country, about 35 percent of the world's total. US biotech firms have higher revenues than those in other countries, in part because of strategic alliances with drug companies in the US. Most of the financing for biotech companies in the US comes from the big pharmaceutical firms, including European firms, which have been very profitable and have been consistently increasing their global market share.

Canada is second to the US in number of biotech companies, with 10 percent of the world's total, although Canadian biotech firms tend to be smaller in size than those in the US. Canada ranks third in the world in revenue from its biotech sector. Many multinational pharmaceutical firms have built production and research facilities in Canada to take advantage of its low costs, low risks, and close proximity to the US market. Unlike the US, stem cell research is permitted in Canada, and is a national research priority. However, Canadian firms are hampered by a shortage of scientists and skilled support personnel coming out of their university system, as well as price caps negotiated through their single-payer health system.

Europe is the biggest biotech region after North America, with 40 percent of the total number of firms in the world. However, Europe has been losing ground to the US since the early 1990s, mainly due to the lack of innovation among the European pharmaceutical firms. In the late 1980s, European firms released nearly twice as many new drugs as firms in the US. By the end of the 1990s, however, US firms had taken the lead. In 2001, biotech companies in the US generated around \$25 billion in revenue, compared to around \$8 billion for European firms.¹⁶

Lack of private sector financing remains a serious problem for European biotech firms. Unlike the US, the pharmaceutical industry finances only around 20 percent of biotech research and development in Europe. Moreover, European pharmaceutical firms have been transferring much of their research and development activity to the US. In 1990, they spent 73 percent of their research and development funds in Europe. By 1999, this figure had dropped to 59 percent. Private companies attribute this trend to the increasing regulation of the biotech industry and the difficulty in getting decisions made in a timely way by the European Commission's bureaucratic structures.¹⁷

The European Union has adopted the same kind of restrictions on federally funded stem cell research as the US, although it does allow financing for some new embryonic stem cell lines. But, the policies in the European countries vary widely. For example, Britain

¹⁶ Bergeron and Chan, Chapter 7.

¹⁷ Robert L. Paarlberg, "The Great Stem Cell Race," *Foreign Policy*, May/June 2005.

is actively encouraging stem cell research, while Germany and Italy have criminalized the extraction of stem cells from embryos.¹⁸

Even in Britain's favorable environment for innovation, progress is slowed by heavy reliance on public funding sources with slow-moving budget cycles, and by bureaucratic delays. In addition, there is less experience or capacity in Europe, relative to the US, in mobilizing resources through partnerships between universities, companies, and venture capitalists.

As a result, the European biotech industry remains in a slump, while other regions are experiencing a resurgence. In 2003, while the market cap of US biotech firms gained 60 percent and Canadian firms gained 56 percent, the market cap of European firms gained only 17 percent. In Europe, 43 percent of the publicly traded biotech companies have less than two years of cash on hand, compared to 31 percent of publicly traded firms in the US.¹⁹

In Asia, several governments are making it a strategic national priority to grow their biotech industries. Japan, concerned about its maturing semiconductor and electronics industries, has set a goal of tripling its number of biotech firms by 2010. Singapore has a goal of doubling the value of its biomedical production to \$12 billion by 2010. And China, already a world leader in agricultural biotech, is targeting the global pharmaceutical biotech market.

Japan got a slow start in biotech. Its efforts in the 1980s to commercially exploit recombinant DNA were hampered by weak intellectual property laws. That problem was not addressed until 2003. However, with its ageing population, Japan is the second largest pharmaceutical market in the world, giving it a strong incentive to develop its biotech industry. The five-year plan developed by the Ministry of Health, Labor, and Welfare sets a goal of becoming a significant supplier of pharmaceuticals worldwide, while becoming self-reliant at home.²⁰ Japan is also a leader in agricultural biotech research.

There is strong government support for biotech research and development in Japan. The stability of that funding has reduced the risk for other investors and attracted significant industry support and venture capital. Japan has also formed a strategic alliance with Korea, Taiwan, and Singapore to conduct research and development, spreading the risk and pooling investment capital.

Singapore has been actively courting the biotech industry for the past decade. Since 1994, it has attracted more than \$1.6 billion in factory investments from Schering-Plough, Merck, Wyeth, and Pfizer.²¹ Manufacturing costs are 30-40 percent lower in

¹⁸ Michael Woods, "U.S. Relatively Hospitable to Stem-Cell Research," *Pittsburgh Post-Gazette*, June 5, 2005.

¹⁹ Ernst & Young, "Ernst & Young Global Biotechnology Reports Track Dramatic Industry Rebound," News Release, May 12, 2004.

²⁰ Japan Bioindustry Association.

²¹ Jim Hopkins, "Drugmakers Shift More Production Outside USA," *USA Today*, October 19, 2004.

Singapore than in the US. But the government is also pushing hard to attract research and development, luring leading scientists from the US and Europe with high salaries, state-of-the-art laboratory equipment, few restrictions on stem cell research, ample funds for research, a highly educated workforce, and a legal environment that respects international patents. Many of the major pharmaceutical companies have established research and development centers in Singapore, such as Pfizer, GlaxoSmithKline, Merck & Co., Aventis, Roche, Novartis, Eli Lilly and Wyeth Pharmaceuticals. They are actively engaged in drug development and clinical trials, hoping to gain entry into the larger Asian economy.

China's biotech industry dates back to the mid-1980s, when Chinese Premier Deng Xiaoping identified genetic engineering as one of seven technologies critical to economic growth. The emphasis has been mainly on agricultural biotech to feed an expanding population and to improve the competitiveness of small farms. Most of the funding has come from the government, which has aggressively funded research and development. The most recent five-year plan (2001-2005) called for a 400 percent increase in government biotech funding over the previous plan.²² China ranks second in the world in biotech research funding behind the US, accounting for as much as one-third of global spending on agricultural biotech.²³

China's pharmaceutical production is also expanding, although most of it is for internal consumption. China is currently the world's largest producer of antibiotics, accounting for about one half of the world's production.

However, China faces a number of obstacles in expanding its biotech industry. The biggest obstacle is funding. Although there is growing government support for research and development, Chinese biotech firms have little access to private investment capital. The stock markets in China are designed for state-owned enterprises that have been privatized. Although China has removed some of the barriers to foreign investment, there is still a high level of risk involved. There's no clear exit strategy for venture capitalists to use to sell out their stake and get a return on their investment. One solution has been to spin off new technologies to a Hong Kong or US-based company, making it possible for the company to go public through an IPO, but this practice is not widespread.²⁴

Another obstacle is the shortage of trained scientists and managers. Most Chinese researchers and scientists who study abroad choose to remain abroad to work. China is addressing this problem by giving researchers joint appointments that allow them to spend half their time in China and half their time abroad. China is also offering stock options, profit sharing, bonuses, and protected research budgets. These incentives are

²² "Biotech Outsourcing Lures Chinese Firms," *China Daily*, July 29, 2004.

²³ Randi Fabi, "Half of China Crops May be Biotech by 2014," *Reuters*, September 12, 2004; Valerie Karplus, "Global Anti-GM Sentiment Slows China's Biotech Agenda," *YaleGlobal*, September 26, 2003.

²⁴ Fred Greguras, "Will China Become a Global Power in Biotech?" Fenwick and West LLP, December 5, 2003.

starting to make a difference. Many Chinese are starting to return home, expanding the talent pool for biotech firms.

A final obstacle is the weakness of intellectual property rights. Although China has been taking steps to strengthen protections since it became a member of the World Trade Organization, concern about intellectual property rights remains one of the biggest obstacles to biotech investments in China.²⁵ Full compliance with WTO obligations may take a decade or more.

A final country worth mentioning is India, although mainly for the absence of a viable biotech industry there. Many of the multinational pharmaceutical companies have sales offices in India, but they generally avoid locating research and development functions there, because India's patent law only recognizes processes, not products. As a result, Indian scientists can transform drugs patented elsewhere into their generic equivalents without any legal consequences. The government funds some research, and there are pockets of expertise. The tightening of intellectual property protections in 2005 may lead to increased foreign investment.²⁶

Outlook

Employment in the biotech industry has been growing at around 10 percent a year, and the Bureau of Labor Statistics expects the industry to continue to grow rapidly during the next decade, outpacing the average for overall employment by 13 percent.²⁷ However, it's important to remember that increases in biotech employment are starting from a relatively small base. For instance, the state of California estimates that the Bay Area saw a 40 percent increase in biotech jobs from 1993 to 2003. But that added up to just 13,640 new jobs, nowhere near the 200,000 high-tech jobs lost in Silicon Valley when the dot.com bubble burst.²⁸

Even the largest biotech companies are comparatively small. Genentech, the second-largest biotech company in the world, which is located in the Bay Area, has approximately 9,500 employees. Most biotech companies have fewer than 100 employees. So, it will take a lot of new biotech companies to make up for the jobs lost in other industries such as high tech.

There are some promising signs for the biotech industry. A decade ago, 14 biotech firms in the US marketed a total of 22 products. In 2003, 66 companies marketed 187 products, including 12 blockbusters that reap over a billion dollars a year. Today, there are 230 medicines on the market developed using biotech techniques. An estimated 50 more in late-stage clinical trials are expected to win FDA approval, and another 400

²⁵ Matthew Chervenak, "An Emerging Biotech Giant?" *China Business Review*, May/June 2005.

²⁶ Kerry Dolan, "The Drug Research War," *Forbes*, May 28, 2004.

²⁷ U.S. Department of Labor, "Industry Output and Employment Projections to 2012," February 2004; Battelle Technology Partnership Practice and SSTI, "Laboratories of Innovation: State Bioscience Initiatives 2004," Report Prepared for the Biotechnology Industry Organization, June 2004.

²⁸ Paul Jacobs, "Biotech Companies Growing, but They're Not a Panacea," *San Jose Mercury News*, August 15, 2004.

products are in the pipeline going through Phase III trials.²⁹ Four out of five drugs currently in development are founded on biotech discoveries or employ biotech tools.³⁰ A particular area of focus is cancer. Over 400 cancer drugs are currently being tested in humans, almost all of which are targeted biotech medicines, which have minimal side effects, compared to the highly toxic chemotherapies common in many cancer treatments.³¹

Investment in private biotech firms, mainly by venture capitalists, hit a record of \$5 billion in 2004. In addition, the new federal BioShield law provides \$5.6 billion over the next 10 years to develop products critical to defending against bioterrorism. In California, voters passed an initiative to fund \$3 billion in stem cell research over the next 10 years, and Connecticut followed suit with a similar \$1 billion initiative. These public funds will spur research that is likely to spin off many new commercial applications.

A growing number of states are targeting biotech as an economic development opportunity. In 2001, 14 states had strategies to grow their biotech industries. That number has now grown to 40. These states are making significant investments in their universities and research institutions, looking for ways to promote more academic-industry interaction, and finding ways to help companies commercialize the products of their research. The states are also experimenting with ways to help fund the development of these new technologies through tax credits and equity investments, funded in some cases by state pension funds. Finally, state higher education systems are reaching out to biotech companies to better understand their needs, and responding with new curricula at colleges and universities.³²

There is some concern that biotech jobs will be outsourced to other countries as the industry grows and matures. With the cost of doing early drug development work like toxicology studies in countries like China or Singapore as low as 10-40 percent of the US cost, there's strong incentive for companies to move this work overseas. Indeed, there's evidence that the pharmaceutical industry is conducting a growing number of clinical trials outside the US to lower costs and expedite approval. Since 2000, the number of principal investigators leading clinical trials in the US fell by 11 percent, while the number of principal investigators working on FDA-approved trials abroad increased by 8 percent.³³

²⁹ Mike Hildreth, "Resurgence Reported in U.S. Biotech Sector," Ernst & Young Video Transcript; Cynthia Webb, "Biotech: Mainstream or Pipe Dream?" *The Washington Post*, June 7, 2004.

³⁰ Arthur D. Levinson, "Beyond Borders: The Global Biotechnology Report 2005," Ernst & Young, June 21, 2005.

³¹ Arlene Weintraub, John Carey, Kerry Capell, and Michael Arndt, "Biotech, Finally," *Business Week*, June 13, 2005.

³² Battelle Technology Partnership Practice and SSTI.

³³ Marc Kaufman, "Clinical Trials of Drugs Fewer, Study Says," *Washington Post*, May 4, 2005; Schmit, "US Drug Companies Conducting More Clinical Trials Overseas to Reduce Costs, Speed Approval," *USA Today*, May 18, 2005.

However, there are some limits to the ability of companies to do all of their drug development work offshore. First, the early research and development phase requires collaboration across disciplines and tends to flourish when linked to world-class universities. The leading university centers are currently located in the US, particularly in Boston and in the Bay Area. In fact, these centers are magnets for foreign researchers and scientists, and for foreign investment, which is flowing into the US much faster than work is being sent overseas. Most of private venture capital firms are also concentrated in the Bay Area.

A second reason, mentioned earlier, is concern about intellectual property rights. Unless there are legal protections and consistent enforcement against infringing intellectual property rights, companies may continue to be wary of shipping their research operations overseas. Currently, the US has the strongest legal framework protecting biotech research.

Therefore, US biotech companies are likely to continue outsourcing clinical trials to other countries, but they are likely to keep their research and development operations close to home. That suggests that the clusters that have sprung up in certain regions of the US will continue to flourish, and new clusters are likely to appear.

Telecom Industry Trends

Pete Carlson

Introduction

The telecommunications industry is one of the fastest growing and fastest changing sectors of the US economy. The industry includes local and long-distance phone service, wireless communication, Internet access, and cable and digital television service. In 2004, total spending for telecom services and equipment in the US was more than \$784 billion, and is projected to pass \$1 trillion by 2008.¹

The industry has gone through a remarkable transformation over the past decade, driven by changes in government regulations, technologies, and market conditions. Prior to 1996, the industry was dominated by a handful of phone companies and a handful of equipment makers. In an effort to end the Baby Bell's monopoly in local phone markets and open those markets to competition, the Telecommunications Act of 1996 required the Baby Bells to rent their networks at a discount to competitors, and encouraged cable operators, long distance carriers, and new entrants to compete directly in local phone markets. Congress envisioned that once the newcomers won enough local phone customers, they would build their own networks and break the monopoly hold of the baby Bells. Between 1996 and 1999, 144 telecom companies, mostly start-ups, went public, raising more than \$25 billion.²

Encouraged by Congress and lured by the rapid expansion of the internet, the start-ups and traditional phone companies made unprecedented investments in transmission capacity in the late 1990s, convinced that internet traffic was doubling every 100 days. WorldCom initially espoused this notion, but it gained widespread currency after appearing in a report by the Department of Commerce. As it turns out, internet traffic was doubling at less than a third of that rate.³

One result of that miscalculation was a significant over-speculation in transmission capacity, particularly in fiber optic cable. Between 1998 and 2001, the amount of fiber optic cable laid increased by a factor of 5, while the transmission capacity of a single strand of fiber increased by a factor of 100. So, total fiber optic transmission capacity increased by a factor of 500. Meanwhile, demand only increased by a factor of 4. The resulting excess transmission capacity, along with the additional competition in the industry, led to falling prices, declining revenues, and huge debts across the industry, which in turn led to massive layoffs, accounting scandals, and bankruptcies, most notably at Global Crossing and WorldCom.

¹ Telecommunications Industry Association, "Spending in U.S. Telecom Industry Rises 7.9% to \$784.5 Billion in 2004," February 1, 2005.

² Stephanie N. Mehta, "Why Telecom Crashed," *Fortune*, November 27, 2000.

³ *The Economist*, "Beyond the Bubble," October 9, 2003.

After the telecom bubble burst in 2001, price wars and industry restructuring drove most of the newcomers out of business and reestablished the dominance of the Baby Bells and AT&T, and equipment makers Lucent, Cisco, and Nortel. However, other underlying trends have continued to shake up the industry.

This report describes those key trends and the global dynamics that are reshaping the telecom industry, as well as the implications for employment in the US.

Key Trends

From Wires to Wireless. One of the biggest shifts in the industry over the past decade has been the growth in wireless phone service at the expense of wired service. Wireless service has been growing by 15 percent a year, while the number of telephone lines has fallen by 11 percent, since 2000. The number of wireless phone customers now exceeds the number of residential wired customers, and the gap is widening. In 2004, there were 72 percent more wireless than wired customers.⁴ Around 6 percent of households in the US now rely solely on their wireless phones.⁵ This number will likely continue to increase as wireless service improves in quality.

With falling revenues from traditional local and long-distance phone service, and a penetration rate of 94 percent, competition has heated up among phone companies for wireless customers. Although new companies entered this market, the Baby Bells and AT&T responded by launching their own wireless divisions. As the wireless market has become more saturated – currently two-thirds of the US population has a cell phone – the industry has consolidated, increasing the dominance of the Baby Bells and AT&T.

In the last two years, the number of major players in the wireless market has consolidated even further, going from six to four. In October 2004, Cingular, a joint venture between SBC and Bell South, purchased AT&T Wireless to become the nation's largest wireless operator. In December 2004, Sprint and Nextel, the nation's third and fifth largest operators, merged to become Sprint Nextel, making them number 3 behind Cingular and Verizon Wireless, of which 45 percent is owned by Vodafone, the world's largest mobile phone service provider, based in the UK. T-Mobile, a subsidiary of Deutsche Telekom, is fourth with around 20 million subscribers, well below its rivals, all of which have 40 million or more subscribers. In 2004, these four carriers accounted for around 95 percent of all new wireless subscribers in the US.⁶

The industry consolidated even further in 2005, as SBC acquired AT&T, and MCI accepted a takeover bid from Verizon. Long-distance prices and revenues have been declining for years, making it difficult for AT&T and MCI to survive on their own. The use of wireless, e-mail, and instant messaging has cut the demand for long-distance

⁴ Thomas M. Lenard and Michael J. Pickford, *The Digital Economy Fact Book*, The Progress & Freedom Foundation, Washington, DC, 2005.

⁵ Cellular Telecommunications and Internet Association website, www.ctia.org, "Wireless Quick Facts."

⁶ Kenneth M. Leon, "Wireless" Quick-Shrink Act," *Business Week*, January 20, 2005.

services by half since 2000.⁷ Through these acquisitions, SBC and Verizon gain access to the lucrative business market and expand their reach overseas through contracts with multinational corporations.

From Phones to Broadband. As the US market for phone service, both wired and wireless, has become more saturated, the focus of competition has shifted to internet access, particularly broadband. The percentage of the US population with internet access has grown steadily over the past decade, and now stands at around 74 percent. The number of households with high-speed internet access more than tripled between 2001 and the end of 2004, and the percentage of US households with broadband is currently at around 60 percent.⁸ The most common use of the internet is sending and receiving e-mail, with more than half of those online using e-mail daily. In addition, it's now possible to make phone calls over the internet with a broadband connection, using Voice over Internet Protocol (VoIP). Both e-mail and VoIP have the potential to significantly reduce demand for traditional phone service.

