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WHAT THE IT REVOLUTION MEANS FOR REGIONAL ECONOMIC DEVELOPMENT

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EXECUTIVE SUMMARY

Information technology (IT) saturated American business in the 1990s, and countless new companies sprang up around Internet applications. In response, economic development officials across the country have tried to catch the “tech” wave by stimulating the growth of high technology companies and “clusters.”

This effort has been impressive, but as this paper argues, it may have remained too narrow. The IT revolution extends far beyond the technology sector, after all. All kinds of firms—not just “tech” companies—are finding ways to cut costs dramatically by automating tasks, outsourcing certain functions, and linking customers to the factory floor. IT is also accelerating the ongoing fragmentation of large firms into separately located functional units, and the establishment of strategic relationships with other firms to perform functions formerly kept in-house.

In view of these changes, this report seeks to give readers a look inside companies to see how they are using IT, and to begin a conversation about what regional leaders can do to support technology-based development. The study builds on interviews with the chief information officers (CIOs) and information architects of 28 firms located in five metropolitan areas—Atlanta, Cleveland, Minneapolis/St. Paul, Phoenix, and Seattle. Ultimately, it seeks to clarify the nature and direction of key trends in order to explore their implications for public policy.

Several key insights emerge from this analysis that shed light on the impact of IT on regional economic development:

- **Both “new” and “old” economy firms are embracing IT, which means that both Sunbelt and Rustbelt cities and metropolitan areas can benefit from the technology revolution.** Several U.S. metropolitan areas—such as Seattle, Austin, and Washington, D.C.—have become well-known centers for high technology companies, and others continue to emerge. However, success in the new economy does not depend solely upon attracting or growing high tech clusters. Traditional industries in diverse sectors of the economy are also integrating new technologies into their operations. Companies like Parker Hannifin, a Cleveland engineering firm, employ computers and computer-controlled tools to design and manufacture products, and they increasingly use web-based purchasing technologies. That means that even manufacturing regions need to recognize companies’ shifting needs, and ensure that their economic development strategies respond to them.
- **IT enables the “fragmenting firm” to split off key functions throughout the U.S. and abroad, which presents both opportunities and challenges.** The cluster phenomenon is still alive and well, but it increasingly revolves around portions of firms and functions within firms—from data processing to distribution—rather than whole companies and industries. Federated Department Stores, for example, maintains its headquarters in Cincinnati, but has located its design and product development operation in New York City, and its data and financial management group in Atlanta. Similarly, the Boeing Company recently moved its

headquarters to Chicago, but left its commercial airplane production facilities in Seattle and Southern California—traditional sites for aerospace manufacturing. The upside of this trend is that metropolitan areas now gain an opportunity to specialize. All regions can now focus on and compete for key firm functions, whether they entail manufacturing, research and development, logistics, or sales. The downside: Cities like Seattle or Cleveland may lose high-powered intellectual capital—as well as beneficial civic leadership—as top executives move to headquarters meccas like New York and Chicago.

- **IT generates new criteria for firm locations, which may bring competitive advantage to some regions.** Intel, for example, maintains a list of prerequisites when it chooses a site in the United States or abroad that includes a qualified, educated workforce; quality of life factors; infrastructure; availability of land; and tax incentives. Possessing extensive broadband capacity, a skilled labor force, and a good environment in which to live and work can give U.S. regions the edge they need to compete—not only domestically, but against developing countries that may have cheap labor, but lack technology infrastructure and other locational advantages.
- **IT helps firms go “global,” increasing the need for U.S. regions to market themselves internationally.** To be sure, the globalization of manufacturing has been taking place for decades. But IT has also enabled financial and other business services firms to go global. Companies are increasingly outsourcing key functions to obtain a higher level of efficiency, profitability, or competitiveness. This means U.S. metropolitan areas must compete with regions all over the world for firms, portions of firms, and employment. Regions with particular niche capacities, and the ability to market them globally, have an opportunity to cultivate linkages with corporations abroad and improve their ability to compete on the international playing field. These global relationships may facilitate specialization in higher skill/higher wage operations, while at the same time reveal new markets for companies’ products or services.

Ultimately, cities or metropolitan areas can do little to reduce the likelihood—accelerated by IT—that firms will globalize, fragment, or relocate headquarters. Regional leaders can, however, work to create a competitive setting for *all* business’ survival and success in a high tech era. This means investing in IT infrastructure; providing the right education programs at adequate scale to meet new skill requirements of employers; supporting innovative firms with research and development programs at universities and institutes; and assuring adequate venture capital for startup companies. Leaders also need to insist that their own organizations lead in the effective use of new technologies, and that their metropolitan areas build strong relationships with regions abroad.

Those metropolitan areas that understand the changing nature of business—and respond nimbly to its demands—will create the best environments for firm and economic growth.

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WHAT THE IT REVOLUTION MEANS FOR REGIONAL ECONOMIC DEVELOPMENT

I. INTRODUCTION

The second half of the 1990s brought rapid adoption of the Internet by consumers and business, and an unprecedented explosion of new companies built around Internet applications. During this time, an outpouring of capital financed startup companies and accelerated market capitalization. This period of expansion, aspects of which were characterized as “irrational exuberance” by Federal Reserve Chairman Alan Greenspan, eventually gave way to the bursting of the speculative bubble, the crash of the NASDAQ, and the return of the Dow Jones to somewhat more plausible investment returns.¹ The nation then entered the recession of 2001. Many observers are now wondering what will come next, how fast the tech economy will recover, and whether productivity advances will resume at the rates of the late 1990s.

In this world of rapid, technologically driven change, regional leaders in both the public and private sectors need to understand the trends, and develop strategies to keep their metropolitan regions economically viable. To this end, states and cities throughout the country in the last decade have tried to catch the “tech” wave, focusing much of their energy and resources into stimulating the growth of new-economy companies and clusters. But as this paper seeks to illustrate, focusing economic development on technology is not just about attracting or creating high tech firms. Rather, it demands that leaders understand the ways in which the information technology (IT) revolution is transforming business operations across both new *and* traditional industries. Only by doing so will they be prepared to respond to the new challenges and opportunities these changes present.

The goal of this report is to give readers a look inside companies to see how they are using IT, and to begin a conversation about what public leaders in urban areas can do to both cultivate technology-based development and ensure that it yields long-term benefits to local residents. The evidence we have gathered from a number of firms in several cities demonstrates that fundamental changes are in fact occurring in the economy, in many places and in many kinds of businesses. From the point of view of mayors and civic leaders in cities and metropolitan regions, these changes are reshaping the economic landscape in complex ways. This report is a first attempt to understand the nature and direction of key trends, and their implications for public policy.