The cable industry got a head start in offering high-speed internet access. While the phone companies were building their wireless networks, the cable companies were building their own digital networks with the capacity to offer hundreds of channels of video, movies on demand, high-definition TV, and high-speed internet access. And they have been aggressively promoting phone service over their networks. VoIP is starting to take off, particularly with businesses, but also increasingly with residential customers. An estimated 52 percent of all businesses are currently using VoIP.⁹ One in four international calls is now on VoIP.¹⁰ Meanwhile, the number of residential VoIP subscribers, currently around 3 million, is expected to grow to 27 million during the next three years.¹¹ If that expectation is realized, one-quarter of all the households currently wired for residential phone service could be using VoIP by 2008.

The phone companies have responded with digital subscriber line (DSL) technology, to take advantage of the wires they already have in place. During the second half of last year, DSL subscriptions grew by 20 percent, while cable subscriptions grew by only 14 percent. Also, the phone companies continue to drive down the price of their broadband service, and now are priced an average \$2 below cable service. But, the cable companies still hold the high ground in the broadband market, with 59 percent of all subscribers.

The phone companies have also been fighting back with fiber optic cable, allowing them to offer video, as well as provide even faster internet access. An FCC decision in late 2004 ruled that the phone companies do not have to lease their fiber optic networks to competitors at a discount, as they are required to do with their copper wires. That has touched off a race between Verizon and SBC to expand their fiber optic networks.

⁷ Matt Richtel, "The Diminishing Bell: The Industry; Bells Win a Battle, Not Necessarily the War," New York Times, July 23, 2004.

⁸ *The Digital Economy Fact Book*; and "FCC Fudging Broadband Figures? - US Broadband Penetration Jumps to 58.6% in June - July 2005 Bandwidth Report," www.websiteoptimization.com/bw/0507/.

⁹ Olga Kharif, "VoIP Providers: Heeding the Call?" *Business Week*, November 28, 2005.

¹⁰ iLocus, *Global VoIP Market 2004: 5th Annual Industry Update*, July 2004.

¹¹ *The Digital Economy Fact Book*.

However, fiber optic cable is very expensive and time-consuming to install. And the phone companies have a lot of catching up to do. At the end of 2004, only 2 million households were wired with fiber-optic cable, while 99 million households were already wired with coaxial cable.

Phone companies may face an uphill battle on the regulatory front as well. Currently, the cable companies pay around \$2.4 billion a year in franchise fees to local communities to secure the rights to run cable lines under public streets and sidewalks. They also have to provide universal access. The cable companies are insisting that if phone companies want to enter the market for video services, they need to play by the same rules. Many local communities, in need of additional revenue, agree. So far, the FCC has not weighed in on this issue, leaving the phone companies to negotiate with each community separately.¹²

From Wired to Wireless Broadband. While the cable companies appear to have the advantage at the moment in offering the “triple play” package of video, high-speed internet access, and VoIP phone service, the phone companies may have a trump card yet to play – their wireless networks – giving them the possibility of a “quadruple play” bundle of services. Conventional wireless internet access is relatively slow, and cell phones can only display limited amounts of information. But wireless companies are beginning to deploy the next generation of wireless technology – called “3G” for third generation. Verizon’s 3G network is currently available to about one-third of the US population, and is expected to cover one-half of the population by the end of 2005. Sprint Nextel and Cingular are also expanding their 3G coverage.¹³ The 3G technology provides much faster data transmission and internet access, making it possible for cell phones to replicate many of the functions of computers wired to broadband networks.

Wireless broadband has been available for several years, mainly within homes and offices, using a router to allow computers to share an internet connection. However, Americans are increasingly demanding mobile access to the internet outside their homes and offices. Around 41 percent of all Internet users – or 56 million Americans -- use computers or hand-held devices that are capable of accessing the Internet wirelessly. Half of all new computers now come with wireless fidelity, “Wi-Fi,” technology already installed. Users are becoming accustomed to the freedom and mobility that Wi-Fi offers. The resulting demand and the falling cost of equipment are spurring establishments and local governments to install network “hotspots” in public spaces. These hotspots are increasing at a rapid rate, and there’s speculation that Wi-Fi will become as common as a modem in the near future.¹⁴

However, one of the drawbacks of Wi-Fi is its limited range, typically from 100-300 feet, with reception getting weaker further from the signal source. WiMax technology (Worldwide Interoperability for Microwave Access) is designed to cover a much larger

¹² Brian Grow, Roger Crockett, and Cathy Yang, “Telecom: the Fiber-Optic Quagmire,” *Business Week*, December, 6, 2004.

¹³ *The Digital Economy Fact Book*.

¹⁴ Wi-Fi Alliance, “Enabling the Future of Wi-Fi Public Access,” February 2, 2004.

area, as much as 5 miles, making it possible for an entire community to have access to broadband services.

WiMax is still in development, with tests going on in Atlanta, Philadelphia, Portland, and other cities. However, it could become an alternative to DSL and cable. The costs of installing and maintaining a WiMax network are significantly less than either cable or wires. Since the signal travels through the air, there's much less equipment involved. That makes it possible to extend the reach of broadband technologies to traditionally underserved communities, such as rural areas and less affluent urban markets. There's also little danger of construction crews digging through the cable, and repairs are simpler following a natural disaster.

The phone companies are trying to stake their claim to this new technology. BellSouth has commercially deployed WiMax in Georgia and Florida. AT&T has conducted trials in New Jersey and Atlanta. And Verizon and Sprint Nextel are also running tests of their own.¹⁵

But Wi-Fi and WiMax are also attracting new players that don't have a vested interest in either cable or DSL, such as internet-based companies like Microsoft, Yahoo, AOL, and Google. Microsoft and MCI recently announced a partnership to offer VoIP service through Microsoft's instant messaging service.¹⁶ Yahoo, Google, and AOL already offer free calling within the same instant messaging system. They are also developing systems similar to what Microsoft is implementing. The price of the calls will be less than traditional long-distance phone service, but still higher than the rates offered by Skype (recently acquired by eBay), which gives away software that allows people to talk for free over the internet.

These companies are well-established, are very innovative, and have deep pockets. Many telecom industry observers believe that they may significantly alter the competitive landscape in the years ahead.

Global Competition

The same trends outlined above for the US are also playing out globally. Although the number of fixed phone lines continues to creep up around the world, mostly in developing countries, the number of wireless subscribers is growing six times as fast.¹⁷ Wireless customers now outnumber wired customers worldwide, and wireless carriers now bring in half of global phone revenue. The biggest increases in wireless use have been in the Asia-Pacific region, followed by Europe, then North America.¹⁸ In Finland, an estimated 35 percent of subscribers now rely solely on their mobile phone.

¹⁵ Ed Sutherland, "Will Mobile Broadband Kill WiFi?" www.commsdesign.com, December 20, 2005.

¹⁶ Yuki Noguchi, "Microsoft, MCI Partner on Calls," *Washington Post*, December 13, 2005.

¹⁷ Andy Reinhardt, "The Wireless Challenge," *Business Week*, October 20, 2003.

¹⁸ *The Digital Economy Fact Book*.

Global internet access is expanding rapidly. Between 2000 and 2005, internet usage grew by 146 percent worldwide. Currently, the country with the largest on-line population is the US, followed by China, Japan, Germany, India, and the UK. But the biggest growth has been in China, Brazil, India, Russia, and Indonesia.¹⁹

Broadband access is also expanding rapidly. Total broadband lines, both cable and DSL, increased by 50 percent worldwide during 2004. DSL lines grew by 24 percent, while cable grew by 16 percent. Over all, there are nearly twice as many DSL subscribers as cable subscribers worldwide, and that gap is widening. North America is the only place in the world where cable use is more prevalent than DSL for broadband access.

US Behind in Broadband. Until recently, the US led the world in the technological development and deployment of internet services. However, over the past several years, there is evidence that the US has steadily fallen behind other nations in terms of its share of the population with broadband access and the speed of those connections. According to data compiled by the International Telecommunications Union, the US ranked third in broadband penetration in 2000. The US now ranks 15th, up from 16th a year ago.²⁰ Worldwide, broadband deployment is growing at 78 percent a year. In the US, broadband deployment is growing at 35 percent a year.²¹

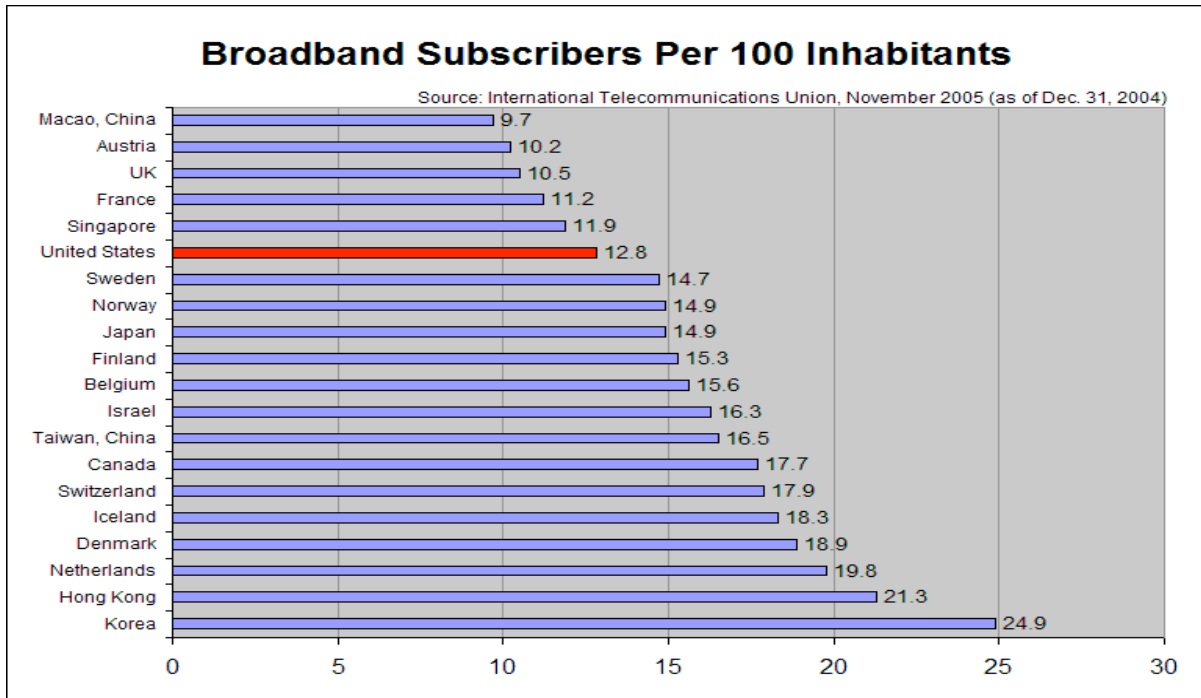
South Korea leads the world in the deployment of broadband. More than 76 percent of South Korean households currently have broadband access at speeds up to 20 megabits per second. In addition, some 75 percent of South Koreans have mobile phones, most of which are also enabled for high-speed broadband access. As the most wired country in the world, South Korea is where leading high-tech and telecom companies go to test their new products. For instance, Microsoft tested its MSN Messenger service, which enables instant messaging on mobile phones, first in South Korea before bringing it to the US six months later.²²

¹⁹ *The Digital Economy Fact Book.*

²⁰ WebSiteOptimization.com, "US Passes Singapore to 15th in Global Broadband Penetration," accessed November 28, 2005.

²¹ Charles H. Ferguson, "Broadband Policy and the Future of American Information Technology," Testimony Before the Senate Commerce Committee, April 28, 2004.

²² Birgitta Forsberg, "The Future is South Korea – Tech Firms Try Out Latest In World's Most Wired Country," *The San Francisco Chronicle*, March 13, 2005.



Japan is also far ahead of the US in broadband service. Today, nearly everyone in Japan has access to “high-speed” broadband, at speeds on average 16 times faster than in the US, and at prices one-third less than what the average subscriber pays in the US.²³ Ultra-high-speed broadband through fiber optic cable (up to 100 megabits per second) is scheduled to be available throughout Japan by the end of 2005 at prices comparable to what customers in the US pay for basic service (at 1.5 megabits per second). Currently, most Americans only have access to basic service, which is among the slowest, most expensive, and least reliable in the developed world.

The US is falling even further behind in wireless access to the internet. Japan has been actively promoting the use of its wireless network for internet services. In December 2004, 86 percent of cell phone subscriptions in Japan included internet services. Building on this success, the Japanese have made significant strides in deploying 3G technology, which is growing at nearly 190 percent a year. And they are now testing fourth generation broadband wireless phones that are capable of supporting high-definition television reception, movie downloads, and sophisticated games. As a result, Japan is in a strong position to develop new commercial applications, products, services, and content.

One reason the Japanese have been so successful is their development of a national IT strategy with strong government support for its implementation. In contrast, the US stands alone among developed nations in its lack of a comprehensive broadband plan. In 2004, President Bush set a goal of “universal, affordable access for broadband technology by the year 2007,” and the Federal Communications Commission (FCC) now claims that 99 percent of the US population has access to high-speed internet service. However,

²³ Thomas Bleha, “Down to the Wire,” *Foreign Affairs*, May/June 2005.

critics point out that the FCC definition of “high-speed service” is anything above 200 kilobits per second, which is only about four times the speed of dial-up service, one-eighth of the average DSL connection, and just a fraction of what’s available in other countries. The definition of “access” is similarly watered down to include any zip code that has at least one person with a broadband connection.²⁴

Another reason the Japanese have been so successful is their development of a competitive marketplace for new broadband services. As the number of broadband connections in Japan has surged in the past few years, the established providers have only accounted for 40 percent of the new connections.²⁵ That contrasts with 98 percent in the US, where most consumers can only get broadband service from their local cable or phone company.²⁶

There is concern that this duopoly structure may be slowing the pace of innovation in the US. Since high-speed broadband is leading to more widespread use of cheaper internet telephone service, it is undercutting the wired and wireless phone business that is the bread and butter of the local phone companies. Similarly, high-speed broadband service makes it possible for internet-based companies to offer movie and video offerings, undercutting the traditional business of the cable companies. So, even though the Japanese have shown that it’s possible to offer cheap, high-speed service on a large scale, the cable and phone companies that dominate the market in the US may have financial incentives to drag their feet.

The duopoly structure was reinforced in 2005, first by the Supreme Court in its ruling in *Brand X v. the FCC* that cable companies are not required to provide open access to their networks to competing internet service providers, then by an FCC decision that phone companies are no longer required to provide the same open access to their DSL networks that they have provided in the past. Those in favor of restricting open access, including the Bush administration, argue that open access puts a damper on innovation by restricting the investments that cable and phone companies can make in improving broadband speed and access. Critics argue that restricting open access will limit competition, lead to higher prices, and reduce incentives to improve the quality of service.

Some industry observers argue that if the US is ever to achieve world-class performance in broadband, it will need to create a viable competitor to cable and DSL. One candidate is to have electric companies provide broadband over their power lines. EarthLink, concerned about restrictions on open access to cable and phone lines, has been conducting trials of this approach with three power companies. Google is investing in a Maryland company, and IBM is partnering with a Houston-based power company. However, critics point out that previous experiments ran into technical problems that

²⁴ S. Derek Turner, “Free American Broadband!” www.salon.com, October 18, 2005.

²⁵ Philip J. Weiser, “Which Broadband Nation?” *Foreign Affairs*, September/October 2005.

²⁶ Elliott Maxwell, “A New Future for Telecommunications Policy: Learning From Past Mistakes,” Economic Policy Institute Working Paper No. 274, November 2005.

haven't been completed resolved, and that it would be difficult for power companies to bundle services in the same way that cable and phone companies are able to do.²⁷

The other obvious candidates are WiFi and WiMax, which are capable of transmitting data at 75 megabits per second, nearly as fast as fiber optic cable, but at much lower cost to install and operate. The market is still open for new companies, and even municipalities, to get into this game.

However, the established phone companies are taking steps to block access by competitors. After Philadelphia announced its intention to partner with EarthLink to build a wireless network to span the entire city last year, at no cost to the taxpayers, Verizon successfully lobbied the state government to pass a bill preventing cities and townships from offering broadband services unless the phone company agrees. Similar laws are already on the books in a dozen states. And similar legislation has been introduced at the federal level.²⁸

As part of its reconstruction efforts, New Orleans is setting up a municipally owned WiFi system to provide free internet access to all users across the city. Although Louisiana has a state law prohibiting any municipality from offering internet connections any faster than 144 kilobits per second (one-twentieth of a typical DSL connection), New Orleans has been granted an exemption because it's under a state of emergency. City officials say they plan to fight to keep their system in place when the state of emergency is lifted.²⁹

There's also a technical roadblock to the expansion of wireless broadband networks. The best radio spectrum for wireless broadband is currently being used by TV broadcasters for analog transmissions. Although broadcasters have been granted another spectrum of airwaves for digital TV, and most viewers have already switched to cable or satellite TV, broadcasters have been reluctant to give up this valuable public commodity.

Stiff Competition in Telecom Equipment. Another arena of global competition is in telecom equipment. The stiffest competition is among the makers of mobile phones and internet gear.

There were 664 million mobile phones sold worldwide in 2004, a 29 percent increase over the previous year. And sales are expected to top 810 million in 2005.³⁰ The market leaders are Nokia (Finland), with a 32 percent global share, Motorola (US) with 18 percent, and Samsung (South Korea) with 13 percent. These large companies are making gains at the expense of their smaller rivals.

At the high end of the market, most of the mobile phones sold are replacement phones, and the biggest growth is in "smart phones," which combine voice service with e-mail and other web applications, and allow users to take pictures and record video. Smart

²⁷ Marguerite Reardon, "Broadband's Power Line Push," www.news.com, July 11, 2005.

²⁸ Adam L. Penenberg, "The Fight Over Wireless," *Slate*, October 24, 2005.

²⁹ Jonathan Krim, "New Orleans's New Connection," *The Washington Post*, November 29, 2005.

³⁰ BBC News, "Big Growth in Mobile Phone Sales," November 22, 2005.

phone sales increased by 135 percent in the first quarter of 2005, relative to the first quarter in 2004. Nokia is the undisputed global leader with 65 percent of this market, followed by RIM, the maker of Blackberry devices, with 9 percent of the market, then Fujitsu, palmOne, and Sony Ericsson.³¹

At the other end of the market, most of mobile phone sales are to first-time subscribers in developing countries. That market is expected to grow by 100 percent annually for the next five years. The only serious contenders in this market are Nokia and Motorola, who are able to use their economies of scale to produce a high volume of ultra-cheap phones, and sell them for less than \$50. Since the margins on these cheap phones are higher than on the high-end models, Nokia and Motorola are in a strong position to compete with other mobile phone makers who focus just on the high end.

So far, low-cost Chinese mobile phone makers have not been able to match Nokia and Motorola, because their volumes aren't high enough yet to enjoy the same economies of scale. Nor are their engineers as adept. In addition, consumers in developing countries are surprisingly fashion conscious and prefer brand names, even if they have to pay a bit more for them.³² As a result, Nokia and Motorola are holding their own even in China, the fastest growing mobile phone market in the world.³³ However, both are facing increasing pressure from Chinese rivals TCL and Bird, which are reducing their dependence on foreign help and growing their own in-house R&D capacity. TCL and Bird also have the advantage of established distribution networks in smaller cities and in the countryside, which are becoming more important as the market becomes more saturated in the big metropolitan areas.³⁴

The competition is even stiffer when it comes to the equipment used for routing phone calls and internet data. In response, the major players have sought to achieve dominance in particular niches. Nokia, Motorola, and Ericsson (Sweden) have focused on networks for wireless markets. Alcatel (France) dominates in DSL equipment. Fujitsu (Japan) has been developing WiMax technology. And Cisco has focused on internet-based communications equipment. Meanwhile, Lucent and Nortel have had significant market declines, due to their failure to initially embrace these new technologies.

Cisco has dominated the market in Asia ever since it installed the first generation of internet equipment there in the 1990s. It currently enjoys a 62 percent share of the market for routers and switches for internet gear, and an 87 percent share of the market for the routers that phone companies use.³⁵ But Cisco is starting to face some tough competition from Huawei and ZTE, two Chinese companies that are beginning to make inroads not only in China, but in Europe as well. Huawei currently controls 21 percent of the market in China for routers and switches, and recently signed deals in Europe with

³¹ *The Digital Economy Fact Book*.

³² Andy Reinhardt, "Cell Phones for the People," *Business Week*, November 14, 2005.

³³ Agence France Presse, "Nokia's Cell Phone Sales Skyrocket in China," www.yahoo.com, November 25, 2005.

³⁴ Bruce Einhorn, "Motorola's China Challenge," *Business Week*, September 23, 2003.

³⁵ Brian Bremner and Peter Burrows, "Will Cisco Rewire Asia?" *Business Week*, February 7, 2005.

Marconi and Siemens, as well as with Dutch mobile phone operator Telfort to build a 3G wireless network.³⁶

For years, Huawei was content to rely on Western engineering and low labor costs, and to focus mainly on developing countries for exports. However, the company now claims that nearly half of its workforce is engaged in R&D, and that 85 percent of them have at least a university degree.³⁷ Huawei also has two R&D centers in the US, and another in India, where Cisco holds 75 percent of the market for routers and switches. If Huawei can take advantage of its low labor costs and the highly competitive and technologically advanced Asian market, and continue to innovate, it will likely meet its goal of earning 65 percent of its revenue from markets outside of China by 2006.

Implications for Employment

Employment trends in the telecom industry reflect the volatility and shifting landscape of the industry. Following the recession in the early 1990s, the telecom industry grew 10 percent faster than the overall economy between 1992 and 2001 to 1.3 million jobs. After the telecom bubble burst in 2001, the industry lost 380,500 jobs between March 2001 and May 2004. In fact, job losses in the telecom industry made up 29 percent of all jobs lost in the US during that period.³⁸

Telecom employment bottomed out in 2004 and was slowly climbing back until the mergers were announced between SBC and AT&T, and Verizon and MCI. SBC announced plans to cut 13,000 jobs as a result of the merger, on top of another 12,000 that it planned to eliminate prior to the merger. Verizon announced plans to cut 7,000 jobs, while MCI announced plans to lay off 7,500 employees, on top of the 4,500 layoffs it announced several months before the merger. And the Sprint-Nextel merger is expected to result in the loss of thousands of additional jobs.³⁹

These recent job losses have been mainly in the traditional phone businesses, which still employ 54 percent of all telecom workers,⁴⁰ and have been mainly among white collar workers. Meanwhile, employment is growing in the wireless and broadband sectors of the industry, as more people have started using mobile phones than traditional handsets, 40 percent of communication is now done by e-mail and instant messaging, and half of all business calls are made over the internet.

The changing landscape of the industry makes it hard to keep track of who's doing what, as the traditional distinctions between phone and cable companies become increasingly

³⁶ The Economist, "See Huawei Run," March 3, 2005.

³⁷ Mary Hennock, "China IT Giant Eyes New Horizons," BBC News, January 1, 2005.

³⁸ Thomas W. Hazlett, Coleman Bazelon, John Rutledge, and Deborah Allen Hewitt, "Sending the Right Signals: Promoting Competition through Telecommunications Reform," U.S. Chamber of Commerce, October 2004.

³⁹ Ron Sherer, "Telecom Mergers as a Window on the Job Market," *Christian Science Monitor*, February 17, 2005.

⁴⁰ Stephen Pociask, *A Failure to Communicate: Reforming Public Policy in the Telecommunications Industry* (Washington, DC: Economic Policy Institute, 2004).

blurred. Two of the biggest providers of phone service in the US today are the cable companies Cox and Comcast. Meanwhile, phone companies are now providing movies and video-on-demand to people's homes, in addition to voice service and internet access, and are positioning themselves to provide the same services over wireless devices as well.

As voice and other communication migrate to the internet, it's going to get much harder for traditional providers and for regulators to control the market. New services will come in the form of new software, which can be developed by anyone anywhere and sold over the internet. As a result, there will be increasing separation between who owns the telecom infrastructure and who provides the services. And innovation is much more likely to take place in a global market.

The new global frontier for telecom is in broadband, where the US appears to be falling behind other countries. That gap may end up having the biggest impact on employment in the US in the long run, since broadband is also fast becoming the technology platform for productivity improvements across all other sectors of the economy. If other countries continue to advance technologically at a faster pace than the US, then R&D will migrate to those countries, and innovations will be deployed there first. Multinational companies that have the capacity to operate on a global scale will be able to shift their R&D operations to where the action is. But smaller companies will have a harder time following suit.

Alternatively, if the US can make a leap in the deployment and speed of broadband connections, it could become the proving ground for new telecom and other applications, and continue to attract R&D investments and talent from elsewhere in the world, as it has done in the software industry for the past two decades.

Personal Computer Industry Trends

Pete Carlson

Introduction

The personal computer (PC) industry has grown significantly since its inception in the late 1970s, as the computer has become an essential tool both at work and at home, and has taken on an increasingly important role in communication and home entertainment. Sales of PCs grew at double-digit rates from the late 1970s through the 1990s. In the 1990s, Internet access and new multimedia applications accelerated the pace of this technological change, while stiff competition among PC makers drove prices steadily downward. Over the course of the decade, computing power rose exponentially, while PC prices fell from an average of \$2,500 to under \$500.¹

This growth cycle ended suddenly in 2000, as markets in the US and Western Europe became saturated, and both businesses and households began to hold onto their PCs for longer periods before replacing them. By 2000, a majority of American households already owned at least one PC. Between 2000 and 2001, PC sales actually declined for the second time in 15 years.

Since 2001, the industry has rebounded. In 2004, PC sales in the US increased by 8.3 percent, and worldwide by 11.8 percent, back to the double-digit growth experienced earlier, but this time sales were driven mainly by demand for notebook computers and by demand in developing countries.²

This report outlines the key trends and the global dynamics that are shaping the PC industry, and their implications for employment in the US.

Key Trends

Global division of labor. The personal computer industry has had a global production network almost from its inception. In a rush to catch up with Apple in the early 1980s, IBM decided to standardize the basic components of the PC so they could be assembled in a modular fashion. IBM then outsourced most of those components to other suppliers. The common standards, modular design, and simple assembly of the PC made it possible to disaggregate the production process among the various components, outsource production and even assembly, and locate that work anywhere in the world. Some of the components for the original IBM PC came from Asian suppliers. Other components also began to be produced overseas, as IBM and other PC makers began locating their

¹ Jason Dedrick and Kenneth L. Kraemer, "The Impacts of IT on Firm and Industry Structure: The Personal Computer Industry," *California Management Review*, Spring 2005.

² Thomas M. Lenard and Michael J. Pickford, *The Digital Economy Fact Book*, The Progress & Freedom Foundation, Washington, DC, 2005.

assembly operations overseas to gain access to foreign markets, and as their suppliers moved their operations abroad to reduce production costs.³

Most PC component production and assembly is now outsourced, with component production located mainly in Asia, and with PC assembly located closer to the customer in North America, Europe, and Asia. Given the simplicity of assembly – anyone with minimal training can assemble a PC in 15 minutes with a screwdriver and a socket set – and the lack of differentiation among components, the only way for PC makers to differentiate themselves is by how quickly they get the latest technologies to market, how efficiently they manage their supply chains, and how effectively they manage their branding, marketing, sales, and technical support.

Most PC makers do little product innovation on their own. They have come to rely mainly on their suppliers for product development, and on Microsoft and Intel for new technologies. Apple and IBM have been the exceptions to this rule.

For suppliers of hard disk drives and semiconductors, the main components of a PC, product innovation is critical to their survival. For example, the competitive advantage in hard drives has historically gone to whoever can increase storage capacity the fastest and cut costs at the same time. US hard drive manufacturers have accomplished this through a division of labor that has ended up locating R&D mainly in the US, and production mainly in Asia.

This global division of labor represents a shift from the early days of the hard drive industry. In the early 1980s, virtually all of the world's hard drive production was in the US and Japan. At that time, US firms produced 93 percent of their hard drives in the US, and Japanese firms produced almost all of their hard drives in Japan. However, relentless pressure to cut costs prompted some US firms to move production to Singapore, where they could reduce the cost of labor by 80 percent. Their success prompted others to follow, and by 1990 Singapore was the world's largest producer of hard drives, accounting for 55 percent of global production. By 1995, 70 percent of the world's hard drives were produced in Singapore, Malaysia, and Thailand, while only 5 percent were still produced in the US.⁴ However, these overseas operations remained largely in the control of US-based firms.

By being the first to move production overseas, US firms were able to drive down prices and increase their share of the market at the expense of the Japanese, who were slower to take advantage of the lower-cost labor in nearby countries. And US firms were able to focus more attention at home on R&D, which allowed them to stay ahead of the technological curve. The global leader in hard drives, US-based Seagate Technology, has become the largest private sector employer in Singapore and the largest employer in

³ Jason Dedrick and Kenneth L. Kraemer, "Globalization of the Personal Computer Industry: Trends and Implications," Center for Research on Information Technology and Organizations, University of California, Irvine

⁴ David McKendrick, "Leveraging Locations: Hard Disk Drive Producers in International Competition," in Martin Kenney and Richard Florida, *Locating Global Advantage* (Stanford, CA: Stanford University Press, 2004).

Malaysia and Thailand, while continuing to increase employment in the US by staying on the cutting edge of technological developments.

Semiconductors, the other key component in PCs, have followed a pattern similar to hard disk drives. In 1980, around 80 percent of the world's semiconductor fabrication capacity was located in the US and Japan, with 42 percent in the US and 38 percent in Japan. During the 1980s, the Japanese share grew to 45 percent, and the US share fell to 30 percent, while the share of countries like Taiwan and South Korea grew to 12 percent.⁵ This was largely the result of a strategy adopted by new entrants to the US market to design and market semiconductors themselves, and to contract out the manufacturing to facilities in the Asia-Pacific region, particularly in Taiwan. This model became so successful that the established US semiconductor firms followed suit, outsourcing much of their production to Asian facilities.

As a result, the Asia-Pacific countries more than tripled their share of worldwide fabrication during the 1990s, from 12 percent to 38 percent, almost all at the expense of the Japanese, who were slow to respond to this trend. Today, over 90 percent of the world's foundry capacity is located in the Asia-Pacific region, with most of that capacity located in Taiwan.

Since the greatest value added in semiconductors is in their design, US firms have mainly kept design and development work in house and in the US. In addition, some firms like Intel, which is often on the cutting edge with new technologies, also prefer to keep their production in house to avoid revealing technologies they consider to be a strategic advantage.

Build to Order. Another important industry trend has been the advent of a new business model in which PCs are built only after customers' orders are received, rather than building them to forecasts of customer demand, and in which PCs are shipped directly to the customer, rather than going through a retailer. This model, most closely associated with Dell Computer, takes advantage of the commoditization of the PC by relying on consumers' willingness to purchase a computer sight unseen, basing their purchase primarily on a set of specifications, price, and the reputation of the PC maker.

The build to order model has a number of advantages. Building only what the customer orders makes it possible to eliminate a lot of inventory in components and assembled PCs that are normally needed to buffer against differences between forecasted and actual demand. The costs associated with holding this inventory, and with its obsolescence due to rapid changes in technology, are greatly reduced by building only what the customer orders.

There are also advantages on the back end. By shipping directly to the customer, there's no need for distributors or retailers to handle the PC, and take their own cut of the sale.

⁵ Robert C. Leachman and Chien H. Leachman, "Globalization of Semiconductors," in Martin Kenney and Richard Florida, *Locating Global Advantage* (Stanford, CA: Stanford University Press, 2004).

And there are fewer returns by disappointed customers, since customers order exactly what they want.

Dell embraced this new business model wholeheartedly and now sells 90 percent of its PCs directly to the final customer.⁶ Orders from customers are routed directly to the factory and are compiled into daily production schedules. Dell requires its component suppliers to maintain warehouses within 20 minutes of the factory for easy replenishment of parts, and they don't pay suppliers for the parts until they arrive at the factory, eliminating inventory holding costs for Dell. By tracking trends in customer orders in real time, Dell is able to give accurate information to its suppliers on demand for the components they need to have on hand, eliminating the need for suppliers to maintain a large inventory of surplus parts. Dell considers its ability to manage the smooth flow of information and materials needed to make this system work efficiently to be a distinct competitive advantage.

Dell does most of its final assembly for high-end PCs and configuration for its notebook computers in-house, locating operations as close as possible to the final customer. The company has manufacturing facilities in Texas, Tennessee, and North Carolina for the US market, Brazil for the South American market, Ireland for the European market, and Malaysia and China for the Asian market. However, Dell sources most of its low-end PCs, as well as base units for its notebook computers, from Taiwanese firms with contract operations in China.

The build to order model has paid big dividends for Dell, which went from a global market share of 4 percent in 1995 to its current share of 19 percent, making it the global market leader.⁷ Dell is also the industry leader in the US with 30 percent of the market.⁸ During the downturn from 2000 to 2003, when most other PC makers were reporting big losses, Dell continued to make money and to increase its market share. The saturation of the US and European markets touched off a price war, which Dell was well positioned to win with its vastly more efficient production and distribution system. Dell also benefited from the rapid rise in Internet access and the trend toward shopping on-line.

Dell's success has prompted other PC makers to implement their own build to order and direct sales models, but they have had mixed results. Trying to implement build to order has proven difficult in organizations that have traditionally built to forecast. Also, shipping directly to the customer competes with the distribution and retail channels that those organizations already have in place.

Global Dynamics

Ironically, the business model that Dell exploited to become the industry leader over the past decade may be losing some of its potency. With the markets becoming saturated in

⁶ Kenneth L. Kraemer and Jason Dedrick, "Dell Computer: Organization of a Global Production Network," Center for Research on Information Technology and Organizations, University of California, Irvine

⁷ *International Herald Tribune*, "Apple Passes Lenovo in Computer Sales," July 20, 2005.

⁸ *The Digital Economy Fact Book*.

the US and Western Europe, an estimated 80 percent of new PC sales are expected to come from developing markets like India and China in the next 5 years.⁹ Worldwide, more than 80 percent of PCs are currently sold by retailers, where customers can get assistance from salespeople.¹⁰ That figure is even higher in developing countries like India and China, where most people live in rural areas, have little knowledge of computers, no credit cards, and are not accustomed to making purchases over the phone or on-line.

In 2005, Dell's market share in Asia, excluding Japan, dropped by a full percentage point to 7.8 percent.¹¹ While Dell has been focusing on large businesses and government agencies in the large cities in China, the market has been shifting to consumers in smaller cities, where rivals like Lenovo, Hewlett-Packard, and Founder have established retail outlets.

Rise of Lenovo. Lenovo has been increasing its lead in China, currently around 34 percent of the market, in spite of tough competition from local rivals Tongfang and Founder, and US PC makers Dell and Hewlett-Packard. Dell is currently number 4 in China with 7 percent of the market. However, that may slide even further, since Dell's senior VP for the Asia-Pacific market, William Amelio, was recently recruited to be the CEO of Lenovo.¹² That switch may further strengthen Lenovo's sales in the rapidly expanding Chinese market, at the expense of Dell.

Now that Lenovo has acquired IBM's PC division, it is also expected to increase its share of the global PC market, currently at 8 percent, by expanding its sales to businesses. The deal with IBM will give Lenovo access to IBM's 9,000 global business partners and to IBM's global sales force of over 30,000.¹³ Lenovo's chairman has announced plans to also target consumers in the emerging markets in India, Brazil, and Mexico, before focusing on more mature markets like the US.¹⁴ However, Lenovo already distributes its PCs through retail outlets like WalMart, Office Depot, and Best Buy in the US, and currently controls 4 percent of the US market.¹⁵

Lenovo is able to take advantage of the low labor costs in China, where it carries out all of its production operations in its own plants. Its operating costs are around half of the industry average and about the same as Dell's.¹⁶ But rather than treat the PC as a commodity and mainly compete on price, as Dell does, Lenovo also plans to compete on innovation. Even prior to the deal with IBM, Lenovo was first to the market with instant-on capability, and has gotten great reviews for its easy-to-use internet phone service and

⁹ Olga Kharif, "Dell: Time for a New Model?" *Business Week*, April 6, 2005.

¹⁰ Steve Hamm, "Lenovo and IBM: East Meets West, Big-Time," *Business Week*, May 9, 2005.

¹¹ *Business Week*, "Dell May Have to Reboot in China," October 27, 2005.

¹² Bruce Einhorn, "Lenovo's New Boss – from Dell," *Business Week*, December 21, 2005.

¹³ Steve Hamm, "Lenovo and IBM: East Meets West, Big-Time."

¹⁴ *Business Week*, "A Tough Sell for Lenovo," December 12, 2005.

¹⁵ Bloomberg News, "Apple Passes Lenovo in Computer Sales," *International Herald Tribune*, July 20, 2005.

¹⁶ Steve Hamm, "Lenovo and IBM: East Meets West, Big-Time."

simple controls on the front of the PC to support high-performance gaming.¹⁷ The deal with IBM gives Lenovo access to IBM's R&D centers, which have consistently beaten Dell to the market with new features for laptop computers.

Role of ODMs. In contrast, Dell is not known for its product innovation. The company spends less than 1 percent of revenue on R&D, and most of that is focused on fine-tuning its manufacturing and distribution processes.¹⁸ Like most major PC makers, Dell relies heavily on its suppliers for product innovation. That tendency has fueled the growth of original design manufacturers (ODMs), mostly based in Taiwan, which are responsible for design as well as manufacturing for leading PC makers, especially for notebook computers.¹⁹

Ten years ago, Taiwanese ODMs were responsible for 27 percent of the world's notebook PC production.²⁰ By 2004, they were responsible for 70 percent of the world's notebook production, with operations mainly in China.²¹ There is evidence that product design and development work may be following production work to Taiwan.²² Currently, for notebook PCs, an estimated 80 percent of design and development work is either done in Taiwan jointly between PC makers and ODMs or by ODMs alone, while only 20 percent is done in house by PC makers themselves.²³

Among the largest PC makers, Dell, Hewlett-Packard, and Gateway rely heavily on ODMs for design and manufacturing of their notebooks. Toshiba designs and manufactures its more advanced notebooks in house, but outsources its low-end models to the ODMs. Apple relies on the ODMs to manufacture its products, but does all of its design work in house, including writing much of its own software.²⁴ Lenovo designs and manufactures all of its notebooks in house.²⁵

This heavy reliance on ODMs is significant, because the market for PCs is shifting toward notebook computers. In 2004, notebook computers started outselling desktop models, and that trend is likely to accelerate as more consumers and businesses seek the flexibility and mobility offered by wireless connections.²⁶ Currently, the brand-name PC makers don't view the ODMs as competitors, because the ODMs lack their own capacity

¹⁷ T.C. Doyle and Michael Vizard, "Lenovo's Leadership Eyes More Market Share," *VARBusiness*, March 17, 2005.