The report is based on interviews with IT managers, chief information officers (CIOs), and information architects from a wide variety of companies in five metropolitan areas: Seattle, Phoenix, Cleveland, Minneapolis, and Atlanta. (The interviews are summarized in the Appendix). We chose cities in four regions of the country that represent sharply different mixes of industries and

¹ See Robert Shiller, *Irrational Exuberance* (Princeton University Press, 2000). Shiller sums up the era when he writes: “When Alan Greenspan, chairman of the Federal Reserve Board in Washington, used the term irrational exuberance to describe the behavior of stock market investors in an otherwise staid speech on December 5, 1996, the world fixated on those words. Stock markets dropped precipitously.” (p. 3).

enterprises because we wanted to learn if IT-based innovations transcended geography and business types, or were clustered by geography or business classification. We cannot claim that five metropolitan areas, or the half dozen or so companies we contacted in each, constitute a representative sample of American businesses. We do know, however, that these companies are using IT in creative ways to re-shape their companies, to enter new markets, and to reconfigure their supply chains. The sample includes new companies inventing new software as well as venerable businesses engaged in “old economy” manufacturing. Our findings provide strong evidence that the impact of IT is felt in all regions and virtually all sectors of the American economy.

Table 1. Companies and Organizations Interviewed

Metro Area	Company/Organization	Metro Area	Company/Organization
Atlanta	Atlanta Chamber of Commerce	Minneapolis	Ellerbe Becket
	Delta Technology, Inc.		Onvoy
	Georgia Tech University		Wells Fargo Services Co.
	Techlinks	Phoenix	America West Airlines
Cleveland	Cardinal Commerce		Cadre Business Advisors LLC
	Diebold, Inc.		Greater Phoenix Economic Council
	Eaton Corporation		Intel
	KeyBank	Pinnacle West	
	National City Corporation	Seattle	Amazon.com
Parker Hannifin Corporation	Boeing (ATM Business Unit)		
PolyOne Corporation	Federated Department Stores		
Science Application Int'l Corp. (SAIC)	Starbucks		
	Terrabeam		
		Unigard	

II. WHAT IS INFORMATION TECHNOLOGY?

In this report, we focus on new uses of IT in American business. IT consists of computers, the software used to operate them, and the telecommunications systems that link them. Web technology—the Internet, websites, and web-based programs that have developed very rapidly in the last ten years—remains a critical category of IT. Much of this report focuses on recently developed, innovative uses of web technology.

When we talked to IT managers about their definition of IT, they added an important nuance, describing how it is embedded into their business processes. IT has become a standard function within business, along with production, finance, personnel, operations, and sales. Thus, many companies, both large and small, have established a separate executive office for IT—placing it variously under a CIO, IT manager, or other top executive—that parallels similar offices for other major functional groups within a company. The scope and power of the CIO seems to be growing as web-based technology expands, and CIOs oversee the automation of many company functions and improvements to their efficiency.

Consultant Quentin Smith in Phoenix notes that there are three types of IT in use in businesses.

- **Operating systems:** which create a physical product (e.g., wafers, chips) or service (e.g., paperless bank transactions or image processing in the underwriting sections of insurance companies)
- **Business applications:** employed in accounting or bookkeeping
- **Decisionmaking systems:** used for aggregating and manipulation data to give new and better information for decision makers (e.g., gross profit per worksite per employee per year; or, for an airline, cost per seat-mile, including fuel, overhead, labor, etc)

Economist Richard Lipsey makes a similar distinction, identifying three types of technologies that stem from what he calls the “Information and Communication Technology (ICT) revolution.”²

- *Product* technologies include items for consumption, such as automatic teller machines, e-mail, language translation programs, and electronic books
- *Process* technologies, such as computer-driven robots, computer-assisted design, and teleconferencing, affect how we get things done
- *Organizational* technologies include lean management systems, which have eliminated many layers of middle managers in large organizations; disintegrated operations, in which the main firm coordinates a network of subcontractors; the growing phenomenon of contract labor or “e-lancers,” as Lipsey calls them; and global production systems

² Richard G. Lipsey, “The Productivity Paradox: The Case of the Emperor’s New Clothes,” *Isuma: Canadian Journal of Policy Research* (Spring 2002): 120-126.

During our research, we encountered firms introducing all three forms of the new technology Lipsey identifies. For example, Onvoy's Internet Protocol-based communications services are product technologies. Starbucks offers smart cards and is experimenting with Internet-based ordering systems—examples of process innovations. Amazon, Eaton, Federated, and Unigard are all implementing organizational changes enabled by IT.

We also found that a key feature of new IT-enabled business processes is that companies rely increasingly on a network of external relationships. These strategic partners, linked by the Internet, have become integral parts of the business model, and collaboration within a network of strategically aligned businesses is emerging as an important form of business organization.

III. WHAT DO DECISIONMAKERS NEED TO KNOW ABOUT IT?

Our interviews with 28 companies in five metropolitan areas confirm that profound changes are sweeping through the economy—changes heavily tied to IT, and usually involving some aspect of Internet use. Based on our research, four dominant trends come into focus:

- IT innovation is pervading both “new economy” companies, such as chip manufacturers, software developers, and e-commerce companies, and “old economy” manufacturing, transportation, and retailing firms
- IT is enabling many improvements in company operations, some of which have major impacts on costs
- Regions are beginning to specialize in certain functions, such as research and development, manufacturing, or distribution, rather than in meeting the needs of particular industries. The cluster phenomenon is alive and well, but increasingly oriented around functions within firms
- The IT revolution remains incomplete; a great deal of experimentation is going on among businesses seeking the most profitable uses of IT

A. All Industries Are Using IT in Creative and Innovative Ways

The IT revolution is impacting virtually all industries in powerful ways. We interviewed both “new” and “old” economy companies for this project and found exciting and innovative applications of IT in all sectors, and across all regions. (See Table 2 below). Wireless devices, for example, are not just for “new economy” firms exploring the cutting edge of the next technology. We encountered interesting IT innovations in many other industries, including manufacturing, financial services, engineering and management services, airlines, utilities, retailing, and higher education. The breadth of impact throughout the economy suggests that Lipsey’s use of the term “revolution” is quite apt; the Internet and other aspects of the IT revolution have important implications for all types of businesses.

Table 2: Companies Interviewed by Industry Category

Sector	Number of Companies Interviewed
Manufacturing	6
Transportation	2
Utilities/Telecommunications	3
Retail	3
Financial Services	4
Business Services and Universities	5
Non-Profit Organizations	3

The companies visited for this project are making very different choices about business structure, as it is aided and abetted by their new IT. IT seems to be enabling a variety of structural

or business-model approaches without necessarily pushing firms in any particular direction overall. These choices do not depend on whether they are in high tech industries or some other part of the economy:

- **Terrabeam and Federated Department Stores** both maintain “brick and mortar” business models, but both employ IT in unique ways: Terrabeam sells the ultimate footloose IT technology, while Federated’s stores have become very high tech versions of old-fashioned haberdasheries
- **Starbucks** possesses a fully integrated supply chain, but it operates a vast network of stores with a roving management and training staff. The company relies on IT to connect its stores and employees with headquarters. Through a partnership with a cell phone company, Starbucks is also adding wireless access in its stores in hopes that it will draw in a few more habitual coffee drinkers, while facilitating its own operations
- **America West, Delta, and UPS** are operating large fleets of aircraft, and handling large quantities of passengers, luggage, or packages. Increasingly sophisticated IT systems are improving reliability and timeliness and reducing costs, making these airline and air freight operations more competitive
- **Ellerbe Beckett**, a large architectural firm, uses computer modeling to show clients design options, and uses Internet technology to facilitate joint work among distant working teams in its several offices.

These companies are technological pioneers that continue to experiment with new products and services.

B. IT is Improving Company Operations

Our interviews revealed that companies in all types of industries are investing in IT to develop new products and services, cut costs, and drive up profits, ultimately enhancing their overall competitiveness. We found that firms are making significant IT investments in two particular areas: (1) improving operating efficiencies; and (2) developing more sophisticated supply chains.

1. Improving Operating Efficiencies

Firms in both new and traditional industries are using IT to improve their internal operations. Many tangible results of IT can be seen in the manufacturing sector. For example, “pull logistics” involves the emerging practice of analyzing direct e-commerce orders and modifying production operations based on the analysis, and it has emerged as one of the major benefits of e-commerce.³

³ Lance R. Grenzeback, “Emerging Freight Transportation Issues.” Testimony for Subcommittee on Highways and Transit, Committee on Transportation and Infrastructure, U.S. House of Representatives, March 21, 2001 (Cambridge: Cambridge Systematics, Inc.).

Pull logistics enables firms to make products faster and more cost effectively, with higher degrees of customization. Our interviews revealed numerous ways IT is being used to streamline operations:

- **Eaton Corporation**, a diversified industrial manufacturer, reported a 35- percent jump in productivity in its electrical distribution and controls business as a result of a software program the company developed and then implemented in 1995. Among other things, the application enables customers to configure their product designs and submit orders straight to the factory floor.
- **Delta Airlines** loads 767s twice as fast as it used to with half the crew due to a new IT system that brings multiple streams of data together on the Internet terminals of gate agents, and of lower-deck managers of baggage, fueling, and cleaning.
- **Federated Department Stores** attributes a long-term trend toward lower prices for many consumer goods to web-based networks that provide almost instant information from the store floor to any decisionmaker in the company who needs the information. Fewer layers of management are needed, better pricing decisions are made, and inventory costs are dramatically reduced.
- **Parker Hannifin**, an engineering/manufacturing company, has reduced its inside sales force by encouraging customers to use a website to get orders straight to the factory floor.
- **Unigard** has replaced expensive human decision makers with rules-based IT systems that make many of its insurance underwriting decisions automatically; these systems also route the unusual cases to staff who can appropriately weigh the risks involved.
- **Amazon and National City Corporation** are going to India for low-cost and high-quality call center services, taking globalization beyond just manufacturing and into the back office support services.

These examples of operating efficiencies lie behind the productivity growth that fueled the economic boom of the late 1990s. The interviews conducted for this project suggest that many additional efficiencies are possible, once the economy comes out of its current slump and earnings become robust enough to permit a resumption of corporate investment. As Delta Technologies' IT architect put it: "We did one IT innovation well, but we probably have a hundred to go." If many additional companies can take advantage of the substantial cost savings and product improvements these leaders have demonstrated, further productivity gains are possible. Regions can gain substantial competitive advantages by broadening and deepening the impact of IT.

2. *Developing Supply Chains*

Another reason IT matters so much for regional competitiveness is that the new IT enables much more sophisticated management of supply chains for manufacturers, distributors, and

retailers. Amazon, Cardinal Commerce, Intel, Parker Hannifin, and Starbucks managers are all focusing very closely on supply chain issues as they seek ways to cut costs, penetrate new markets, and meet customer demands.

Starbucks IT architect James Snook says that the supply chains—including coffee growing, purchasing, transportation, roasting, and distribution—are critical to the company. At Amazon, Vice President for IT Infrastructure Charlie Bell regards the company's IT—the company's "platform"—as the only essential element of the company. Virtually everything else—purchasing, transaction processing, fulfillment, customer service, accounting—can be outsourced to other companies or "in-sourced" by inviting other companies to use Amazon's platform as Borders Books and Target do. Increased use of out-sourcing is common in the manufacturing world, and this trend has extended from production to customer service and even aspects of design and engineering. Many of the manufacturers we interviewed are also employing sophisticated supply-chain management systems to reduce inventory and procurement costs; this increasingly includes automated procurement systems.

Supply-chain management requires solid collaborative relationships. Intel's Mary Murphy Hoye, for example, observes that supply-chain management now means co-owning and co-managing business practices and information exchange, and sharing both within the company and outside it through alliances and collaborations. When a company decides to rely on another company for manufacturing, design of parts, customer service, or data processing, it moves a critical part of the business process outside its own direct control. The success of the lead company and its supplier then become linked. The Internet extends the reach of such collaboration. We found manufacturers turning to customer service firms on the other side of the world in India, and retailers creating specialized back office transaction processing centers in different parts of this country. Collaboration facilitated by the Internet is making not just firms, but also particular functions of firms, more footloose, either through out-sourcing or through the creation of specialized functional centers. As a result, economic development professionals are now witnessing a whole new era within which the rules of the game are being significantly re-written.

C. IT Is Enabling Businesses to Organize in New Ways

Industry clusters represent the new trend in economic development. The National Governor's Association, the Competitiveness Council, and metropolitan areas around the country are all actively exploring the clustering concept, popularized by Harvard Business School professor Michael Porter.⁴ The basic cluster concept holds that buyer-seller relationships between certain groups of industries drives co-location, or at least that regional competitive advantage can be enhanced by locating these industrial groups close together in a single region. Auto manufacturers in Detroit, for example, gain advantage from having parts manufacturers in the area, and Boeing benefits from having key suppliers located in Seattle near its major airplane assembly plants.

⁴ Michael Porter, *On Competition* (Harvard Business School Publications, 1998).

Our interviews suggest that the cluster phenomenon may be evolving as large firms that are not limited to a single location identify the best location for particular functions, and then rely on Internet technology to link these functional centers into a single corporate structure. Cleveland remains a manufacturing center, but IT, customer service, and corporate headquarters of these operations may be located in other cities or countries. Boeing has moved its headquarters to Chicago, but none of its far-flung manufacturing centers have followed. So while some observers have concluded that the Internet enables unconstrained choice of locations for people and business, we suggest instead that clustering retains its strategic value.⁵ A new version of clustering is more likely, based on allocation of functions to metropolitan areas with the best characteristics for each function.

Ned Hill at Cleveland State University, for example, writes about “the fragmented firm” as the paradigm displacing outdated clustering and hub and spoke location theories in the IT age. His work shows how manufacturing, research and development, and logistics functions can be located separately from the headquarters of the corporation, or in multiple locations, connected through IT.⁶ He maintains that firms do not cluster by SIC code but rather by five broad functional categories:

- Headquarters
- Research, design, and product development
- Production
- Marketing and sales
- Distribution and logistics

Our interviews confirm this clustering by function. Federated Department Stores is headquartered in Cincinnati, but its design and product development is based in New York City, an international fashion center. Federated’s data and financial management group is based in Atlanta, a city with a growing IT cluster. The Boeing Company recently moved its headquarters to Chicago, leaving its commercial airplane production facilities in Seattle and Southern California, traditional locations for aerospace manufacturing. Intel is headquartered in Silicon Valley, but its manufacturing is centered in Phoenix and its research and design functions are housed in the Portland, OR area. This company also has strategic research groups at major universities in Boston, Seattle, and other research centers. Amazon’s headquarters and IT development group remain in Seattle, an area well known for its software and IT cluster, but Amazon’s distribution systems extend all over the world. In Cleveland, we interviewed several manufacturing firms who value the skilled workforce and a rich array of manufacturing subcontractors in the area. However, some of these firms are thinking of locating customer service, IT, and headquarters operations elsewhere.