¹⁸ Peter Burrows, "Innovation, Lego-Style," *Business Week*, June 23, 2003.

¹⁹ John Hagel, "Offshoring Goes on the Offensive," *The McKinsey Quarterly*, March 17, 2004.

²⁰ Jason Dedrick, Kenneth L. Kraemer and Fei Ren, "China IT Report: 2004," Personal Computing Industry Center, Graduate School of Management, University of California, Irvine, September 2004.

²¹ Jason Dedrick and Kenneth L. Kraemer, "The Impacts of IT on Firm and Industry Structure: The Personal Computer Industry."

²² Jason Dedrick and Kenneth L. Kraemer, "Is Production Pulling Knowledge Work to China? A Study of the Global Computer Industry."

²³ Jason Dedrick and Kenneth L. Kraemer, "Is Production Pulling Knowledge Work to China? A Study of the Global Computer Industry," Personal Computing Industry Center, University of California, Irvine, 2006.

²⁴ Peter Burrows, "Apple's Blueprint for Genius," *Business Week Online Extra*, March 21, 2005.

²⁵ T.C. Doyle and Michael Vizard, "Lenovo's Leadership Eyes More Market Share."

²⁶ Cliff Edwards, and Olga Kharif, "Intel to AMD: Bring it On," *Business Week*, August 24, 2005.

in sales, marketing, and distribution. However, another deal like IBM and Lenovo, this time between a brand-name PC maker and an ODM, could change the competitive landscape very quickly.

Implications for Employment

How will these trends affect PC industry employment in the US? First, it's important to note that, even though PC sales have rebounded since 2000, employment in the industry has continued to fall. Over the past decade, the number of jobs in the PC industry has fallen from 298,700 to 212,100, or roughly 29 percent. The Bureau of Labor Statistics predicts that industry employment will continue to fall over the next decade, despite projected growth in output of 23 percent, which is higher than any other industry.²⁷ The combination of rising output and falling employment is mainly due to continuing technological advances, the outsourcing of production work overseas, and stiffening competition from imports.

Some of the stiffest competition from imports is at the low end of the market, where imports from China are starting to make inroads in the US and around the world. That trend is likely to continue, as growth shifts to developing countries, where the demand is mainly for low-end PCs. In general, China is well positioned to benefit from the shift to low-end PCs, because of its low labor costs and high-volume manufacturing. China is also well positioned to benefit from the shift to notebook PCs, because 85 percent of notebook PCs are already being made in China today.²⁸

With one-third of the Chinese market, which on its way to becoming the largest market for PCs in the world, and an expanded global reach following its deal with IBM, Lenovo is in a strong position to become the world leader in low-end PCs. Dell is no longer able to lay claim to being the lowest-cost PC provider, and with margins thinning at the low-end of the market, they will need to focus more attention on the high end of the market.

Demand for high-end PCs will continue to increase, particularly in developed countries, and especially if the PC becomes central to the digital home and office. The key to how growth at the high end of the market will affect employment in the US over the next decade will be innovation. Currently, the picture is mixed for US-based PC makers and their suppliers.

With the exception of Apple and IBM, US PC makers have not made a big investment in R&D. As mentioned earlier, they have mainly relied on their suppliers for product development, and on Microsoft and Intel for new technologies. For example, in 2004 Microsoft spent \$6.2 billion on R&D (16 percent of revenue), and Intel spent \$4.8 billion (14 percent of revenue), while Dell spent just \$463 million (less than 1 percent of

²⁷ Jay M. Berman, "Industry Output and Employment Projections to 2014," *Monthly Labor Review*, November 2005.

²⁸ T.C. Doyle and Michael Vizard, "Lenovo's Leadership Eyes More Market Share."

revenue). In contrast, IBM spent \$5.7 billion on R&D in 2004 (6 percent of revenue), while Apple spent \$489 million on R&D in 2004 (6 percent of revenue).²⁹

Lenovo is now in a position to benefit from IBM's investments in R&D. In addition, Lenovo is opening joint innovation centers in Beijing and Raleigh, NC to leverage the R&D capacity of Microsoft, Intel, Symantec, and LANDesk, as well.

Convergence. Another factor affecting employment in the PC industry is the emergence of new devices that perform many of the same functions as a PC. For example, in the home, many TV sets now have set-top devices that perform many of the same functions as a PC. And video game consoles, like Microsoft's XBox, are becoming increasingly sophisticated and include many of the same components as a PC. Businesses are turning to wireless personal digital assistants (PDAs), such as the Blackberry, to keep their employees connected. Wireless PDAs accounted for more than half of all PDAs shipped in 2005, and sales of Blackberry devices grew by 76 percent, making it the global leader in PDAs.³⁰ Wireless phones are also starting to perform many of the same functions as a PC, particularly as wireless broadband access becomes more available and more phones come equipped with 3G technology.

It's unclear at this point whether PC makers will be helped or hurt by this trend. They have been trying to establish a foothold in these new product markets, but they face well-entrenched players, and stiff competition, particularly in the consumer electronics industry where there's fierce price competition. They are also relying heavily on the ODMs for design and technology expertise that they lack in these new arenas, which limits their ability to differentiate themselves based on design, since they all use the same ODMs.

Gateway was one of the first PC makers to branch out beyond PCs, establishing itself as an early leader in plasma televisions, betting that consumers would link their PCs with their TVs in a wirelessly networked home. Hewlett-Packard has expanded into digital cameras, capturing 6 percent of the market from industry leaders such as Nikon and Canon.³¹ Dell has targeted printers, MP3 players, TVs and smart phones, hoping to leverage its direct sales model to get a foothold in new markets. Lenovo offers its own cell phones, digital cameras, and printers domestically, with plans to begin exporting them globally.³²

Dell has managed to eke out a 2.4 percent market share in LCD TVs, and a 3.3 percent market share in plasma-screen TVs.³³ But, Dell's direct sales model may be getting in the way. Most consumers prefer to see what kind of picture they will get before buying a TV. Gateway sells its TVs through major retailers like Circuit City, Best Buy, Comp USA, and Costco to take advantage of this preference.

²⁹ 2005 SEC Filings (10K Reports) for Microsoft, Intel, IBM, Apple, and Dell.

³⁰ *The Digital Economy Fact Book.*

³¹ John Hagel, "Offshoring Goes on the Offensive."

³² T.C. Doyle and Michael Vizard, "Lenovo's Leadership Eyes More Market Share."

³³ Andy Serwer, "Dell's Midlife Crisis," *Fortune*, November 16, 2005.

Apple has opened its own retail outlets, as well as selling through major retailers. And the company has hit it big with its iPod, which has more than 70 percent of the market for all types of MP3 players, and 90 percent of the market for those with built-in hard drives.³⁴ Apple claims that the success of the iPod is boosting computer sales, with two out of five computers it sells through its Apple Stores going to first-time Mac buyers. Apple's strategy is to become the digital hub that connects all of consumers' digital devices together through the computer, using software developed by Apple that works with all digital devices, no matter who they are made by.³⁵

It remains to be seen which strategy will work best for PC makers. However, PC component suppliers like Seagate and Intel are clearly benefiting from convergence already. Their substantial investments in R&D have allowed them to stay on the cutting edge of new technologies. For example, Seagate's strategy has been to focus its R&D on the most technically advanced, lowest cost products in the widest range of markets. They are now positioned to supply disk drives to hand-held media players, digital video recorders for TV, home networks, gaming consoles, PDAs, and media servers. Their revenue from these devices grew from 5 percent of total revenue in 2004 to 13 percent of total revenue in 2005.³⁶

Between them, US-based Intel and Advanced Micro Devices (AMD) control almost the entire global semiconductor market for PCs. Intel continues to increase its spending for R&D, which reached \$4.8 billion in 2004. Approximately 25,000 Intel employees were involved in R&D in 2004, out of a total workforce of 85,000, with the majority of them located in the US. However, product development work has been shifting to Israel, India, Malaysia, China, and Russia.³⁷

In general, there's evidence that an increasing number of design jobs in the semiconductor industry are going overseas, driven by the need to reduce costs to keep expanding demand³⁸. As they recover from the downturn in 2000, semiconductor firms now appear to be expanding their design operations abroad faster than at home. Further, there's evidence that in their efforts to gain a foothold in China, semiconductor firms are breaking with their recent pattern of locating innovation in Silicon Valley and manufacturing in China, and relying more on Chinese engineers for design.³⁹

In sum, global PC production has been shifting to Taiwan and China, and will likely continue to do so. The global market has been shifting toward notebook PCs, developing countries, low-end products, and distribution through retail outlets. Those trends favor PC makers like Lenovo, which is well positioned to expand globally, at the expense of Dell, the current global leader.

³⁴ Ina Fried, "Apple Earnings Continue to Hum Along," CNET www.news.com, April 14, 2005.

³⁵ Joe Wilcox, "Jobs: Flat-Panel iMacs on the Way," CNET www.news.com, January 7, 2002.

³⁶ "2005 Shareholder Letter," Seagate.com, accessed January 3, 2006.

³⁷ Intel Corporation, "2004 Annual Report," www.intel.com.

³⁸ Clair Brown and Greg Linden, "Offshoring in the Semiconductor Industry: A Historical Perspective," Center for Work, Technology, and Society, University of California, Berkeley, 2005.

³⁹ Suzanne Berger, *How We Compete* (New York: Random House, 2006).

Dell and most other PC makers are shifting their focus to high-end products and to emerging products that perform many of the same functions as a PC or can be packaged with the PC as part of a digital home or office. However, they are limited by their over-reliance on others for innovation and by the stiff competition they face from other companies already entrenched in these product markets. Apple is the exception, with their heavy emphasis on innovation and their strategy of tying other companies' products together with Apple's software.

The key to keeping high-wage jobs in the US will be innovation, but with the exception of Apple, US-based PC makers make limited investments in R&D and rely heavily on Taiwanese ODMs for product design and development. On the other hand, Lenovo is in a strong position to pursue innovation through its deal with IBM and through its partnership with Microsoft, Intel, Symantec, and LANDesk to jointly conduct R&D.

R&D for hard drives and semiconductors, the main components of the PC, remains rooted in the US, at least for the time being. These high-paying jobs are likely to expand, given the dominance of US-based companies like Seagate, Intel, and AMD in world markets, and the success they are having in bridging into new technologies.

Software Industry Trends

Pete Carlson

Introduction

The software industry has changed significantly since its inception in the 1950s, and its boundaries have gotten blurry as software has become a key facilitating technology in many other industries. In the early years of the computer industry, manufacturers bundled software with their mainframe computers as a package deal. Following the unbundling of software by IBM in 1969, and the advent of the personal computer in the 1970s, the software industry grew rapidly as new firms entered the market with packaged applications and customized services for businesses, and increasingly with packaged applications for homes. The internet revolution in the 1990s spurred the development of new web-based applications and new services to businesses. Employment in this sector of the industry is currently estimated at around 1 million, and is projected to be the fastest growing sector of the economy over the next decade.¹

In addition to stand-alone software publishing and services firms, many firms develop software for their own internal use. This is particularly true in banking and finance, telecommunications, retail, and manufacturing, where information technologies now provide critical support to business processes. Employment in this segment of the industry is estimated at around 2 million, twice the number of jobs in stand-alone software firms.²

The digital revolution is further expanding the scope of software development, as the chips, software, and network connections associated with computers are now being built into phones, hand-held devices, and other consumer electronics. Increasingly, these products are defined more by their software, which supports innovation in features and functions, than by their hardware. Although there is no available estimate of the number of jobs in this rapidly growing sector, the market for these products is currently more than twice the size of the market for more traditional forms of computers and software.³

This report describes the key trends and the global dynamics that are reshaping the US software industry, and the implications for employment in the US.

Key Trends

Within the sector of traditional stand-alone software firms, there are several trends that are reshaping the industry.

¹ Jay M. Berman, "Industry Output and Employment Projections to 2012," *Monthly Labor Review*, February 2004.

² "The Outlook in 2003 for Information Technology Workers in the USA," A Report by the IT Workforce Data Project, August 28, 2003.

³ Stephen Baker and Heather Green, "Big Bang!" *Business Week*, June 21, 2004.

Consolidation. The first trend is the consolidation of large software firms that serve corporate customers. Underlying this trend is corporate frustration with trying to make all of the software applications they have purchased work together. Their focus is shifting away from increasing productivity within vertical functions and shifting toward better integrating functions horizontally across the entire corporation. As corporations make that shift, they are reducing the number of software suppliers they work with and are counting on them to provide a broader range of capabilities. Software firms are responding by offering integrated packages of products and services on a common platform to make them easier to use.⁴ Since most software firms have traditionally specialized in specific areas, they are merging with other companies to broaden the scope of what they have to offer.

These mergers are taking place at two different levels. The mergers that are getting the most attention are those among the big players like Oracle and PeopleSoft. Oracle already has 60 percent of the market in database software, which they believe offers the platform for an integrated system. SAP, Microsoft, and IBM are also competing to establish a common platform for all other business applications to run on.⁵

At the same time, start-up software companies are constantly bringing new applications to market. With their corporate customers increasingly demanding that their applications be integrated into larger packages, start-up companies are finding that they need to build close alliances with the big players through partnerships and technical integration.⁶ The pattern that is emerging looks a lot like what's going on in the biotech industry, where established pharmaceutical companies provide the funding for start-up efforts, and in return get the benefit of innovative new products to add to their portfolio.

Web Services. A second trend is the delivery of software over the internet. Traditionally, software has been a licensed product sold in a box with a fixed life cycle and installed on a specific computer. But increasingly, consumers are downloading the software they need over the internet and paying for it on a subscription basis. This new model has less up-front costs for the customer, and it means that they get updates more frequently, since the people who wrote the software are the ones who are also running it.⁷ Some analysts estimate that by the end of this decade, as much as half of the software sold to corporations will be paid for on a subscription or pay-per-use basis.⁸

This new business model changes the relationship software firms have with their customers. In the old model, the relationship was distant, with little interaction except providing service or support. In the new model, software companies are constantly

⁴ Steve Mills, "In the Shadow of Software's Titans," *Business Week*, March 17, 2005; Steve Lohr, "Software Sector Finally Enters a Merger Phase," *The New York Times*, December 15, 2004.

⁵ "Softwar or Hard?" *The Economist*, March 23, 2005.

⁶ Martin LaMonica, "Survival of Software's Fittest," www.news.com, August 16, 2004.

⁷ Jim Kerstetter, "So, What the Heck are Web Services?" *Business Week* Special Report, February 8, 2005.

⁸ Jim Kerstetter and Jay Greene, "Software: Pay-As-You-Go is Up and Running," *Business Week*, January 12, 2004.

interacting with customers, so security and trust become big issues, particularly when it comes to the use of personal data and the reliability of the services being provided.⁹

For this system to work, different types of software need to be able to talk to each other over the internet, without human intervention. The World Wide Web Consortium is managing the development of standards to support that process, similar to the Hypertext Markup Language (HTML) that is the common face of much web programming, and is not owned by anyone.

This trend is further blurring the definition of what constitutes a software company. For instance, is Google a software company? Or Yahoo? Or eBay? They are web-based and provide the same kind of service that software running on PCs or corporate servers used to provide. But the code happens to reside on a remote server, rather than on a local computer.

Open Source. A related trend is the movement toward open-source software, which makes it possible for others to view and improve on the source code of software, rather than patenting it and licensing its use by others. The open source model is a direct challenge to existing licensing arrangements, and especially to companies like Microsoft, which has denounced these developments as a threat to intellectual property, and has embarked on a campaign to acquire as many software patents as possible.¹⁰

Here in the US, IBM once led the nation in amassing patents and licensing them, but in recent years Big Blue has made open-source software a key part of its business strategy, giving strong support to the Linux operating system, an open-source alternative to Microsoft's Windows. Recently, IBM announced that it is giving away rights to 500 of its patents to spur growth of the open-source movement. Other software companies are also getting on the bandwagon, or at least hedging their bets. With 25 percent of its deployments on the Linux operating system, Oracle has announced its unwavering support for the open source model.¹¹

Overseas, there is a growing movement in support of open-source software, partly in reaction to the domination of US software firms, particularly Microsoft, and also as a way to introduce modern information technologies on limited budgets. Led by Brazil, a number of governments have passed legislation requiring government agencies, and in some cases government-owned companies, to use open-source software. In China, the government has chosen to install the Linux operating system on its computer systems as part of a strategy to avoid reliance on US software companies.¹² This has opened up opportunities for IBM, already the biggest player in China's business computer market, to also expand its software services.¹³

⁹ Fred Hoch, "Brave New World," *Upgrade*, August/September 2003.

¹⁰ Paul Festa, "Governments Push Open-Source Software," www.news.com, August 29, 2001; Jonathan Krim, "IBM to Help Open-Source Developers," *The Washington Post*, January 11, 2005.

¹¹ Michael Singer, "IBM, Oracle Lean on Open Source for Grid," www.internetnews.com, April 6, 2005.

¹² Festa, 2001.

¹³ "IBM Eyes 50% Market Share," *China Business Weekly*, September 24, 2004.

Global Dynamics

U.S. firms lead the world in the development and production of software-related goods and services. Of the top ten software firms in 2003, eight were American (Germany's SAP and Japan's Softbank were the two non-U.S. firms). These ten firms earned about one-third of total global sales, and employed nearly 180,000 people.¹⁴ Microsoft's revenues alone accounted for more than 15 percent of the global software market.

One of the first service sectors to shift significant activity overseas, the software sector has become highly globalized. The rapid growth in packaged software during the 1980s helped fuel the spread of high-technology industries across the major industrialized economies.¹⁵ During the past two decades, financial incentives, the availability of skilled labor, and low wages helped trigger dramatic growth in the software sectors of many emerging economies. The most celebrated newcomers—Ireland, Israel, and India (the “3Is”)—have become major software exporters, reaching sales in the tens of billions and growth rates in the double-digits.¹⁶ Numerous other transitional and developing economies have developed extensive software sectors, and some are poised to become significant software exporters, especially China and Russia, but also Brazil, the Philippines, and Mexico.¹⁷

Each of these countries has followed its own path. Ireland, for example, was very successful in luring multinational corporations with tax breaks, a highly skilled workforce, the overhaul of their communications system, and access to the European market. During the 1980s, U.S. multinational companies like Microsoft focused mainly on manufacturing and distributing off-the-shelf products, including work like duplicating disks, printing manuals, and shrink-wrapping packages. During the 1990s, some of these companies also began to provide customized software development services for client companies. Although some indigenous Irish software firms have emerged, they are generally small and poorly funded, and the country remains dominated by U.S. multinational firms.¹⁸

In Israel, the software industry was preceded by a successful hardware industry, which was the product of national defense and economic development strategies to develop Israel's R&D capability, leveraging the country's strong academic research base. U.S. multinational corporations sought to take advantage of Israel's R&D capability by opening their own R&D centers there or by buying an Israeli technology company and

¹⁴ “Changing Dynamics of Global Computer Software and Services Industry: Implications for Developing Countries,” United Nations Conference on Trade and Development (UNCTAD), 2002; and “OECD Information Technology Outlook,” Organization for Economic Co-operation and Development, 2004.