The reorganization of firms, enabled by IT, has global implications. For example, almost all the firms in our study employ outsourcing to obtain a higher level of efficiency, profitability, or

⁵ Joel Kotkin, “The Declustering of America” *Wall Street Journal*, August 15, 2002, p. A12.

⁶ Personal communication with Ned Hill, Cleveland State University, November 2002. His work will be published in a forthcoming book on fragmented firms.

competitiveness. For firms that have a physical product, this results in global operations and a global customer base facilitated by the Internet. For financial services, insurance, and utilities, activities are often directed at domestic or regional markets, but IT is facilitating the emergence of a global marketplace for these types of firms as well, as is indicated by the flood of credit card and insurance offers arriving in residential and business mailboxes. A forthcoming study of IT-oriented economic development strategies discovered a pension management and financial services firm, managing billions of dollars of assets for major corporations in the United States, Europe, and Japan, located in the medium-sized city of Tacoma, WA, a place not known for financial services.⁷

D. The Information and Communication Technology Revolution is Still Underway

Clearly, firms in all economic sectors are undergoing profound changes in operations and organizational structure, enabled by rapid rates of innovation in IT, and the rapid diffusion of that technology throughout the marketplace. Our research revealed that the IT revolution is far from complete, however. Firms foresee many opportunities for further innovation, and will continue to push forward as business conditions permit.

Several of the companies indicated that they have gained significant competitive advantages through IT innovations, but expect their competitors to imitate their innovations over time and narrow the advantages they have just achieved. Thus, the next wave of innovation will likely move the state-of-the-art out even further. To be sure, weak revenue projections in many industries are for now enforcing caution about investments to improve operations or to introduce new products. Nevertheless, many interviewees have IT projects on the shelf, and are just waiting for the right moment to implement them.

⁷Paul Sommers and Deena Heg, "Using the Experience of Washington Communities as a Model for Technology-Based Development" (Washington: Brookings Institution and CEOs for Cities, forthcoming 2003).

IV. WHAT DO THESE TRENDS MEAN FOR REGIONAL ECONOMIC DEVELOPMENT?

Our research indicates that the economic landscape is “deconstructing” and reorganizing into new geographic patterns. This reorientation demands that regional leaders understand the shifting economic environment. Several key insights emerge from our analysis that may help shed light on what these new trends mean for cities and regions, and how their leaders can best respond.

- Both “new” and “old” economy firms are embracing IT, which means that both Sunbelt and Rustbelt cities and metropolitan areas can benefit from the technology revolution. Several U.S. regions—areas like Seattle, Austin, and Washington, D.C.—have become well known centers for high technology companies, and others continue to emerge. Success in the new economy does not depend solely upon attracting or growing high tech clusters, however. Manufacturing regions like Cleveland should focus on meeting the shifting technology demands of traditional industries as they continue to integrate new technologies into their operations.
- IT enables the “fragmenting firm” to split off key functions throughout the United States and abroad, which presents both opportunities and challenges. Hill’s fragmented firm model, for example, predicts that as firms achieve a global reach, they will outgrow their original headquarters location and move to a metropolitan center that specializes in headquarters. The downside of this trend is that it is likely to move key intellectual capital and a certain amount of prestige—as well as the civic and philanthropic influence of that corporation’s power elite—away from former headquarters sites like Seattle or Cleveland and into cities like New York and Chicago. The upside is that all metropolitan areas now gain an opportunity to specialize. All regions can now focus on and compete for key firm functions, whether they entail data processing, manufacturing, research and development, distribution, or sales.
- IT generates new criteria for firm locations, which may bring competitive advantage to some regions. Intel, for example, maintains a list of prerequisites when it chooses a site in the United States or abroad that includes a qualified, educated workforce; quality of life factors; infrastructure; availability of land; and tax incentives. Possessing extensive broadband capacity, a skilled labor force, and a good environment in which to live and work can give U.S. regions the edge they need to compete—not only domestically, but against developing countries that may have cheap labor, but lack other technological, infrastructure, and locational advantages.
- IT helps firms go “global,” increasing the need for regions to market themselves internationally. The increased ability to outsource certain operations means that metropolitan areas need to compete with regions all over the world for companies, and the jobs they provide to a locality. Regions with particular niche capacities, and the ability to market them globally, have an opportunity to expand their linkages with firms abroad and improve their ability to compete on the international playing field.

Ultimately, there is little that city or metropolitan policymakers can do to lessen the ability or likelihood that firms will globalize, fragment, or relocate headquarters. They can, however, refocus economic and community development strategies, while supporting infrastructure, training, financing, and other programs appropriate to businesses' changing needs.

V. WHAT CAN LEADERS DO TO FOSTER REGIONAL ECONOMIC VITALITY?

Interviews with business people suggest that diverse companies are using IT in highly diverse ways to create new products, streamline operations, and reduce the costs of doing business. These changes have important implications for regional economies, making this a critical time for metropolitan leaders to get a handle on onrushing trends, and engage other public and private sector leaders in the development of new strategies for growing, attracting, and retaining firms.

What follows, then, are some recommendations for public leaders engaged in maximizing regional competitiveness. Of course, this particular agenda should hardly be considered definitive, given the constantly evolving nature of the IT revolution. Instead, it represents one possible approach to success in the new economy. Clearly, refinements and new departures will be needed as companies continue to innovate with new IT.

A. Understand Key Trends

Understanding the flow of IT innovation looms as an obvious strategic imperative for regional leaders. Leaders need to move beyond old modes of thinking if they are to successfully navigate the challenges and opportunities inherent in current and future waves of change.

A primary challenge of the IT revolution, for example, is that rapidly innovating firms—in their quest to reduce costs and improve the quality of services to customers—are capable of moving activities around rapidly to find the best place for each function. In addition, many companies have begun to outsource functions formerly performed in-house. The decisions of individual companies can sometimes add up to significant geographic impacts in regions where whole integrated companies used to cluster. For example, Immergluck concludes that financial services jobs declined in 25 of 40 cities he examined in the first half of the 1990s; he cites new technology such as automated teller machines as a key factor in producing these changes.⁸ Lang, meanwhile, suggests that much of the new office space in his sample of 13 metropolitan areas is being built in a formless, edgeless space on the periphery of urban areas.⁹ He does not link this phenomenon to IT, but rapid adoption of Internet technology, including email and video conferencing, certainly makes it easier for far-flung offices to stay in contact with parts of the organization located elsewhere, as well as with their clients.

In this context, keeping tabs on what companies are thinking of doing becomes a necessity for regional leaders. This means knowing the needs of firms—from increased broadband infrastructure to skilled workers—and developing policies and programs to address them. It also means identifying the characteristics of the region that are conducive to performing certain business functions, and marketing those attributes to companies as part of a business recruitment campaign.

⁸ Daniel Immergluck, "The Financial Services Sector and Cities: Restructuring, Decentralization, and Declining Urban Employment," *Economic Development Quarterly*, 15(3)(2001): 274–288.

⁹ Robert Lang, "Office Sprawl: The Evolving Geography of Business" (Washington: Brookings Institution, 2002).

Furthermore, cities can deliberately invest in certain regional characteristics to make a region more attractive for desired functions of companies. If a college boasts programs attractive to growing businesses, local governments should support that college, help it expand, and help it build strong relationships with companies. If there is a key research institution whose output is driving one or more industry sectors, local government should provide it with funding, infrastructure, or other resources. Likewise, if a region has established a significant presence in the Internet world based on available fiber optic connectivity, then it should invest in that infrastructure to make it even better. As with any economic development effort, identifying existing strengths and building upon them is critical.

Some regions are already moving in this direction. They are taking aggressive steps to assess IT trends and build economic development strategies on that knowledge. In Atlanta, the Chamber of Commerce is bringing together software companies, electronic hardware manufacturers, and transportation companies in an initiative to develop new technologies to improve the flow of goods. In Cleveland, a regional leadership organization has organized a technology industry initiative to devise effective strategies to build up the Cleveland area as a center for IT and intelligent use of IT in manufacturing. Each initiative exemplifies the sort of effort every metropolitan area should be making to assess the role IT can play in enhancing regional competitiveness.

B. Encourage Local Networking and Cluster Building

In the new economy, regional leaders need to continually evaluate how they can improve their competitiveness. As the economy globalizes, corporate strategists may overlook both potential customers and suppliers in their home state or region. Developing and marketing local competitive advantages requires economic developers to focus on strengthening nearby business relationships and cultivating local clusters.

In some regions, public leaders are working to establish venues for fostering business-to-business relationships at home. In this vein, urban leaders around the country should consider Atlanta's efforts to build competitiveness by establishing tight linkages among regional IT companies, logistics companies, and other key clusters. Encouraging such clustering will generate new business opportunities among private sector players, and help the public sector build specialized infrastructure, education, and research programs. All of the advantages of clustering identified by Michael Porter and others are relevant, with the twist that the clusters are likely to be built around particular capacities or functions of companies, rather than complete industries.

An important tool in building these capacity-based clusters is to provide new venues for technology leaders from diverse industries to articulate trends and discuss strategic options. A number of regions are already doing this, at various geographic scales. In Minnesota and Washington, state-level venues have been created—a governor's commission in Minnesota and a technology advisor on the governor's staff in Washington. These venues stand a good chance of widening the impact of technology around a state. Examples of more localized strategies include the appointment of a technology advisor to the mayor in Chicago, and the organization of technology

cluster initiatives by the Atlanta Chamber of Commerce. In Seattle, private leaders have formed industry associations and a multi-industry technology alliance to foster discussions of both public and private strategies to keep the technology industries in the forefront of economic development discussions in the area.

In short, urban leaders need to encourage industry experts to share information about the latest trends, and continually ask themselves what local strategies will advance the fortunes of locally based companies so as to expand opportunities for local workers. This ongoing inquiry will in turn help to constantly upgrade the mix of strategies and initiatives needed to respond to the ongoing restructuring of companies.

C. Enhance the Urban Quality of Life

High tech companies tend to seek diverse, high-quality urban settings that provide the alternative transportation modes, entertainment venues, restaurants, bars, health clubs, and other amenities that young and talented technology workers prefer.¹⁰ Major American tech centers all offer a distinctive quality of life, and numerous cities pay increasingly careful attention to such issues as they attempt to sustain and enhance their economic base. The need to attend to such issues will only increase as the IT revolution sweeps through more and more industries.

Quality-of-life issues arose in several of the interviews conducted for this report. One company in Cleveland, for example, is deliberately imitating some of the lifestyle characteristics of technology firms on the West coast. Now, such imitation may not comport with every local leader's desire for a high-quality city environment. But the fact remains: Our interviews point to a critical rationale for improving the livability of regions. High-quality places attract the talented people needed by companies embracing new technologies.

D. Encourage Investment in IT Infrastructure

Fiber-optic cable runs beneath more and more of the nation's streets and other rights of way. Some of it pulses with activity; much remains "dark." Yet despite the apparently excessive level of investment in telecommunications capacity in the 1990s (punctuated by the ensuing bankruptcies and financial scandals of telecom companies), the need to upgrade communications networks persists. Most notably, excessive investment in fiber trunk lines has overshadowed a deficiency of attention to the "last mile" problem—that is, the problem of bringing high-capacity links from the trunk line to the individual local user.

At the same time, numerous companies are just beginning to realize the advantages of broadband connections. In the process, they are discovering the continuing difficulty of accessing the highest-quality broadband service.

¹⁰Paul Sommers and Dan Carlson, "10 Steps to a High Tech Future" (Washington: Brookings Institution and CEOs for Cities, 2000).

Intel executives note that telecommunications capacity remains the competitive downfall of some countries such as India or Russia, where poor communications networks rule out potential manufacturing locations with otherwise desirable attributes such as a highly educated workforce. Yet not only foreign countries struggle with limited bandwidth. Unigard Insurance, located a stone's throw from Microsoft's headquarters in the Seattle area, indicates that limitations in the DSL and cable broadband systems that currently serve many residential areas in the United States effectively prevent telecommuting by its employees, many of whom remain unable to use Unigard's online document archive and retrieval system. PolyOne, a giant plastics and polymer manufacturer now based at the western edge of the Cleveland metropolitan region, failed to obtain DSL service from its local telephone provider. This failure, along with space limitations, led the company to relocate its worldwide IT division to a suburb served by a large telecommunication provider. Even successful e-commerce companies such as Amazon—whose existence depends on broadband access—suggest that opportunities remain to improve local broadband networks and thereby create new competitive advantages.

Seizing such opportunities will be complicated, of course, since private telecommunications companies and public agencies share responsibility for creating world-class local telecom networks. For example, public leadership is often needed to articulate regional needs and prod private companies into dealing with the last mile problem. In some cities, the public sector also operates utilities that have the responsibility for providing these networks, or for issuing franchises to private companies who actually install the infrastructure. State agencies are often involved in regulatory processes that can inhibit access or limit competition among vendors. Owners and developers of buildings also have roles to play to ensure that older as well as newer office spaces can access broadband communications. Two of the firms we interviewed are contemplating relocation because of inadequate telecommunications capacity in their current buildings.

Many companies are working on solutions to infrastructure limitations. Starbucks is attacking the problem through a relationship with TMobile USA that allows anyone with the right hardware to easily access the Internet via a very substantial wireless broadband connection in the vicinity of any of its U.S. stores. Terrabeam will beam a laser-based broadband connection right through your window if you are not near a Starbucks store or a fiber-optic connection point. If you need to provide unusually high levels of connectivity for an event, Terrabeam can also easily set up a temporary high-speed, high-capacity connection, and then take it down on demand. Many companies are coming out with new portable devices to provide wireless connectivity, and these innovations, along with varied "hard wired" solutions, will extend the Internet infrastructure from the fiber networks through the many "last mile" problems to reach business users.