¹⁵ UNCTAD, 2002.

¹⁶ Ashish Arora and Alfonso Gambardella, “The Globalization of the Software Industry: Perspectives and Opportunities for Developed and Developing Countries,” Working Paper 10538, National Bureau of Economic Research, June 2004.

¹⁷ Erran Carmel, “Taxonomy of New Software Exporting Nations,” *The Electronic Journal on Information Systems in Developing Countries*, Vol. 13, May 2003.

¹⁸ Anita Sands, “The Irish Software Industry,” in Ashish Arora and Alfonso Gambardella, *From Underdogs to Tigers* (Oxford: Oxford University Press) 2005.

transforming it into an R&D center. But U.S. multinational involvement in the software sector has been limited. Israeli software firms have been able to leverage new developments in information technology to create cutting-edge software applications, which they have used to penetrate foreign markets. They have secured financing from venture capitalists in the U.S. and from selling shares on the NASDAQ. Most Israeli firms maintain headquarters and R&D divisions in both Israel and the U.S.¹⁹

The country that has received the most attention is India. From a base of almost no software exports in the early 1980s, India has built a software and services export market worth \$9.2 billion annually, with a domestic software market worth \$3.6 billion.²⁰ Employing more than 450,000 people today, the software industry has grown 30 to 40 percent annually over the past decade.²¹

Unlike Israel, the Indian software industry has focused on customized software services, rather than products. Unlike Ireland, it has been led by domestic, rather than foreign, firms, which generate two-thirds of the industry revenues. In the 1980s, the shift from mainframe to networked computing created a huge demand for technical help in migrating data across the different systems. Indian firms were able to take advantage of a highly skilled technical workforce, low wages, and experience gained on earlier data conversion projects to expand. Multinational firms soon recognized that they could achieve significant cost savings by using the 10-hour time difference and dedicated satellite links between the U.S. and India to utilize idle hardware facilities in the U.S., effectively extending the U.S. work day with labor at one-fifth of the U.S. rate.²²

Two other countries worth mentioning are China and Brazil. Although the software industries in both countries have experienced double-digit growth rates over the past decade, the path they've taken offers a sharp contrast to Ireland, Israel, and India. Both China and Brazil have focused mainly on developing customized software products and services for their own domestic markets, rather than for export. As the economies in both countries have expanded and adopted information technologies to improve productivity, the demand for software products and services also has expanded. This has created opportunities for domestic software firms, which have grown in number, even as multinational firms continue to dominate the market for large enterprises. But a focus on the domestic market also has a downside. Since neither country has an advanced economy, and the software developed domestically is tailored to local uses, domestic firms are limited in what they have to offer to other countries. In addition, both countries are constrained by language barriers and access to capital.²³

¹⁹ Dan Breznitz, "The Israeli Software Industry," in Ashish Arora and Alfonso Gambardella, *From Underdogs to Tigers* (Oxford: Oxford University Press) 2005.

²⁰ National Association of Software and Service Companies (NASSCOM), "IT Software and Services Market: Industry Trends (2003-2004)," http://www.nasscom.org/artdisplay.asp?cat_id=804.

²¹ Arora and Gambardella, 2004.

²² Suma S. Athreye, "The Indian Software Industry," in Ashish Arora and Alfonso Gambardella, *From Underdogs to Tigers* (Oxford: Oxford University Press) 2005.

²³ Ted Tschang and Lan Xue, "The Chinese Software Industry," and Antonio J. Junqueira Botelho, Giancarlo Stefanuto, and Francisco Veloso, "The Brazilian Software Industry," in Ashish Arora and Alfonso Gambardella, *From Underdogs to Tigers* (Oxford: Oxford University Press) 2005.

Offshoring. The most controversial aspect of globalization in the software industry is the movement of some jobs overseas, particularly to India. During the 1990s, the widespread diffusion of the internet, the use of standard software platforms in corporate systems, improved and cheaper telecommunication capabilities, trade liberalization in developing countries, and the availability of skilled, low-cost labor—especially English-speaking science and engineering graduates—propelled U.S. companies to begin off-shoring business processes. These processes range from lower-end data entry, customer support/billing, and call centers (back-office functions) to higher-end management consulting, engineering, and R&D.²⁴ Indian software firms were able to position themselves as low-cost outsourcing centers for global software needs, capable of delivering a team of highly skilled software professionals to any part of the world to do any software engineering job, or performing the work in their facilities in India.

Despite the rapid growth in the global sourcing of IT software and services in recent years, a body of evidence suggests that off-shoring has not led to net job losses in the U.S.—and, in fact, has created net additional value for the U.S. economy. First, offshore outsourcing mostly affects the IT jobs inside companies, not stand-alone software firms. Second, while services off-shoring has increased steadily, it remains at low levels, particularly vis-à-vis other phenomena that induce job shifts, such as automation/technological change, job churn, and mass layoffs due to corporate mergers.²⁵ A recent analysis suggests, for instance, that no more than 134,000 software sector jobs moved to India between 2000 and 2003.²⁶ While not insignificant, this figure is below the new annual services job increase of about 327,000 during that period, and is small compared to the 2.1 million service jobs that were created each year during the 1990s. Moreover, a study on IT outsourcing estimated that spending for global sourcing of computer software and services amounted to \$10 billion in 2003, which represented a mere 2.3 percent of total IT software and services spending by U.S. corporations that year.²⁷

Third, there is evidence that the number of jobs has grown, not declined, in many high-tech occupations considered susceptible to offshore outsourcing. One study finds that employment in white-collar occupations related to IT was stable or higher in 2003 than in 1999, and notes that the “computer and mathematical” occupations grew six percent over this period.²⁸ Finally, and perhaps most significantly, research shows that the jobs migrating offshore tend to be relatively low-skill and low-wage, and that their loss is

²⁴ Kyle Eischen, “Working Through Outsourcing: Software Practice, Industry Organization and Industry Evolution in India,” March 2004. *Center for Global, International and Regional Studies*. Paper CGIRS-2004-4.

²⁵ Mary Amity and Shang-Jin Wei, “Demystifying Outsourcing: The Numbers Do Not Support the Hype Over Job Losses,” *Finance and Development (IMF Quarterly Magazine)*, Vol. 41(4), December 2004; see also McKinsey Global Institute, “Offshoring: Is it a Win-Win Game?” August 2003.

²⁶ Martin Baily and Robert Lawrence. “What Happened to the Great American Job Machine? The Role of Trade and Electronic Outsourcing.” *Brookings Papers on Economic Activity*. Ed. William C. Brainard and George L. Perry. Brookings Institution, 2004.

²⁷ Global Insight, Inc., “The Comprehensive Impact of Offshore IT Software and Services Outsourcing on the U.S. Economy,” March 2004.

²⁸ Catherine Mann, “Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth,” *International Economics Policy Briefs*, December 2003.

counterbalanced by the creation of higher-skilled IT jobs. According to one recent estimate, the number of advanced and higher-paid IT jobs in the U.S. increased from 2000 to 2003, more than offsetting the loss of lower-skilled IT jobs.²⁹ Specifically, the number of high-value computer software engineers and computer and network systems analysts increased by 277,540, while the number of lower-level computer programmers decreased by 96,960. Moreover, the job categories projected to have the largest numerical increases over the coming decade include several advanced computer software-related occupations.³⁰

Other studies advance the claim that the globalization of IT and software leads not only to outsourcing but also “in-sourcing,” -- the process whereby foreign firms buy goods or services from U.S.-based firms. One analysis relies on BLS data to show that, from 1983 to 2000, the number of in-sourced jobs increased by 4 million, compared to a 3.5 million increase in number of outsourced jobs.³¹ Another review claims that in-sourcing leads to higher-value jobs.³²

A recent study conducted by Global Insight and commissioned by the Information Technology Association of America (ITAA), the U.S. IT industry’s leading trade association, examined the impact of offshore IT software and services outsourcing on the U.S. economy and employment—one of the few studies specifically to have done so. Among other benefits, the study found that global sourcing of IT software and services created net new jobs, increased real GDP in the U.S., and increased U.S. workers’ average wages. Specifically, it found that global sourcing created over 90,000 net new jobs in 2003, and predicted that the process would generate 317,000 net new jobs in 2008. It also estimated that the economy would create more IT jobs over the next five years in an environment with offshore outsourcing than without it (516,000 compared to 490,000). Moreover, the study found that global sourcing of IT software and services added \$33.6 billion to real GDP in the U.S. in 2003, and increased the real wages of U.S. workers by 0.13 percent.

Another industry report likewise estimated that, for every dollar that the U.S. spent on outsourcing to India, it gained between \$1.12 and \$1.14 in benefits.³³ Such studies tend to attribute the anticipated gains from offshore outsourcing to a number of factors, including cost savings and greater flexibility, which in turn are expected to lead to greater productivity, lowered interest rates and lowered inflation.³⁴ In addition, outsourcing has allowed American firms to gain an advantage over their Japanese and European competitors.³⁵ While approximately 60 percent of U.S. companies conduct some IT work in low-cost countries, only 11 percent of European firms currently are outsourcing IT

²⁹ Bailey and Lawrence 2004; see also Jacob Kirkegaard, “Outsourcing—Stains on the White Collar?” Institute for International Economics Paper, February 2004.

³⁰ Mann 2003.

³¹ Daniel Drezner, “The Outsourcing Bogyman,” *Foreign Affairs*, May/June 2004.

³² Jagdish Bhagwati et al. 2004. “The Muddles Over Outsourcing.” Forthcoming: *The Journal of Economic Perspectives*.

³³ McKinsey Global Institute, “Offshoring: Is it a Win-Win Game?” August 2003.

³⁴ Global Insight, Inc. 2004.

³⁵ Arora and Gambardella 2004.

work, largely because they are constrained by language, social legislation, trade unions, and regulations.³⁶

Design Work. There is concern that the higher-paid design work is also moving to India. For instance, a number of multinational companies, including Oracle, Microsoft, and Texas Instruments, have established “software development centers” in India, which undertake more sophisticated product development. Moreover, in an effort to “move up the value chain” and ultimately develop the capacity to create new products and offer IT “solutions” to clients, several leading Indian software firms, such as Wipro and Tata Consultancy Services, have created R&D divisions.³⁷

However, Indian R&D services and software products exports have not been substantial to date, amounting to \$2.3 billion in revenues (or about 1.3 percent of the global software market).³⁸ In addition, foreign global software development centers in India are less productive than those in their home markets, especially the U.S.³⁹ In general, India’s software industry is far less productive than that of the U.S., with revenue per Indian employee amounting to only about a quarter of the revenue of a U.S. employee.⁴⁰

For the most part, the work performed by Indian software firms has focused on maintaining and enhancing existing software code, not designing new software. As the Indian software industry has expanded, firms have taken on larger projects, leveraging the experience and capability they have gained from previous efforts. However, most Indian firms have not taken on higher value-added design work.⁴¹ While some U.S. software companies are conducting their design work overseas, the evidence suggests that high-level design work remains concentrated in the U.S. Microsoft, for instance, has set up research laboratories in several cities around the world, such as Bangalore and Beijing; yet the global software leader still conducts 85 percent of its R&D in the United States.⁴²

Moreover, an increasing number of foreign-owned software companies are locating their design work in the U.S. in order to be close to customers in the world’s largest market and to be situated in clusters with other innovative companies. The global R&D headquarters of several leading Indian software companies, for instance, are located not in India but in Silicon Valley.⁴³ Indian software firms have begun setting up operations in the U.S. to be nearer to their clients.⁴⁴ For instance, a 2002 Nasscom-McKinsey study

³⁶ “Sink or Schwinn,” *The Economist*, November 11, 2004.

³⁷ Ashish Arora et al., “The Indian Software Services Industry,” *Research Policy*, Vol. 30(8), October 2001.

³⁸ NASSCOM, “R&D/Offshore Product Development,”
http://www.nasscom.org/artdisplay.asp?cat_id=779.

³⁹ Eischen 2004.

⁴⁰ Arora and Gambardella 2004.

⁴¹ Arora and Gambardella, 2004.

⁴² David Vise, “Gates Cites Hiring Woes, Criticizes Visa Restrictions,” *The Washington Post*, April 28, 2005.

⁴³ Eischen 2004.

⁴⁴ Narayan Ramasubbu et al., “Empirical Analysis of Quality Management Practices in Distributed Custom Software Development,” *Proceedings of the Academy of Management Annual Meeting*, New Orleans, LA, August 2004.

found that around 270 Indian firms had established bases in the U.S.⁴⁵ Some of these firms, like Infosys and Wipro, have begun hiring U.S. workers as consultants.⁴⁶ Also, despite the global integration of multinational activities, multinational companies continue to perform their headquarters' services activities in the U.S. In addition, foreign multinational companies with U.S. subsidiaries are more likely to integrate their service transactions in the U.S. than at their headquarters abroad.⁴⁷

The United States' strong comparative advantage in design stems largely from the fact that it has become the largest market for software services in the world, as well as the most advanced. For instance, new applications emerge and become standardized first in the U.S. As in other design activities, innovation in software development requires proximity to end-users with specific domain knowledge. In large part, this is because the creation of new software applications requires an intimate understanding of the demand for and use of such applications⁴⁸ This understanding (or tacit knowledge) is best gained through direct client contact and interaction.⁴⁹ Hence, both U.S. companies and foreign-owned firms tend to maximize productivity and quality by locating within the vast final markets in the U.S.

A number of other factors serve to maintain the presence of critical design activity within U.S.-based firms—and, conversely, to limit the potential for U.S. offshore outsourcing of high-level software jobs. First, the U.S. provides sufficient access to software talent through production of highly skilled labor and, perhaps more significantly, the attraction of skilled labor from abroad. Second, the U.S. has the world's strongest venture capital market, which firms tend to access more successfully when they have a presence in the country.⁵⁰ Third, design work tends to be a proprietary source of competitive advantage. Weak intellectual property laws overseas, especially in India, dampen enthusiasm for outsourcing such work to foreign-owned companies. Fear of security breaches likewise limits global outsourcing.

Finally, there may be limits to the offshore outsourcing of software design work based on the very nature of software development activity. As theorists have observed, the process of software development is fundamentally a process of tacit knowledge communication, approximating a craft-like activity.⁵¹ To be effective, such communication requires agglomeration, not only near final markets, but also within the development process, for example, face-to-face communication between software developers. It appears that distance matters for purposes of higher-end software development.⁵²

For these reasons, it is likely that the U.S. will remain a leader in software innovation for the foreseeable future.

⁴⁵ Cited in Ramasubbu et al. 2004.

⁴⁶ Olga Kharif, "The Outsourcing Boomerang," *Business Week*, August 11, 2004.

⁴⁷ Mann 2003.

⁴⁸ Arora and Gambardella 2004.

⁴⁹ Eischen 2004

⁵⁰ Arora and Gambardella 2004.

⁵¹ Eischen 2004.

⁵² Eischen 2004.

Immigration. However, fears of a shortage of scientists and engineers continue to worry software industry leaders. The number of US citizens pursuing PhDs in science and engineering in US universities has not changed very much over the past decade, but the proportion of US candidates in science and engineering PhD programs has declined significantly, from 77.5 to 58.3 percent. Almost all of the growth in the number of science and engineering PhDs awarded during that period has come from foreign students. As a result, US reliance on foreign-born scientists and engineers has greatly increased.

Foreign-born workers now account for one-fifth of all core IT workers, up from one-tenth in the mid-1990s. Asian immigrants alone now account for 13 percent of all IT workers – with nearly one-third of them from India.⁵³

Legislation in the 1990s paved the way for this rapid rise in foreign-born worker participation in the IT workforce by expanding the number of persons allowed to enter the US with H-1B temporary worker's visas. As the high-tech industry boomed in the 1990s, the cap was raised from 65,000 to 195,000. The number of L-1 visas, which help multinational businesses transfer workers with "specialized knowledge" to the US, also tripled in the past decade. Indian workers are by far the largest users of the L-1 visas, accounting for one-quarter of the total in 2002.

High unemployment in the IT sector, following the dot.com bust, provoked a backlash against the industry's heavy reliance on foreign-born workers. The cap on the H-1B visa program was allowed to revert back to 65,000, although later raised by 20,000 in response to pressure from large high-tech firms, who complained that they couldn't find qualified workers in the US and who worried that there would be a brain drain from the US if foreign students were forced to return home after graduation.

There were also some restrictions added to the L-1 visa program in response to reports that employers were moving large numbers of non-U.S. engineers and information technology professionals to the United States as a source of lower-cost contract labor. Several foreign corporations even established U.S. subsidiaries specifically for that purpose. L-1 visas do not have an annual cap and are not subject to prevailing wage laws.

China and India have led other nations in the number of students enrolled in IT-related programs in US universities, and in the number of H-1B visas approved by the INS. But those two countries have also made great strides in educating their own IT workforces. Between 1997 and 2001, the number of IT graduates from accredited programs in India rose from 42,800 to 71,000, compared to an increase from 37,000 to 52,900 in the US over roughly the same period.⁵⁴ China is catching up, with 41,000 IT graduates in 2001. In overall science and engineering, China has increased its number of graduates by 75

⁵³ The IT Workforce Data Project, 2003.

⁵⁴ Arora and Gambardella, 2004.

percent over the past decade, compared to an 8 percent increase in the US.⁵⁵ However, there is some evidence that only about 13 percent of university graduates in other countries are suitable for employment by multinational companies – the figure is 25 percent for India and 10 percent for China.⁵⁶

Nevertheless, with IT salaries rising in both India and China, and restrictions on finding employment in the US, there is a growing risk that foreign students in the US will take the lessons from their participation in cutting-edge research in US universities back to their home countries to support the growth of competitor firms there. There is also a risk that they would choose never to come to the US in the first place. If more foreigners decide to start their careers and their own companies back in their home countries, the US could find itself lacking a vital resource.

⁵⁵ Babco, 2004.

⁵⁶ Diana Farrell, Martha A. Laboissiere, and Jason Rosenfeld, “Sizing the Global Labor Market,” *The McKinsey Quarterly*, 2005, Number 3.

Entertainment Industry Trends

Ellen Scully-Russ

Introduction

The modern entertainment industry has undergone great change since its inception in the 1920s. Although some differ on the make up of the industry, its core includes the production, distribution, and exhibition of entertainment products and services.

Analysts expect the industry could grow as much as 7.3 percent each year for the next five years. If these projections hold, revenues would climb to \$1.8 trillion by 2009.¹ The U.S. is the dominant exporter of entertainment, with a net trade balance of at least \$3 billion a year.² In fact, the industry is second only to aerospace in U.S. exports.³

Once synonymous with Hollywood, the industry has become more global. Foreign investors seeking to exploit the growing entertainment market are investing in projects, production companies, and in U.S. entertainment conglomerates. In turn, U.S. entertainment companies are building new distribution networks in Europe and Asia. Also foreign production centers, once focused on the production of local content, now attract both Hollywood productions and a broader audience for their own work. Their experience in the global market, coupled with the cultivation of local talent and government investments in film production, may make these centers more attractive to U.S. filmmakers who want to lower cost.