We can expect that all of the choices that connectivity enables will sweep through the global economy quite rapidly. As Federated Department Stores IT executive Steve Stockett says, "the Internet changes everything," and as we enter the emerging era of ubiquitous broadband connectivity, it seems likely that everything will change again. As this occurs, public and private sector leaders need to focus on creating world-class broadband access in commercial and industrial centers, along with some level of access in residential neighborhoods. They also need to allow as

much competition as the local market can sustain to ensure continuing innovation in telecommunications services.

E. Foster Entrepreneurship

Leading technology centers depend on a culture of entrepreneurship. As the IT revolution brings new creativity and innovation to a greater number of sectors, leaders throughout the country need to cultivate entrepreneurialism in their individual regions. Oregon consultant Joseph Cortright argues that high tech centers are growing systems that must be carefully nourished like forests.¹¹ Calling the Portland region a “Silicon Forest” reinforces the analogy, and highlights the necessity of fostering entrepreneurship.

An entrepreneurial culture can be developed through programs that educate entrepreneurs in business schools, incubators, and a variety of less formal settings such as business and professional associations. Linkages between university and private institute research programs and local entrepreneurs are critically important, as is a strong angel-investor and venture capital base in the area. Atlanta has focused steadily on these issues, building on the research tradition at the Georgia Institute of Technology and a series of state and municipal level technology initiatives. In Seattle, the University of Washington’s technology commercialization programs tie into the entrepreneurial programs of several industry associations, private angel-investor networks, and venture-capital companies. These linkages enhance the opportunities for new entrepreneurs to acquire and develop intellectual property and create successful new companies. A forthcoming report on technology development strategies in smaller cities offers an interesting additional example of entrepreneurship programs in the city of Spokane. There a private association, a university, and a public research institute are collaborating on a program to prepare startup firms for the key challenge of securing venture capital.¹² Drawing insights from these and other programs, cities should be building strong entrepreneurship programs focused on technology firms.

In this regard, recruitment programs have dominated the economic development agenda in many regions and states. However, we suggest that success in the IT revolution turns on stronger support for entrepreneurship efforts. Attracting new firms and workers should be just one component of any economic development strategy. Equally important is providing an environment conducive to allowing local businesses to grow and thrive.

F. Focus on Education

Government plays a key role in educating the workforce of the future, and retraining the current workforce as local skill requirements change. Regions that respond to this need increase their opportunities to attract new IT-based business operations. Leaders need to focus their efforts

¹¹ Joseph Cortright and Heike Mayer, *“The Ecology of the Silicon Forest”* (Portland: Institute for Portland Metropolitan Studies, 2000).

¹² Paul Sommers and Deena Heg, *“Using the Experience of Washington Communities as a Model for Technology-Based Development”* (Washington: Brookings Institution, forthcoming 2003).

at all education levels, from elementary schools to universities to continuing education and workforce programs.

Support of the math and science programs that can lead talented students to careers in IT has been a key issue in public policy discussions in Cleveland and Seattle. At the higher levels, both regions have also focused on the need for combining business related skills with technical skills. Universities with good business schools and computer science departments have not always found creative ways to bring these two fields together in joint degree programs or other interdisciplinary offerings. In addition, both of these regions have found it difficult to convince students to learn COBOL (a programming language used in older mainframe computers), which would provide them with the skills needed to support mainframe computing systems—systems that are not going to disappear anytime in the near future. The emergence of these issues in each of these regions suggests that universities and colleges nationwide may need to adjust their offerings in order to meet the demands of growing IT-based companies and departments. Making such adjustments will depend on sound ongoing efforts to track the evolving demand for IT skills throughout local industries.

Computer and web skills are increasingly part of every young person's repertoire, but city and regional leaders must understand business needs in the IT global world and train the regional workforce to fill niche markets. The prosaic labor markets for call center workers and software coders illustrate what's at stake. We found that firms such as Amazon or Eaton locate call centers where a relatively well-educated labor force is willing to work for modest wages. Loyalty and low turnover are also desirable. Smaller university or college towns are desirable domestic locations for call centers. Could urban university and community college populations serve the same market? Perhaps only at lower wage levels than this potential workforce seeks. Similarly, routine computer programming is more and more often sent offshore to India or Ireland where skill levels are high and wages low. Ireland, for its part, made a policy decision to include programming as a secondary school requirement, and so profited handsomely by creating a pool of programmers. Can U.S. school districts do the same? Or should U.S. schools and higher education institutions focus on the upper end of this labor market segment, and train software developers and information architects instead of C++ coders who can take a job order created by a developer and grind out the code to the order's specifications? These are strategic issues that schools and colleges need to ponder in consultation with the industry leaders who will ultimately decide what sorts of people to employ at business establishments in American cities.

G. Build Global Relationships

Information and communications technologies are globalizing the new economy. While the globalization of manufacturing has been taking place for decades, IT is now enabling global operations in financial and other business services, as well as retailing. Companies are creating global production systems, using strategic relationships with companies in Europe, Asia, and other regions. Globalization can be seen solely as a threat to locally-based employment and wage levels. However, global relationships may also facilitate specialization in higher skill/higher wage portions of

the work, shifting more routine IT operations offshore, and they may reveal new customers and opportunities to develop new products or services. Opportunities may emerge if active and diverse relationships are built in regions local companies are looking to for subcontractors.

City leaders can augment private-company globalization strategies and company interactions, seeking to expand markets and preserve domestic jobs and wages. If mayors and economic development department directors in U.S. cities know their counterparts in Bangalore, Beijing, and Dublin, these relationships may prove instrumental in linking a manufacturer with a customer service company in another country, or a software developer with a coding firm, or a financial services company with a back office transaction processing company. Global production systems are a reality, and they are spreading into many new sectors of the economy. Public leaders need therefore to respond to this reality by expanding their international networks to market the capacities of firms in their own regions. Trade missions, cultural exchanges, and international education linkages can be arranged to build a variety of relationships that will ultimately yield business benefits.

Regional leaders in some areas take great care to build relationships to decision makers in other parts of the world. Seattle's Trade Development Alliance leads frequent trade missions, often to Asia—a region where West Coast cities have some advantage. The City of Seattle has dozens of sister city relationships. Other areas may also wish to examine where companies in their region are currently developing business relationships, and complement these efforts with a new sister-city relationship or academic exchange programs. Public-private collaborations are very possible in this arena and often very fruitful.

H. Lead by Example

City and metro governments can and should employ many of the same e-commerce and customer-oriented technologies corporations are using. Information about land availability, zoning requirements, utility alignments, and other factors related to business location decisions can be made web accessible, along with certain administrative transactions. The city of Phoenix, for example, has placed its construction permit process online, allowing permits to be obtained and paid for electronically.

These business-to-business conveniences can enhance a city's attractiveness to firms. The State of Washington's technology policy, for example, includes a clause addressing IT applications in government. The state has won many awards for its innovations in e-government, and is using its innovations to market itself as a site for technology firms. All governments need to consider how they can take advantage of IT innovations to improve efficiency, streamline government processes, and create a favorable image among companies who value this type of innovation.

VI. CONCLUSION

The profound changes being wrought by information and communications technology continue to remake how companies do business. That, in turn, determines how state and metropolitan leaders must respond in order to maintain and enhance regional economic viability.

Much is in flux right now. Businesses are creating new strategic alliances. They are increasingly deciding to outsource projects and whole functions, resulting in troubling workforce dislocations as whole pieces of companies get moved around to achieve greater efficiency. Businesses are also reorganizing internally, substituting new technology for labor, and using technology to improve the efficiency, quality, and marketing of their operations.

In this environment, regions that are not quick and nimble in responding to these trends will likely lose employers and good-paying jobs to other areas. Regional leaders therefore need to adapt their infrastructure; provide the right education programs at adequate scale to meet new skill requirements of employers; support innovating firms with research and development programs at universities and institutes; and assure adequate venture capital exists for startup companies. Leaders need also need to insist that their own organizations lead in the effective use of new technologies, and that their regions build strong international relationships with foreign regions whose local businesses want to partner in a more collaborative and globalized economy. Ultimately, those regions that move the most adeptly to create the right conditions for business survival and profit will create the best opportunities for local residents to earn a living in satisfying careers.

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APPENDIX

WHAT ARE COMPANIES DOING WITH IT?

The following pages summarize key points company executives made about the IT innovations inside their companies, and the impacts these new technologies are having on their businesses. The interviews document a number of “experiments” with the alternative types and uses of IT at the heart of this report; they provided the information from which we identified the key trends and policy recommendations described above. Hopefully these notes will stimulate thoughts about new IT applications, and insights about how to prepare regions to respond to the rapid growth in IT.

A. Greater Phoenix

Context

The greater Phoenix area encompasses Maricopa County in central Arizona. In 2000, greater Phoenix ranked 14th in size among the nation’s largest metropolitan areas, with a population of more than 3.2 million that accounted for two-thirds of the state’s population.¹³

Population

Greater Phoenix has a rapidly increasing population, primarily due to migration. The population grew 45 percent in the 1990s.¹⁴ According to the Greater Phoenix Economic Council (GPEC), the region’s population growth will double the national rate for the next several decades.

In 2000, per capita personal income in greater Phoenix was \$26,013, as compared to \$29,469 for the nation as a whole, and the cost of living in the area exceeded the national average by 2 percent in the fourth quarter of 2001.¹⁵

Nearly 24 percent of people over age 25 in the Phoenix metropolitan area have a bachelor’s degree or more, compared to 26 percent of the national population.¹⁶ Major universities and research institutions in the area include Arizona State University, University of Phoenix, and the American Graduate School of International Management.

¹³ U.S. Census Bureau, 2000. See <http://factfinder.census.gov/> (February, 2003).

¹⁴ Ibid.

¹⁵ U.S. Bureau of Economic Analysis, 2000. See www.bea.doc.gov/bea/regional/data.htm (February 2003). Also: ACCRA Cost of Living Index, 2001. See www.coli.org (February, 2003).

¹⁶ U.S. Census Bureau, 2000.

Market Overview

Greater Phoenix has a diverse economic base and steady job growth. However, there have been challenges with finding workers with appropriate skills for many of the new jobs, particularly in the high tech sector.¹⁷ Evolving from a tourism and resource-based economy, greater Phoenix has moved toward high tech manufacturing such as semiconductors, electronics, and aerospace. Jobs in these new fields require very different skill sets than the old economy jobs.

Historically, Arizona has ranked among the top employment growth states in the country, primarily due to rapid employment growth in greater Phoenix. In fact, employment in Greater Phoenix is estimated to have grown 4.8 percent (or 68,200 jobs) in 1999.¹⁸ The largest labor segments in Arizona are professional and technical, followed by administrative support and service jobs. According to the Arizona Department of Economic Security, more than 300,000 new professional, service, and technical jobs will be created in greater Phoenix by 2005.

In 2002, Phoenix ranked 17th among the best places to do business in the United States, down from ninth in 2001.¹⁹ Five Fortune 500 companies maintain their headquarters in the greater Phoenix area, including Avnet, Allied Waste Industries, Pinnacle West Capital, and Microage.²⁰

High Technology Industry

The high technology industry in greater Phoenix is divided between aerospace and electronics. The Progressive Policy Institute ranks Phoenix as the 17th most significant high tech cluster among the largest metro areas in the nation.²¹ The Arizona Department of Commerce created an Office of High Technology to help existing high technology companies to grow and to attract additional companies to Arizona. The rapid economic growth in metro Phoenix is in large part due to the high technology sector, which accounts for over 60,000 employees and nearly \$33 billion a year in economic activity.²²

¹⁷ Morrison Institute for Public Affairs, "The Achilles Heel of Future Economic Growth" (Tempe: Arizona State University, 1998).

¹⁸ Greater Phoenix Economic Council. See www.gpec.org/InfoCenter/Topics/Labor_Force/Employment.html. (February 2003).

¹⁹ Forbes.com and the Milken Institute, "Forbes/Milken Best Places for Business and Careers" (2001 and 2002). See www.forbes.com/2002/05/09/bestplaces.html (February 2003).

²⁰ Forbes.com. (2001) See www.forbes.com/tool/toolbox/forbes500s/ (February 2003).

²¹ Progressive Policy Institute, "The Metropolitan New Economy Index" (2001). See www.neweconomyindex.org/metro/part5_page1.htm (February 2003).

²² Greater Phoenix Economic Council, *Greater Phoenix Fact Book*. See www.gpec.org/InfoCenter/Reports/Fact%20Book%20PDFs/05.%20Economic%20Factors.PDF (February 2003).

Company Interviews

Intel

Intel, the leading developer and manufacturer of computer chips, employs 88,000 people, 55,000 of whom work in 18 manufacturing facilities worldwide. Intel has four manufacturing locations in the United States in Oregon, Massachusetts, New Mexico, and in Chandler, AZ, a Phoenix suburb. The 700-acre Chandler campus employs 11,500 workers speaking three primary languages (English, Spanish, and Hebrew) in two large fabrication plants and other divisions encompassing 23 business units.

- **IT has the potential to transform supply chains, information, and coordination, but limitations still exist.**

Mary Murphy-Hoye, director of IT research, is responsible for developing Intel's strategy for using IT as a competitive advantage. She also leads a team of ten researchers at the Massachusetts Institute of Technology investigating next generations of IT. She defines IT as a combination of disciplines to implement business strategies. Given Intel's extensive array of alliances and collaborations, for example, she says "supply-chain management" now means co-owning and co-managing business activities and information exchange both within the company and outside it.

IT tools today are not invisible and reliable like TV or a car. There are still too many limitations and glitches to enable optimal collaboration across space and time. Murphy-Hoye cited two examples. First, in order to work globally, broadband must exist everywhere. Right now this is a serious impediment to Intel's business strategy of diversifying away from wafer/chip manufacturing through the acquisition of the best products, intellect, and resources to connect current and acquired intellectual capital by IT. The IT connection has been more difficult and more costly than anticipated. India and Russia may have cheaper labor costs, but they lack a reliable broad band network— and that needs to be created.

In addition, software tools like CAD and Excel do not yet accommodate real time collaboration, especially for engineering and manufacturing problem solving between, say, U.S. and Russian teams. Language is a partial barrier, but a three-dimensional/holographic model environment needs to be developed to promote problem-solving. Murphy-Hoye notes that it is necessary to develop IT which can support virtual teams of engineers and scientists.