Deregulation has spurred a continuous cycle of corporate mergers from across once separate industries. Large and diverse conglomerates have emerged to exploit the growing entertainment marketplace. Intellectual property developed in one part of the corporation can be re-packaged and re-sold many times over in domestic and international markets giving rise to a costly, yet lucrative blockbuster business model.

At the same time, new interactive media compete with traditional entertainment products for the consumers' time and money. New media give consumers control over not only what they watch, read, and listen to, but also over how entertainment products can be used. The entertainment experience may transform from a one-way, mass viewing experience - to an interactive, personalized, yet social activity.⁴ The traditional entertainment business model, which is based on tightly controlled intellectual property, may face serious challenges from these trends in the years to come.

¹ *Global Entertainment and Media Outlook: 2005-2009*. (2005) Pricewaterhouse Coopers International Limited.

² Gray, L. S., & Seeber, R. L. (Eds.). (1996). *Under the stars: essays on labor relations in arts and entertainment*. Ithaca: ILR Press.

³ Vogel, H., L. (2004). *Entertainment Industry Economics: A guide for financial analysis* (Sixth ed.). New York: Cambridge University Press.

⁴ Lasica, J. D. (2005). *Darknet: Hollywood's War against the Digital Generation*. Hoboken, NJ: John Wiley & Sons, Inc.

This report will trace the evolution of the entertainment industry from its early years in the movies to the new dominance of home and interactive media. The report also explores the dynamics shaping the industry and the implications for U.S. employment.

From The Box Office to Video Games

The Box Office: In 1940 seven companies (or the “studios”) owned and operated all movie production facilities, distribution firms, and most of the movie theaters in the U.S. The vertically integrated, oligopolistic structure kept competition and costs low and profits high. Studios had one source of revenue, the box office.⁵ Virtually all films made money because people would go to the movies whether films were good or bad. The engine of the studio system was its production model. Each studio owned the entire means of production – including the sound stages and all the equipment and materials. All staff, even the talent - the actors, directors and producers - were under contract to the studio and they did not share in the revenues.

In 1947 the Supreme Court in the *Paramount* decision ruled that the studio system amounted to a restraint of trade and ordered the studios to disinvest their exhibition holdings.⁶ The studios lost power over what was shown in theaters yet they continued to control the fiscal, intellectual, and social capital in the industry. Production and its risk were shifted to a new network of independent producers and sub-contractors, while the studios continued to manage the financial and distribution streams.

Gradually a new disintegrated production system emerged. In this system independent producers assembled the initial funding and talent for each project and drew upon a network of sub-contractors for production support and the post-production work. Studios would ‘pick up’ a project - i.e., finance and distribute it – at some point during the development and production cycle. Film production became more specialized and modularized, while employment became project based and contingent. These flexible formats continue to underlay the industry’s structure today.⁷

The disintegrated industry yielded more innovation because studios could pick from among a range of proposed movie projects. However, costs skyrocketed. The studios lost control of production budgets and schedules so production costs grew. Distribution costs also increased. A new audience had to be created for every release and multiple prints were needed for simultaneous openings. Now, a typical feature film costs about \$4 billion to produce, plus another \$54.8 million in advertising costs, and an additional \$4.2 million for the prints.⁸

⁵ Ebstein, E., J. (2005). *The Big Picture : The New Logic of Money and Power in Hollywood*: Random House.

⁶ Ibid.

⁷ Christopherson, S. (2003). The limits to "New Regionalism" (Re)Learning from the media industries. *Geoforum*, 34, 413 - 415.

⁸ Ebstein, op cit.

In an effort to control escalating costs, film distributors are re-integrating the production system, not by ownership, but through contracts with, and investments in, existing production firms. Production firms still produce films – however these firms are now more dependent on distributors for projects and for financial support. Distributors pay production costs, and control personnel, budgets, and shooting schedules, and they distribute the film. In turn, producers are streamlining production and controlling costs by merging with each other, rationalizing their subcontracting relationships, and moving work to low cost locations in the U.S. and abroad.⁹ Given these structural changes and the flexible movie-making process, the industry is poised to globalize its production system.

From the Box Office to the Home: Around the time of the *Paramount* decision, television exploded onto the U.S. market. American consumers bought millions of television sets between 1946 and 1948. The studios viewed the new medium as a threat to their monopoly on the viewing public. Charging the new medium jeopardized their library assets; the studios sued the networks.¹⁰ Their suit was unsuccessful.

In 1954 Disney became the first studio to work with a television network to produce an original television series. The program, *Disneyland*, accounted for nearly half of ABC's advertising billing that year. More importantly, the arrangement established a new business model in the industry. The series became both an entertainment program and a vehicle for relentless cross-promotion of Disney's other ventures, including feature films, theme parks, and merchandise based on Disney characters.¹¹

In 1971 with pressure from the studios, the Federal Communications Commission (FCC) stepped in with two rulings, the Prime-Time Access Rules, and Financial Interest and Syndication Rules, to curtail the networks' control of both the production and distribution of TV programs. The networks had no choice but to turn to the studios and their growing network of independent producers for its content. The studios regained their control over the growing entertainment industry.

Since then, the VCR, and now the DVD and a myriad of video-on-demand options, have sparked new and expansive growth in the home market. Like TV, the studios initially viewed the VCR with its recording and play back technology as a threat, and once again sued – this time, one company - Sony, the first to bring the new technology to the market.¹² After eight years of litigation, Sony won and ironically paved the way for a new, and now the most profitable outlet for entertainment products. DVD sales can account for half a film's expected revenues. In fact, Americans spent \$9.1 billion on DVD films in 2004.¹³

⁹ Gray and Seeber, op cit.

¹⁰ Ebstein, op cit.

¹¹ Ibid.

¹² Ibid.

¹³ Teather, D. (2005, July 12, 2005). Media business: Double trouble for Dreamworks. *The Guardian*, p. 19.

The studios now see the two markets, the box office and the home, as synergistic. Indeed the industry is experimenting with new film release strategies that reduce the amount of time between a film's release into the theaters and the home so they can quickly capitalize on the lucrative ancillary marketplace. Even so, the box office release continues to play an important marketing role. National campaigns introduce the film and set the tone for how it will perform across all markets.¹⁴

From Home Viewing to Home Play - The Digital Revolution and a Renewed Struggle for Control: Although the box office remains the cornerstone of the movie industry's marketing strategy, the locus of the entertainment industry has clearly shifted to the home. This shift goes far beyond the logistics of how or where movies are viewed. New production and distribution technology, and changing social norms, have altered expectations of the entertainment experience. The digital generation see themselves as users, not consumers, of entertainment products. The one-way, mass-entertainment experience and the control oriented business models that sustain traditional entertainment industry do not appeal to this new market.¹⁵

Games, the strongest pillar of the new media industry¹⁶ may actually be the first wave of a new entertainment form that takes programming straight to the audience, circumventing the traditional production and distribution system.¹⁷ Edge TV, blogs and other peer-to-peer networks, collaborative tools, social software, and mobile devices allow people to download, adjust, make, and share their own media. These new media have fragmented the audience and cut into the amount of the time and money people invest in traditional products.¹⁸

The global video game industry, with current revenues at \$24.5 billion, could grow to \$55 billion by 2008.¹⁹ More than 50 percent of U.S. households have a game console. Games have surpassed hours spent going to movies, watching home video, and reading books. Although the number of young men in the U.S. playing electronic games grew by 22 percent in 2002,²⁰ more adults play games than kids, and 39 percent of gamers are women.²¹

Console games generate about half of the game revenue worldwide.²² A new generation of consoles starting rolling out with Microsoft's Xbox 360 in November 2005, and will continue through the end of 2007 with the introduction of the Nintendo GameCube, and Sony's Playstation 3.

¹⁴ Burr, T. (2005, June 26, 2005). Are the movies dying? *The Boston Globe*, p. 9.

¹⁵ Lasica, J. D. (2005). *Darknet: Hollywood's War against the Digital Generation*. Hoboken, NJ: John Wiley & Sons, Inc.

¹⁶ Grover, R., Edwards, C., & Rowley, I. (2005, February 28, 2005). Game Wars: Who will win your entertainment dollars, Hollywood or Silicon Valley? *Business Week*.

¹⁷ Green, H. (2006, January 23, 2006). Is the Web the New Hollywood? *Business Week*.

¹⁸ Lasica, op cit.

¹⁹ Grover et al, op cit.

²⁰ *Plunkett's Entertainment and Media Almanac 2004*. (2005). Houston, TX.: Plunkett Research Ltd.

²¹ Grover et al, op cit.

²² Campbell, C. (2005, October 24, 2005). Report Predicts \$58.4 Billion Games Market. *Business Week*.

The introduction of new game consoles has disrupted the game production sector. Embedded in the new consoles is a supercomputer chip that can generate realistic new graphics and lightening speed. The new consoles will make existing games seem quaint.²³ Gamers, anticipating the new game consoles, have held off on purchasing games. As game developers' profits sink, the cost of game production has more than doubled in the last five years. Budgets for individual games can run from \$3 million to \$20 million.²⁴ The new consoles' capacity for enhanced graphics and speed will only increase development costs.²⁵

Game production for the new consoles is not only costly; it is also risky. The new consoles require a significant consumer investment that may impede the pace and the extent to which the new console, and therefore the demand for new games, will infiltrate the market. The Xbox 360 debuted at \$400 per unit and some estimate the Sony Playstation 3 could cost Sony as much as \$900 a unit to build. In addition, the new consoles perform best in concert with HD TV, another expensive consumer investment.²⁶ Game developers facing growing production costs for this uncertain market also face consumers who are unwilling to pay more than \$50 per game. Each new game will therefore require a mass audience before producers can recoup their growing development costs, and this mass audience is not assured given the initial consumer investment required by the new consoles.

Meanwhile, U.S. console game producers face new competition from on-line and mobile game producers who reside mostly in Europe and Asia.²⁷ The increased diffusion of broadband has spurred the demand for on-line games.²⁸ In addition, mobile games, including hand-held consoles and phones, are the new growth area in the industry. Even though only 5 percent of mobile phone users have ever downloaded a game, mobile games generated \$2.6 billion in revenues in 2005. With over 600 million new phones sold in 2005, there is plenty of room for growth.²⁹

As cost, risk, and competition continue to rise, game production has become more integrated and rationalized. Last year, the top five game developers accounted for 56 percent of the industry's more than \$7.3 billion in U.S. sales. The strongest players are buying up many of the independent game developers, including many in England.³⁰ At the same time, these large game developers are looking to Hollywood for new capital and for new distribution streams for game plots and characters. Many in Hollywood are

²³ Grover et al, op cit.

²⁴ Ibid.

²⁵ Musgrove, M. (2006, February 23, 2006). An Industry Off its Game: Product delays and prices hurt the business of video play. *The Washington Post*, p. D01.

²⁶ Ibid.

²⁷ Schiesel, S. (2006, February 2, 2006). A bright spot in the dim video game picture. *New York Times*.

²⁸ PWC: Video game industry to drive entertainment sector. (October 7, 2005). *Business Week*.

²⁹ The games people play --- Wirelessly. (August 23, 2005). *Business Week*.

³⁰ Grover et al, op cit.

likely to oblige as the traditional entertainment sector seeks new ways to remain the dominant player in the growing, yet more fragmented, entertainment industry.³¹

Market Dynamics

Convergence and Conglomeration: Modern entertainment companies grew from the old Hollywood studios into major international financial and distribution organizations. Starting in the 1950s, the studios became part of diversified conglomerates involved in a wide range of entertainment activities, from video products to theme park operations. Since the 1980s, deregulation, privatization, technological developments, and the opening of new international markets have set off an ongoing series of mergers and consolidations that continues to change the make up of the industry today.³²

Currently, six entertainment giants, Time Warner, Viacom, Fox, Sony, NBC Universal, and Disney dominate the entertainment and media industry. They own all six U.S. broadcast networks and sixty-four cable networks, giving them control over 96 percent of the prime time programs in America. They also own the broadcast rights to all sporting events, as well as the major radio networks in the U.S. Additionally they dominate the world-wide distribution of movies.³³ These companies are now exploring a new relationship with the game sector. A central question is whether they can leverage their capital and expansive distribution network to garner control over new media, the fastest growing segment of the entertainment industry.

Trends indicate that the convergence between these now separate industries may be on the horizon. Indeed, the re-integration of the film production sector is only part of the story of change in the traditional entertainment industry. As deregulation made it possible for TV and movie studios to merge on the corporate level, new technology also worked to eliminate the technical differences between TV and film production. Gradually deregulation and technological change came together to allow both industries to draw upon the same workforce and production facilities, further fueling the trends towards industrial convergence and corporate conglomeration.

Although deregulation is not a factor in the relationship between the studios and games, capital and technology are. In fact, the new graphics technology is contributing to the increasing cost of both film and game production. In film, action movies are now more popular than ever and many of these films have more computer-generated scenes than live ones. Like in game production, computer graphics now account for a growing share of a film's budget.³⁴ However the end game for these two entertainment genres is different. Movies have neat, linear story lines, whereas games provide an experience that give players the power to create their own stories.³⁵ Computer graphics may underlie

³¹ Grover et al, op cit.

³² Litman, B. (1998). *The Motion Picture Mega-Industry*. Boston: Allyn and Bacon.

³³ Ebstein, op cit.

³⁴ Ibid.

³⁵ Grover et al, op cit.

both, but the program is different. Convergence will not only require reconciliation of these cultural differences, but of two very different business models as well.

Changing business models: In the traditional entertainment sector the aim is to create a product or a brand so distinct that it can become a cultural icon, a fixture in the public's imagination.³⁶ Such characters can be franchised and re-sold many times over in a variety of forms and settings. Indeed profits from the ancillary markets, including toys, games, theme park rides, etc. have come to represent a growing portion of Hollywood revenues.

As Hollywood continues to seek out those plots and characters that can fit the franchise model, it also has come to depend upon a smaller number of blockbuster films for its revenues and profits. Blockbusters are not new, but their modern versions are different. A small number of profitable films now wipe out losses from the majority of other productions. For example, in 2002 Sony's Spider-Man kept the studio from having the second-worst year in its history.³⁷ In the longer term, franchised characters can generate revenue for years to come. Disney's Lion King, released into the movies in 1994, turned into a \$1 billion business with more than 60 licensed consumer products, DVDs, and a hit Broadway show.³⁸

Marketability is now a key factor in most production decisions. In vogue today are the action-packed special effects films that not only attract large audiences, but lead to sequels. Animated movies are also popular since their characters do not require residuals and they can be licensed and resold many times over as toys, video games and other merchandise.³⁹

The question is whether the blockbuster, franchise market-oriented strategy is sustainable, especially as end markets become more fragmented and consumers have more entertainment choices.⁴⁰ Homogenized entertainment content is problematic because it appeals to a relatively small demographic. As new technologies bring new choices, and globalization opens up new markets, excluded consumers may continue to gravitate to alternative forms of entertainment.⁴¹

Expanding the international market for current products has proven to be an effective short term growth strategy for the industry.⁴² Long-term domination and control of the market, however, may not only entail content innovation, it may also require significant in-roads into the interactive digital entertainment sectors. However, the traditional

³⁶ Stevens, L. S., & Grover, R. (1998, February 16, 1998). The Entertainment Glut: Entertainment companies spend more and more on content, but the audience is fragmenting amid the clutter. What will it take to win in a climate this tough? *Business Week*, 88.

³⁷ Ebstein, op cit.

³⁸ Grover, op cit.

³⁹ Litman, op cit.

⁴⁰ Lippman, J. (2004, June 25, 2004). Hollywood Report: Summer of 44; Dozens of Releases Overload Schedule, Tire Audiences; Onset of 'Event Fatigue'. *The Wall Street Journal*, p. W. 4.

⁴¹ Stevens and Grover, op cit.

⁴² Ebstein, op cit.

entertainment sector is slow to respond to this challenge. Hollywood remains unprepared to meet even the basic requirement for entry into the digital marketplace – the digitization of feature films.

In the case of the box office, distributors have yet to agree on a common standard for the digitization of film, and once they do, it will cost as much as \$100,000 per theater to convert to digital projection. Digital distribution into the home via the Internet is hampered by limited broadband availability. Only 12 percent of Americans had high-speed or broadband access in 2000, so receiving feature films via computers remains a slow and cumbersome option for many in the U.S.⁴³

When broadband becomes more widespread in the U.S. the demand for Internet transmission of films will rise. But Hollywood continues to lack a viable Internet business model. The Internet is different from the alternative distribution outlets, like TV or DVD. These outlets have traditionally provided the studios with new and profitable revenue streams. In the Internet, content providers actually pay money to software companies and Internet providers to distribute their products. Advertisers will not help defray these distribution costs because Internet audiences for a single production are usually smaller than the mass audiences the advertisers traditionally seek.⁴⁴ Download fees from small and fragmented audiences will not result in a significant source of new revenues. Hollywood has yet to figure out who will pay them in cyberspace.

Yet the concern over piracy is perhaps the biggest barrier to Hollywood going digital. The industry loses about \$2 billion each year to audiovisual pirates. Once digitized, films can be downloaded, modified, and shared many times over, potentially accelerating this growing problem. Hollywood will be slow to build digital distribution capacity until regulatory and technological solutions are found to protect copyrights - or until they find a profitable digital business model - or both.

Meanwhile, alternative media producers, telecommunications firms, and electronics companies have an advantage over Hollywood in the growing interactive media marketplace precisely because they all have digital business models.⁴⁵ Game producers may have a particular advantage because they understand the new media consumer and the difference between interactive and passive entertainment. Rather than discouraging consumer infringements on copyrights, games producers encourage consumers to modify their product and share their enhancements. In fact such player modifications are seen as major source innovation and marketing in the industry.⁴⁶

In the long term, traditional entertainment companies may be hindered by their opposition to the borrowing and participatory culture that are inherent in interactive media. Business models based on tight control over intellectual property are not suited for this new world. In deed, the traditional entertainment outlets have recently showed

⁴³ Wasco, J. (2003). *How Hollywood Works*. London: Sage.

⁴⁴ Ibid.

⁴⁵ Grover et al, op cit.

⁴⁶ Lasica, op cit.

signs of increased stress. NBC and Disney both have initiated major restructuring efforts in which they have reduced the number of their productions, consolidated programming, and streamlined corporate functions. Collectively the two eliminated over 1,350 jobs in the Fall of 2006.⁴⁷ Meanwhile, investment in new media – specifically internet based interactive social hubs like MySpace and UTube, have received billions of dollars of new investments from the IT sector during the same period.⁴⁸ Forecasters claim that these new start-ups are the leading edge of a new online interactive entertainment model. In fact several new start-ups are planned for 2007 that will enable people to download, use, create and share professional quality video content via the internet.⁴⁹

As the new media genre evolves it will also become more complex. Development costs will surely rise and new media producers may need to turn to the entertainment conglomerates for capital. In addition, as new media outlets become popular, traditional media producers will have more incentive to look to them as a viable distribution stream for their content.⁵⁰ Innovations to marketing and to the management of intellectual property are both anticipated in the years to come within the industry. Indeed, the future success of both the traditional entertainment industry and the new media sector will require nothing less.⁵¹ The outstanding question however is how will these very different sectors reconcile their very different cultures and views of the entertainment experience and the economic models.

Globalization: There is no question that film and TV production have become more global.⁵² The question is whether globalization will result in new foreign competition to U.S. dominance of the entertainment industry, or in the formation of a globally dispersed and rationalized American entertainment production system.⁵³ Regardless, the American entertainment workforce is sure to be impacted because both scenarios portend the continuation of run-away production, Hollywood's version of outsourcing its production to lower cost centers around the world.

In 1999 the Screen Actors and the Directors Guild estimated the total economic impact of run-away production in Hollywood at \$10.3 billion, a fivefold increase in the decade.⁵⁴ New digital technology and a more flexible and modularized production process have allowed producers to take production anywhere, while new subsidies and tax breaks in Britain, Canada, Australia, New Zealand, and in several US states including New York,

⁴⁷ Helft, M., & Richtel, M. (2006, October 10, 2006). Venture Firm Shares a YouTube Jackpot. *New York Times* and Lieberman, D. J., P., & Levin, G. (2006, 10/20/2006). NBC Universal plans cost cuts, layoffs. *USA Today*.

⁴⁸ Lieberman, D. J., P., & Levin, G. (2006, 10/20/2006). NBC Universal plans cost cuts, layoffs. *USA Today*.

⁴⁹ Green, H., & Lacy, S. (2006, October 30, 2006). What comes after YouTube: Meet the startups making deals with Big Media for online video's next step *BusinessWeek Online*.

⁵⁰ Ibid.

⁵¹ Grover et al, op cit.

⁵² Gray and Seeber, op cit.

⁵³ Klein, C. (2004, April 30, 2004). The Hollowing-Out of Hollywood. *YaleGlobal Online* Retrieved March 1, 2006, from www.yaleglobal.edu/article.print?id=3794

⁵⁴ Wasco, op cit.

New Mexico, and Louisiana⁵⁵ entice them to do so. Such subsidies, combined with lower wages, can save Hollywood producers as much as 25 percent over the Hollywood production costs. Canada once hosted about 80 percent of all run-away production. Now, lower cost areas such the Czech Republic, Hungary, Romania, Brazil, Morocco, and India seek to attract production away from Canada by offering even larger savings.⁵⁶

Although Hollywood has always relied on foreign labor - actors, directors, and technicians - to make films, and on foreign audience to make money,⁵⁷ the locus of the industry - its financial and social capital, and its creative and distribution center - historically remained in Hollywood. But this too may be changing.⁵⁸ America's dominance of the entertainment industry was built upon the American audience.⁵⁹ U.S. entertainment distributors recouped their production costs at home and this has allowed them to capitalize on foreign markets in ways that foreign producers could not.⁶⁰ But now foreign countries and producers are seeking to combine government subsidies with Hollywood's investment to build new production centers that can meet the rising demand for culturally relevant local productions as well as compete head to head with Hollywood productions in the global marketplace.

India is a case in point. Bollywood, the Hindi-language movie industry based in Mumbai, produced over 240 films in 2000. Most of these films were distributed within India and to Indian markets in the United Kingdom, North America, the Gulf States, and parts of Africa.⁶¹ However, producers now seek to leverage their movie-making capacity to increase the world-wide market share for locally produced films. *My Bollywood Bride* (2005) is an example of an Indian made, Hollywood-class movie that is performing well in the global market.⁶² More is expected from Bollywood as Indian producers continue in their efforts to convince the Indian government to invest in the film industry because, like the telecommunications and information technology industries, it can leverage the country's skilled workforce and low costs to create an internationally competitive economy.

In response to these growing centers and the growing international market for films, US distributors are developing new strategies to maintain their historic domination of the industry. Studios now operate overseas divisions that finance and produce local language films aimed at local audiences in Germany, Spain, Italy, Mexico, Brazil, Argentina, India, China, Hong Kong, Taiwan and elsewhere. Indeed Hollywood is now a major producer of foreign films.⁶³ For example, both Sony and Disney have struck co-production deals in China to produce and distribute Chinese films. Sony also has plans to

⁵⁵ Wadhwa, V. (2005a, March 8, 2005). Hollywood, Meet Wilmington. *Business Week*.

⁵⁶ Klein, C. (April 30, 2004). Op cit.

⁵⁷ Ibid.

⁵⁸ Ibid.

⁵⁹ Wasco, op cit.

⁶⁰ Litman, op cit.

⁶¹ Wasco, op cit.

⁶² Wadhwa, V. (2005b, April 11, 2005). Lights! Action! Overruns! *Business Week*.

⁶³ Klein, C. (2005, Feb. 27, 2005). Globalization: Is 'King Fu Hustle' Un-American? *Los Angeles Times*, page 2.

produce TV programs in China over the next two years. On the other hand, Disney plans to build a theme park in Shanghai and also is seeking full access rights to Chinese TV networks. Unlike the original forms of run-away production, these new strategies are not cost-cutting measures. Rather they represent a new model for how Hollywood will operate in foreign markets.⁶⁴

Many argue that film production continues to remain largely an American industry because the creativity that drives the industry resides in Hollywood. But this long held belief may be challenged now. Even though the American film genre continues to set the benchmark for entry into the international film marketplace, Hollywood's continued reliance on franchised characters and sequels has chipped away at the American art form. Also studios, in an effort to cut costs, are buying the remake rights to foreign films, raising questions of whose originality and creativity is really being displayed in contemporary American films.⁶⁵ Hollywood innovation may soon be rivaled.

These trends point to at least two scenarios for the future globalization of the entertainment industry. In one scenario, foreign production centers use government and Hollywood's investments in their film-making industry to not only make Hollywood feature films, but also to cultivate new national and alternative film industries with the capacity to compete with Hollywood in the global market. It is not likely however, that these centers will match the distribution capacity of Hollywood, or producers and investors will take-on the long-term risk required to build a globally successful movie industry. In the end, a second scenario is more likely, where Hollywood investment in foreign production capacity results in enhancements to the run-away production infrastructure and in reinforcement of Hollywood's traditional dominance of the entertainment industry.⁶⁶ Uncertainty remains about where Hollywood and thus the American jobs will reside in the production value chain.

Employment

Traditional Entertainment: Employment in the film production industry includes work on featured films, TV movies, series, commercials, and a variety of industrial, commercial, educational and other film products. Primarily concentrated in Los Angeles, US employment has actually grown by 42 percent since 1992, reaching approximately 542,000 in 2005.⁶⁷

Although run-away production has created new competition for Hollywood production work, a renewed TV business and a rally this year in movie production have kept many

⁶⁴ Wallace, B. (2005, December 30, 2005). HOLLY WORLD; Crouching U.S. studios, hidden Chinese market; Major film companies prepare to pounce if the world's biggest market comes out from behind Communist rules and rampant piracy. *Los Angeles Times*, p. E.1.

⁶⁵ Klein 2004, op cit.

⁶⁶ Klein 2004, op cit.

⁶⁷ *Amazing Post*. (2004). LA: Entertainment Industry Development Corporation.

Hollywood workers employed.⁶⁸ The growing number of new cable channels, coupled with the networks' search for fresh programming, has sparked the demand for new TV content.⁶⁹ Los Angeles, with its proximity to talent and its extensive production infrastructure, remains the logical location to meet this demand.⁷⁰ Although production workers are paid less for work in TV, many prefer its steady work in Hollywood over the alternative of following unstable movie production work to other locations in the U.S. and abroad.⁷¹

However, the projection for work in Hollywood is unclear. Hollywood, with its modular production system and networked industry structure, is poised to follow the path of other U.S. manufacturers. In fact, Hollywood could very easily become a general contractor for, and not a producer of, American and foreign feature films. The impact on the U.S. entertainment workforce could be dramatic. Craft and production work would shrink and financial, administrative, and marketing work would rise.

Change in the Hollywood labor market is not new; in fact it can be traced to the dismantling of the studio system. As studios began to break down, entertainment unions negotiated several institutions that made it possible for the internal labor market functions to be carried on outside the firm, including a roster system to maintain seniority and to certify skill and experience; a health and pension benefit system independent of any particular employer; and a system of supplementary payments to ensure actors "residual" payments from profits made in ancillary markets.⁷² These new institutions actually gave rise to Hollywood's contingent workforce because they maintained wages and extended skills while also helping producers and directors assemble teams for project-based work.

These systems continue today, but face challenges. The apprenticeship system in particular is under great stress. Contingent contracts simply do not provide the continuity needed to sustain programs and help workers build craft skills. Technology also has broken-down traditional craft boundaries and rendered some apprenticeships obsolete. External training programs have grown-up around the industry to fill the void. In fact film and television schools have become the primary providers of skilled workers in these industries in both the craft and talent fields.⁷³

But these schools may not be enough to sustain the movie production labor market. The Hollywood film production knowledge base may be eroding under the dual pressure of run-away production and the break down of the craft apprenticeship system.⁷⁴

⁶⁸ Verrier, R. (2005a, October 23, 2005). HOLLY WORLD; Canada Rolls Credits on a Slump Series: Fourth in a series of occasional articles on how globalization is changing American filmmaking. *Los Angeles Times*, p. A.1.

⁶⁹ Gray and Seeber, op cit.

⁷⁰ Verrier, R. (2005b, August 19, 2005). Movies, Shmovies -- TV's taking over L.A. *Los Angeles Times*, p. A.1.

⁷¹ Ibid.

⁷² Gray and Seeber, op cit.

⁷³ Ibid.

⁷⁴ McNamara, M. (2005, October 9, 2005). HOLLY WORLD: Down-home directing. *Los Angeles Times*, p. E.1.

Community is central to film making because it provides a common language and a clear division of labor that builds the trust and facilitates the teamwork essential for a creative, project based labor market to work. Without steady work in film production, many Hollywood craft workers take on second jobs that weaken their learning curve and take them out of the network so important to finding work in Hollywood.⁷⁵ Meanwhile, as producers and directors gain confidence in the skills of foreign production workers they may continue to move more production abroad, further eroding the Hollywood knowledge base.

New Media: The new media workforce on the other hand are seen as part of the process driving the industrial convergence that is leading to the formation of new media products and marketplace. New media workers merge the old media of film and television with Internet distribution and computer-driven digital technologies to produce a wide range of information, communications, and entertainment products and services. Their mobility among these once-separate industries and their work are helping to transform conventional industries, including the entertainment industries.⁷⁶ Although little is known about the size of the new media workforce, a recent survey of game developers conducted by the International Game Developers Association determined that the ‘typical’ game developer is a white, college educated, 31 year old male, with five years’ experience in the industry, who earns \$57,000 in total compensation per year.⁷⁷

New media workers, like traditional entertainment workers, face challenges to building a career due to the project-based nature of their work. They are under constant pressure to find new work and to continuously upgrade and enhance their skills. Although new media workers must maintain a wide variety of skills, including writing and editing, marketing, sales, database management, graphic design, and software development as well as code writing, these skills are not enough. Success in the industry also requires workers to be “networked” and on the forefront of new ideas. Therefore the nature of skill, community, and creativity are also central to the new media identity.⁷⁸

The costs of sustaining a project-based industry in the U.S. fall primarily on the workforce. But employers also bear the cost of uncertainty.⁷⁹ Producers must scramble to find skilled workers and then face the problem of validating a short-term worker’s credentials. They also face difficulties in managing workers who are always looking to the next assignment.⁸⁰ A study of new media workers in New York City⁸¹ found that

⁷⁵ Ibid.

⁷⁶ Christopherson, S., (2003), op cit.

⁷⁷ Gourdin, A. (2005). *Game Developer Demographics: An Exploration of Workforce Diversity*. San Francisco, CA.: International Game Developers Association.

⁷⁸ Christopherson, S. (2004). The Divergent Worlds of New Media: How Policy Shapes Work in the Creative Economy. *Review of Policy Research*, 21(4), 543 - 558.

⁷⁹ Ibid.

⁸⁰ Ebstein, op cit.

⁸¹ Batt, R., Christopherson, S., Rightor, N., & Van Jaarsveld, D. (2001). *Networking: Work patterns and workforce policies for the new media industry*. Washington, DC: Economic Policy Institute.

workers spend several hours per week looking for new work, even in those weeks when they are working.

U.S. new media workers, like those in the traditional entertainment labor market, may be at a disadvantage when compared with their counterparts in other countries like Canada, Australia, Germany, and the U.K where the governments invest in their training and professional development, and workers have established strong professional associations to assist in validating skills. These institutions may help U.S. producers seeking to lower cost, to gain confidence in the skills of foreign workers, hence hastening the off shoring of the emerging new media as well as the traditional entertainment occupations in the U.S.

Textile and Apparel Industry Trends

Barbara Rivard and Mark Troppe

Introduction

The popular prognosis for the US textile and apparel industries is bleak. The apparel industry alone is projected to lose 68 percent of its present jobs by 2012.¹ Faced with the lower cost of labor overseas and the international pressure to reduce trade barriers, the prevailing notion has been that the textile and apparel industries in the US are dying a slow and painful death. But there are those, including researchers at the Harvard Center for Textile and Apparel Research (HCTAR), who believe that lean retailing and the changes it has brought to modern sourcing strategies and regional trade alliances offer some hope for the future viability of segments of the textile and apparel industries in the United States.

While the textile and apparel industries are clearly two separate and distinct industries, for the purposes of this paper we are addressing them together. The textile and apparel industries, two of the oldest sectors of manufacturing, share many of the same competitive dynamics. Both have been transformed by changes in retailing. Both have adapted major technological innovations. Both have faced growing, in many cases crippling, competition from overseas. Indeed, developed nations in general have lost staggering numbers of textile and apparel jobs in recent years.

Table 1: Job losses in textiles and clothing between 1970 and 2000²

Country	Textiles	Clothing	Total loss	Total loss (percent)	Employment Levels in 2000
France	-337,000	-238,000	-575,000	72.9%	241,000
Germany	-333,000	-262,000	-595,000	67.6%	285,000
Japan	-997,000	-140,000	-1,137,000	66.4%	576,000
UK	-486,000	-248,000	-724,000	73.7%	258,000
US	-585,000	-531,000	-1,116,000	49.0%	1,161,000
Total	-2,738,000	-1,419,000	-4,147,000	62.2%	2,521,000

The US Department of Labor defines the Textile Mills and Products Industry as establishments that produce yarn, thread, and fabric and also a wide variety of textile products for use by individuals and businesses, but not including apparel. Some of the items made in this industry include household items such as carpets and rugs, towels, curtains, and sheets; cord and twine; furniture and automotive upholstery; and industrial

¹ Bureau of Labor Statistics, U.S. Department of Labor, Career Guide to Industries, Apparel Manufacturing, on the Internet at <http://stats.bls.gov/oco/cg/cgs007.htm>

² United National Yearbook of Industrial Statistics; Bureau of Labor Statistics, US Department of Labor; and Cline (1990), http://www.oecd.org/document/63/0,2340,en_2649_201185_34035455_1_1_1_1,00.html

belts and fire hoses. The process of converting raw fibers into finished non-apparel textile products is complex; thus, most textile mills specialize.

The US Department of Labor states that workers in the apparel industry transform fabrics produced by textile manufacturers, as well as other materials such as leather, rubberized fabrics, plastics and furs, into clothing and accessories.

Apparel

The apparel industry provided about 358,000 wage and salary jobs in the US in 2002. About 70 percent of employees in the industry work in production occupations; about 40 percent are sewing machine operators. Other production occupations include patternmakers, markers, cutters, assemblers and pressers. Fashion designers are the artists of the apparel industry. The industry also employs a small number of workers in administrative support, material-moving, and managerial occupations. About three-fourths of the jobs in the apparel industry are found in nine states, concentrated in the Northeast, Mid-Atlantic, and South. In 2002, the industry had about 14,000 establishments with employment concentrated in firms with 50 workers or more.³

Average weekly earnings for production workers in the apparel industry were \$334 in 2002, significantly lower than the overall average of \$619 per week in manufacturing. Traditionally, sewing machine operators have been paid on a piecework basis determined by the quantity of goods they produce.

Traditionally, the apparel industry has consisted of production workers in an assembly line performing cutting and sewing functions. In recent years, most remaining US apparel companies have organized work in teams, or “modules,” in which garments are made by a group of sewing machine operators. Modular manufacturing involves teamwork, increased responsibility, and greater interaction among coworkers than does traditional assembly lines. Each operator is trained to perform nearly all of the functions required to assemble a garment. Each team is responsible for its own performance; many companies are changing to incentive systems that reward group performance as well, based on both the quantity and quality of goods produced. The movement away from traditional piecework systems also offers significantly improved working conditions. Only a few companies pay production workers a salary.

Most apparel production workers are trained on the job. While a high school diploma historically has not been a pre-requisite for employment, employers increasingly prefer it. Some positions, such as patternmakers and markers, usually have technical or trade school training. Regardless of formal training, all apparel workers must have a good understanding of textile characteristics and a good sense of three-dimensional space. Computers are becoming a standard tool for many of these occupations, as so many of the design and layout functions are now performed on a computer screen. Vocational

³ Bureau of Labor Statistics, U.S. Department of Labor, *Career Guide to Industries*, Apparel Manufacturing, on the Internet at <http://stats.bls.gov/oco/cg/cgs007.htm>

schools teach the technical skills needed to use automatic cutting machines. Sewing machine operators are generally trained on the job.

In addition to designers needing a good sense of color, texture, and style, apparel workers must understand the construction and characteristics of fabrics, specifically for durability and stiffness. Employers often want designers who know how to use computer-assisted design. This specialized training usually is obtained through a university or design school that offers 4 -year or 2- year degrees in art, fine art, or fashion design. Many schools do not allow entry into a bachelor's degree program until a student has completed a year of basic art and design courses.

Technology, including computerized equipment and material transport systems, has revolutionized the apparel industry. Computers and computer-controlled equipment assist the design, patternmaking, and cutting functions. Plant efficiency has been enhanced with the aid of wider looms, more computerized equipment, and the increased use of robotics to move material within the plant. Despite these changes, the apparel industry has remained significantly less automated, especially in its sewing functions, than many other manufacturing industries, including the textile industry.

Textiles

In 2002, there were 489,000 wage and salary workers employed in the textile industry, primarily in North Carolina, South Carolina, and Georgia. North Carolina alone accounted for 28 percent of textile jobs in the U.S. The remaining jobs are found primarily in other areas of the South, California, and the Northeast. The majority of textile production is concentrated in large mills. Mills with more than 50 employees account for more than 80 percent of all textile workers.⁴

Average weekly earnings of non-supervisory textile production workers were \$477 in 2002. Wages within the textile industry depend upon skill level and type of mill. Workers in textile goods manufacturing generally make more than those working in yarn and fabric mills. After supervisors and managers, mechanics are paid the highest average hourly wage, while sewing machine operators are paid the least.

As in the apparel industry, production occupations account for the majority, almost 64 percent, of occupations in the textile industry. Some of these occupations are unique to the textile industry. Many textile workers enter the industry as machine setters and operators, the largest occupational group in the industry. This is physical labor and requires on the job training. Entry-level positions generally require high school diplomas or GED certificates. Additional training is obtained at technical schools and community colleges. Extensive training has become increasingly critical to help workers understand the increasingly complex, automated machinery. Additionally, training is being offered to enable people to work well in a team-oriented environment. Firms are placing a premium on teamwork, and are trying to minimize the layers of management in modern

⁴ Report to the North Carolina State Board of Community Colleges on Options and Recommendations for the North Carolina Center for Applied Textile Technology, October 28, 2004

mills. Firms are also encouraging employee self-direction and responsibility and the development of interpersonal skills.

As in apparel, the textile industry has been transformed by technological innovation. In order to compete with growing domestic and international competition, manufacturers have invested in automation and information technology as well as developed new products and services. Advanced machinery is increasing productivity levels in textiles, which results in some workers losing their jobs while it changes the nature of other jobs.

The emphasis in the industry is shifting from mass production to flexible manufacturing, as mills focus on supplying customized markets. Firms are focusing on systems that allow small quantities to be produced with minimum lead-time. They are looking for the flexibility to bring consumer goods to retailers faster than before.

Global Trade Policy and Industry Trends

Apparel manufacturing has always been, and remains, labor intensive. As such, apparel manufacturers depend upon a stable, relatively low wage work force. In the first part of the 20th century, US apparel was manufactured primarily in big cities relying on a workforce composed mostly of recent immigrants. Immigrant groups were known to have a strong work ethic, but because of their limited opportunities for employment, they did not command high wages. In the 1920's and 1930's, segments of the apparel industry and textile production migrated south looking for lower wage rates, a non-unionized workforce, and more modern plants than those found in New England and in larger cities. They settled in the rural south.

After World War II, international trade exploded. Communication lines improved, and shipping routes were more reliable. Developing nations increased their production of apparel as a viable export commodity, continuing the industry's trend of seeking out low-cost locations. Because of the industry's importance in international trade, a series of trade agreements have played a role for decades.

In 1962 the Long Term Arrangement (LTA) Regarding International Trade in Cotton Textiles established a framework for international trade in apparel. LTA was replaced in 1974 by the Multi-Fiber Arrangement (MFA), which created a system of bilateral agreements on quotas for apparel and textiles. MFA also intended to provide time for the textile and clothing industries in developed countries to adjust to more competition from developing nations, while at the same time fostering free trade. On January 1, 1995, the MFA gave way to the Agreement on Textile and Clothing (ATC) under the General Agreement on Tariff and Trade (GATT). The ATC employed a complicated system for the gradual elimination of quotas over the decade through January 1, 2005.⁵

⁵ Huan Liu and Laixiang Sun, "Beyond Phase-out of Quota in Textile and Clothing Trading: WTO-Plus Rules and the Case of US Safeguards against Chinese Exports in 2003," *Asia-Pacific Development Journal*, (United Nations Economic and Social Commission for Asia and the Pacific), vol. 11, no. 1, June 2004, pp. 49-71.

During this time countries such as Mexico and Egypt pressured the World Trade Organization (WTO) to eliminate all the restrictions on trade in textiles and apparel. They assumed that, with their large pools of cheap labor, they could win bigger shares of the North American and European markets if not constrained by quotas.

Most experts had not envisioned the emergence of China and, to a lesser degree, India, as economic powerhouses. These two countries, the most populous in the world, can offer the low wages of poor nations along with the efficiencies of modern economies. The advantages are particularly seen in the textile and apparel industries, both of which require large pools of unskilled laborers but also depend on fast delivery and the ability to adjust quickly to changing fashions. Andrew Tsuei, Wal-Mart's global procurement chief, credits China with having the overall balance of quality, reliability and price that make it the most competitive market in the world.

In spite of the agreement to eliminate quotas in 2005, some tariffs remained in place between signatory nations of GATT, albeit at lower levels. In addition, under a separate agreement between the US and China, the US had the authority to seek to extend quotas with China for an additional four years, for specific goods where the elimination of restrictions would result in "market disruption, threatening to impede the orderly development of trade between the two countries..."

During the first eight months of 2005, overall Chinese textile exports to US surged 54 percent to \$17.7 billion. Removal of quotas exacerbated the already-large imbalance that existed in the prior year, when China bought \$278 million of American textile products in 2004, while selling \$14.6 billion to US. Trade frictions exploded as Chinese exports grew dramatically; many American retailers were reluctant to place large orders because of concerns about the tensions disrupting textile shipments from China.

In November 2005, the US and China announced an agreement to limit for three years the surging growth of Chinese textile imports into the US. The agreement allowed China to increase its exports slightly each year until 2008, but put limits on growth and included a wider range of products than those already affected by restrictions.

Industry Trends and Strategies

Many believe that 2005 was a watershed year for the US apparel and textile industries. The end of the quota system triggered large increases in Chinese exports. The massive shift in the manufacturing of apparel is likely to provide a windfall for millions of people, bringing huge savings to consumers and accelerating the transfer of jobs to centers of low-cost production in China and India. Some estimates say that as much as \$40 billion of production will be transferred to China from the developing world. Other experts expect China to capture as much as 50 percent of apparel production worldwide. But it is likely to have a devastating effect on economies across Latin America, Africa and Asia. Countries that had prospered under the quota system now stand to lose hundreds of thousands of jobs.

The social and economic implications of the end of the quotas for many developing countries would be devastating. In Africa, the battle against AIDS could be weakened because manufacturers have supplied employees with condoms and health care in order to keep production lines running in countries with high AIDS infection rates. The loss of jobs in Latin America could lead to a rise in illegal immigration to North America. Efforts to improve the economic position of women, who comprise the majority of the production workforce in developing countries, could be threatened. In the developing world, women's paychecks have been a driving force behind significant gains in living standards, health indicators and educational levels. The quota system has been an extremely cost-effective method of bringing social and political stability to a very needy part of the world.⁶

At the same time, global trade has become dominated by huge multinationals such as Wal-Mart that can make or break entire economies with their orders. Wal-Mart buys as much as one-third of the clothes made in Bangladesh, a major producer of men's dress shirts and khaki pants. In Cambodia, making clothes for Gap Inc. and other leading Western retailers accounted for one-third of its gross national product in 2003. Any change in the purchasing patterns of these multinationals can have a significant impact on the economies of developing nations.

For example, by opening the doors wider for Lesotho in 2000, the US sent the apparel industry in that nation into overdrive. Exports of clothing to US buyers such as Gap, Wal-Mart and K-Mart have more than tripled from \$120 million to \$400 million. But lifting quotas is already having a ripple effect. The government in Lesotho has already agreed to exempt apparel and textile factory owners from paying mandatory cost of living increases to counter financial losses incurred from changes in orders related to the lifting of quotas.

In a global market with reduced quotas, the drive to minimize costs puts tremendous pressure on employers to keep wages low and to eliminate costly benefits. Multinational agencies are helping developing nations remain competitive with China and India. The World Bank is providing technical assistance and aid for the modernization of ports and highways in countries trying to boost exports. The International Monetary Fund is helping governments that suffer financial crises due to the loss of trade after the lifting of quotas.

Some companies, including Gap and Nike, are encouraging the industry to take more responsibility for helping those countries and workers impacted by the transition to a quota-free world. Gap CEO Paul Pressler has directed his buyers to purchase from suppliers committed to treating employees humanely, for example. But as long as markets and consumers reward low cost producers, competitors will continue to face tremendous pressure to go where the goods are the cheapest. These pressures are felt the most strongly on the factory floor. While many corporate leaders recognize the need to

⁶ Tyler Marshall, "A World Unravels: Clothes Will Cost Less, but Some Nations Pay," *LATimes.com*, January 16, 2005.

treat employees well, they also realize that markets don't necessarily reward responsible corporate behavior.

Apparel and textile firms in the US are countering the threats from competitors using a variety of strategies. One is to diversify the uses for textiles and develop specialty textiles. Textile markets in the US are no longer as dependent on apparel as they were in the past. In 1999, HCTAR estimated that only 35 percent of textile shipments were for apparel items. In a manner similar to apparel manufacturers, textile firms now market products (e.g., sheets, bedding, towels, rugs) directly to retailers. Although demand for industrial textiles remains high, many mills are struggling, having lost their most important customers with the rapid decline of the domestic apparel industry. As a result, there has been movement among mills to shift production to emphasize non-apparel textiles such as designer home furnishings and specialty industrial textiles (automobile interiors and tire cords, knapsacks, tents, airbags, parachutes, etc).⁷

The US textile industry is making a transition away from primarily labor-intensive manufacturing activities. Employers are investing considerable effort and resources on finding new uses for advanced textiles, including non-woven and "smart" or nano-textiles. Non-woven textiles are engineered fabrics designed for specific uses ranging from consumer products such as disposable diapers and air filtration to durable goods manufacturing including automotive and home furnishings, to medical and health care applications.

Nanotechnology is being used to create fabrics or fibers with innovative properties. These fabrics are being engineered to produce materials with enhanced performance regarding strength, temperature sensitivity, stain or wrinkle resistance, water repellence, antibacterial properties, or comfort. In the long term, the technology is expected to advance to where it develops a new generation of programmable materials that are able to interact with other technologies such as computer sensors or microchips. Future applications may include smart garments for military, medical and health applications, and high performance clothing for consumer use.

In the last fifteen years, one of the major transformations in the retailing industry has been the emergence of the concept of lean retailing. Instead of infrequent, large bulk shipments, suppliers are now required to replenish an increasing percentage of their products within a selling season. As described by Frederick Abernathy,⁸

"Modern retailers no longer have warehouses full of apparel products ready for the selling floor. Rather they have become 'lean retailers' owning just the products on the selling floor. As a result, suppliers' warehouses and distribution

⁷ Neil Popowitz, "Nano-Tex: How an Accidental Startup Got Funded, Perfected its Product and Saved Not Only Burlington Industries, but Maybe the Entire U.S. Textile/Apparel Industry," *University of Southern California, Technology Commercialization Alliance*.

⁸ Abernathy, Frederick H., John T. Dunlop, Janice H. Hammond, and David Weil, "Globalization in the Apparel and Textile Industries: What is New and What is Not?" Harvard Center for Textile and Apparel Research, December 2002, <http://www.hctar.org/pdfs/GS07.2.pdf>

centers act in many ways as virtual warehouses and distribution centers for the retailers. At least once a week, most often on Sunday evening after the weekend sales are known, retailers have their computer inventory system order replenishment products from their suppliers. Products are ordered at the stock keeping unit (SKU) level.”

The trend toward lean retailing combines with increased diversity in product availability to create a vastly more complex marketplace for textile and apparel suppliers. Product proliferation requires that suppliers provide a growing number of products on a replenishment basis. Supplier responsiveness is central to lean retailing and replenishing supply as demanded by consumers, whatever variability in demand experienced by the retailer. A manufacturer providing goods to the US market must balance the benefits of more proximate but costly sources that offer short-cycle local production against lower cost offshore operations that require far longer lead times.

In *A Stitch in Time*,⁹ the authors separate product diversity into three groups, represented in the form of a “fashion” triangle. At the top of the triangle are the fashion items including dresses from Paris, Milan, and New York runways, as well as some high fashion apparel meant for a broader market. Fashion products represent very small amounts of apparel sold, and are sold for one season only. At the bottom of the triangle are the basic products that tend to stay in a designer or manufacturer’s collection for season after season (e.g., khakis or men’s white dress shirts). In the middle of the triangle are the fashion-basic products -- basic items that have had some fashion element added (e.g., khakis with trim, stonewashed jeans). Fashion basic items are the fastest growing part of the fashion triangle because an increasing percentage of basic products now have some fashion content.

Competing in the transformed retail-apparel-textile channel now requires a set of management practices for both domestic and international sourcing. A successful US apparel-maker, for instance, may assemble basic men’s khaki pants in average sizes in Mexico, taking advantage of low labor costs as well as Mexico’s proximity to the maker’s Texas distribution centers. At the same time, this company can choose to manufacture products with more variable demand, like khaki pants with narrow waists and long inseams, in the U.S. -- providing fast turnaround for retailers and lower exposure to inventory risk.

Product proliferation has increased the demands on manufacturers because they now must provide a growing number of products on a replenishment basis. In addition to having many new products on the market, manufacturers now must supply multiple variations of a single product (e.g., men’s dress shirts). Product proliferation means that not only do suppliers now have to supply 1,000 products whereas once it might have been ten, but now they must do so on a replenishment or speed-to-market basis. Supplier responsiveness to replenishment orders is central to lean retailing. Dealing with

⁹ Frederick H. Abernathy, John T. Dunlop, Janice H. Hammond, and David Weil. “*A Stitch in Time: Lean Retailing and the Transformation of Manufacturing--Lessons from the Apparel and Textile Industries*,” (New York: Oxford University Press, 1999).

variability in demand is critical to suppliers competing in today's retailing world.

For lean retailing to succeed, the ability to ship via land or only short distances by sea gives great competitive advantage. The more variability added to the shipment process through underdeveloped and/or constrained transportation networks, political instability, or weather related problems, the more risk facing the supplier and consequently the need to hold larger reserve inventories.

One of the critical components in the success of lean retailing is effective inventory management. Holding inventory can be very costly to a supplier. Manufacturers walk a fine line between having the inventory required to supply retailers or customers on a timely basis and having too much capital tied up in work-in-process or finished goods, the costs of warehousing inventory, and the price markdowns later used to dispose of excess inventory. In A Stitch in Time,¹⁰ HCTAR discusses a process by which risks and costs may be minimized, and profits enhanced, by using a combination of short-cycle and longer-cycle production lines. With a short cycle production line, products are turned out faster, but at a higher cost, while the longer cycle line takes longer to produce items, but at lower costs.

Manufacturers that invest in advanced information technologies and use them to change their methods of planning and production can significantly reduce the amount of held inventory, thereby reducing the need to mark down or write off unsold products at the end of a season. These manufacturers have the potential to earn significantly more profits than suppliers that continue to operate along traditional lines. The distinguishing feature of such high performers is not their success in shaving off labor costs in the assembly room; it is their success in changing basic aspects of the way they manage their enterprises.

Successful apparel manufacturers have realized that they must now focus on their capability to respond accurately and efficiently to the stringent demands placed on them by new retailing practices. This requires establishing systems to handle electronic, real-time orders, creating management and information systems capable of using incoming information to forecast, plan, and track production, as well as manufacturing products in a flexible and efficient manner.

The assembly room, the traditional focus of attention for industry competitiveness, can provide competitive benefits only if other more fundamental changes in manufacturing practices have been introduced. Managers in well-integrated channels pay attention to inventory costs, inventory replenishment practices, information reliability, and time to market rather than the traditional direct costs of labor and materials alone.

As lean retailing has become even more widespread and suppliers more sophisticated in thinking about managing risk, replenishment considerations have factored even more heavily into sourcing decisions. This has made countries with proximity to the US more competitive for those goods where replenishment has been important. It is difficult for

¹⁰ Abernathy et al, "A Stitch in Time," op cit.

many nations with inadequate infrastructure, distant locations from major consumer markets, or political instability to compete for manufacturing contracts, even if they have low wage rates. For those categories of apparel where replenishment is not a major factor in sourcing, the presence of a large number of countries with extensive apparel capacity has meant more intense competition among these nations for a smaller market of non-replenishment products.

The Future

The future for apparel and textiles in the US is not entirely bleak. It is likely that additional jobs will be lost to overseas competitors, largely in firms that produce commodities that compete on the basis of price. Nevertheless, firms that have shown an ability to innovate, and to use information technology, speed, and flexibility to identify and capture a market niche, can prosper.

In a world where manufacturers must supply an increasing number of products with fashion elements, speed and flexibility have become crucial capabilities for firms wrestling with product proliferation, whether they are retailers trying to offer a wide range of choices to consumers or manufacturers responding to retail demands for shipments. For apparel manufacturers in the US, this means that the key to success is no longer solely price competition but rather the ability to introduce sophisticated information links, forecasting capabilities, and management systems. Lean retailing offers promise for the future of apparel in the US because it establishes different competitive requirements in which developed countries can excel.

One recent scenario has seen the development of a global market with limited regionalization. Instead of a single international market for textiles and apparel, there may be three regionally based markets anchored in the US, Europe, and Japan.

In such a scenario, some of the more skilled processes such as cutting in apparel making and finishing operations in textiles will remain in the anchor nations like the United States, Japan, Germany, and Italy, while the lower paid, less skilled operations go to developing countries in Latin America, Asia, Eastern Europe, or North Africa. Because time-to-market and the exigencies of short-cycle production are beginning to impact competition in retail-apparel-textile channels, three global regions are emerging: the United States plus Mexico and the Caribbean Basin, Japan plus East and Southeast Asia; and Western Europe plus Eastern Europe and North Africa. Speed and proximity to market are key drivers of this limited regionalization.¹¹

Some short cycle assembly, which involves more sophisticated production lines and planning is likely to remain in places like the US or Europe. The skilled cutting operations that now generally occur in advanced countries may move to developing nations, as industrialization becomes more sophisticated there. For many fashion apparel products, defined as those planned to last only one season, the practice of sourcing on the basis of lower labor costs may be expected to continue. Much of Asian sourcing has

¹¹Abernathy et al, "A Stitch in Time," op cit.

been devoted to such items. But for basic and fashion basic apparel products, for which frequent replenishment orders are becoming the norm, the practice of outsourcing some of the assembly and sewing operations from nearby lower wage regions is emerging. For example, in the US market, most sewing operations take place in Mexico and the Caribbean Basin; in Europe, sewing operations go to North Africa, Turkey, and Eastern Europe; and in Japan, sewing operations go to various East Asian regions. The packaging and distribution operations that prepare garments for retail distribution are likely to stay in the countries where the products will be sold.

For the portion of the US textile industry that supplies apparel, the shift towards Mexico and the Caribbean basin has been very beneficial. Apparel products imported from China and other Asian nations do not contain US fabric. In contrast, Caribbean and Mexican apparel imports draw extensively on US textiles, as highlighted in “Globalization in the Apparel and Textile Industries: What is New and What is Not?”¹² In 1991, the US exported \$48.8 million of textiles to China. By 1999, those exports had grown only to \$82.5 million, or about 1.1 percent of the value of Chinese apparels imports. In contrast, textile exports to Mexico were \$542 million in 1991, growing to \$2.84 billion by 1999, or 36 percent of the value of Mexican apparel imports.

Finally, these trends will have major implications for the number and types of jobs available in the industry. Although the Department of Labor predicts that there will be a loss of 69 percent of the jobs in the apparel industry by 2012, the emergence of regionally-based markets and lean retailing could alter the nature and number of jobs available. Most agree that textile and apparel employers will implement technological and engineering advancements in textile production more rapidly over the coming years. Newer textile products use a variety of industrial manufacturing processes, many of which require technical savvy and different types of skills. This higher-tech environment will result in the need for more highly skilled technically literate workers. The textile jobs that remain or will be created are very likely going to be, on average, better paying and require higher level and different technical skills than current textile jobs.

Low wage jobs in apparel and textiles, such as cutting and sewing, will not completely disappear in the US. Experts believe that less labor-intensive textile companies such as the fabric mills and knitted products (notably hosiery products) will be able to successfully compete with foreign producers based on advantages related to quality of product and speed to market. In the apparel industry, the more creative functions of designing, marketing, packaging and distributing clothing and accessories are likely to remain in the US, while the more labor intensive functions of sewing and assembling clothing are more likely to move offshore.

¹² Abernathy et al, “Globalization...” op cit.