- **Language, culture, tenure, job type, and education both affect and are changed by IT.**

Jeannette Harrison, director of training for the Technology Manufacturing Group worldwide, dwelled on the human interface with IT—how language, culture, tenure, job type, and education affect and are changed by IT.

Harrison says that Intel manufacturing technicians spend half of their time searching for information and tools. They look to consult manuals, schematics, history, application, best practices, and sometimes seek mechanical tools. This search is made more difficult by several aspects of Intel's culture:

- Interdependence amongst personnel in three shifts
- The use of many languages
- Different cultures and learning styles
- A corporate culture that rewards individual excellence without linking to team building

Despite these barriers, the most effective learning does not take place in the classroom, but rather at the site of performance—the manufacturing floor. And people learn from their peers—information endorsed by a colleague is eight times more trusted than from an instructor or supervisor. This awareness has led Intel to a “learner/performer model,” where learning takes place on the factory floor using new wireless technologies. Schematics and specifications information can all be accessed via handheld personal digital assistants (PDAs), or at computer kiosks on the floor. A husband and wife team at one Intel fabrication plant, for example, worked different shifts, but were very entrepreneurial and developed their own information system that they passed along to one another via their own PDAs. They excelled in productivity. So the corporate-culture question becomes how to infuse these productivity enhancements team-wide. This couple innovated; the question now is how they can be made floor-based peer instructors to diffuse their innovations.

Harrison also believes IT raises critical diversity issues. A majority of Intel employees work outside the United States and IT permits new, real-time global interaction among them. This in turn creates new issues. CEO Craig Barrett, for example, gave an address to employees via desktop and phone to announce year-end earnings. How he appeared; the words, hand, and facial motions he employed; and his message itself needed to be culturally appropriate to the 88,000 Intel employees around the world. Much coaching and sensitivity is therefore required for using this technology.

- **Intel deems educational quality, the environment, and access to public services and amenities key factors in attracting and retaining top employees.**

In deciding where to locate its facilities, Intel considers numerous factors:

- Political environment
- Government stability
- Freedoms for citizenry
- Tax incentives
- Workforce quality
- Quality-of-life factors (environment, educational, and recreational options for families)
- Infrastructure (sewer, water, electricity, roads, airports, telecommunications)
- Land availability

To attract and retain top-flight employees, Intel views educational opportunities, the environment, and access to public services and amenities as key factors (trumping tax incentives). For example, luring talent to Chandler, AZ on the basis of economics is easy, given that the average annual salary at the fabrication plant is \$62,000 while the average home costs just \$150,000. However, Arizona ranks next to last among the 50 states in average dollars spent per public school student and 36th in its percentage of children in poverty.²³ The latter two factors do not bode well for recruitment and retention.

Michael Edwards manages Intel's corporate real estate and development and is responsible for locating manufacturing sites worldwide. These sites require, in addition to factors listed earlier, 1.5 to 2 million square feet per building and the potential to accommodate 10 buildings. Also necessary are the availability of 6 million gallons a day of ultra-pure water, the capacity to treat 4 million gallons a day of waste water, and plentiful and reliable electricity.

How investments are taxed is of great interest to Intel. For example, the state of Arizona taxes commercial property at 25 percent of its value. If the property is in a foreign trade zone (FTZ), however, it is taxed at only 5% of its assessed value. Chandler was able to craft an agreement with neighboring Phoenix, a certified FTZ, to extend the zone to Chandler; this was an important deciding factor in Intel's selection of the Chandler site.

Finally, the capacity of the city to process and permit the development at the required speed, and the ability of the region to absorb the enormous impact of the project are also essential. Construction of an Intel fabrication plant will often absorb much of the skilled labor in a 1,000-mile radius.

Arizona Public Service (APS)/Pinnacle West

APS is the private utility serving greater Phoenix. William Post, CEO and chairman of the board (and immediate past president of GPEC), began the interview with some observations about greater Phoenix and the companies' customer base. One-third of the population had arrived since 1990, and the metropolitan area continues to expect high growth. The population is very mobile, with 50 percent of APS customers moving annually (across the street or across the country).

- **CEOs must assess the risks and benefits of using IT to change business operations.**

Post believes that the CEO's job is to manage the art of IT. IT professionals as a generalization have not adhered to traditional values of community/corporate leadership; they have been more abrasive, tend not to believe in social intervention, and are not very good at human interface. Increasingly, however, IT professionals are integrating both technical and people/organizational skills.

²³ National Center on Educational Statistics. See <http://nces.ed.gov/ccd/stfif.asp> (February 2003). Also: U.S. Census Bureau. See www.census.gov/hhes/www/saife/stcty/d99_00.htm (February 2003).

Post notes that the CEO can more quickly and easily implement applications that are cost-justified. Such implications may involve automating activities people are already doing, like meter-reading. In contrast, Post describes the greater difficulty of investing in an entirely new way of doing business, such as wireless technology that informs repair personnel of the location of a meter or transformer failure on a hand-held global positioning system (GPS) gadget. Cost reduction vies with increased business opportunity and the CEO must assess the risks and benefits.

America West Technologies, America West Airlines

Phoenix-based America West Airlines is the ninth-largest domestic airline. Chief Information Officer and Vice President Joe Beery came to America West from process engineering at Motorola and sees many parallels between semiconductor and airline services, including the need to institutionalize good, timely processes utilizing expensive equipment.

- **IT innovations are improving business operations throughout the corporation.**

Over the past 10 years, the company has increased automation and the implementation of IT through wide area networks and computers. Online Internet and wireless technologies have proven especially strategic. Online ticketing through services such as Travelocity and Expedia increases the airline's accessibility at no extra cost to them. Wireless, hand-held equipment pioneered by rental car companies and used by ATMs provides better customer service for airline passengers at the gate, and on the service and repair floor. Kiosks reduce costs—six kiosks are served by one ticket agent—and they increase business opportunity. For example, customers are offered first-class upgrades after they have already swiped their card, and many elect to spend an extra \$100 at point of sale.

Beery contends that the role of IT in business today is not about writing programs, but about integrating and aligning with other divisions of the business. Beery meets with his peers in flight operations and other businesses within the corporation to understand their needs and to plan possible technology solutions. He maps investment options (during a time of lean budgets in the industry) and identifies commonalities which would leverage IT investments and yield benefits corporation wide. During these belt-tightening times, IT is seen as a way to cut costs and boost performance, so IT itself may not experience budget cuts as severe as those in other business units.

- **Hiring young professionals with strong IT and social skills is considered key.**

In hiring, Beery looks for people with enhanced IT and business skillsets who also possess good social skills. Increasingly, he finds more people with these qualities, as more and more entrants in the job market have been introduced to computers and programming at an early age. Knowledge of computers now represents a basic skillset for young professionals. In 1998 it was very hard to find such employees, but with the downturn of the dot.coms, he now finds plenty of good candidates.

B. King County and Seattle

Context

King County is located between the Puget Sound and the Cascade Mountains in Washington State. The City of Seattle is the King County seat and the largest city in the Northwest. Greater Seattle ranked 13th among the nation's largest metropolitan areas in 2000, with more than 3.5 million people.²⁴

Population

Greater Seattle's population grew nearly 20 percent from 1990 to 2000.²⁵ In 2000, per capita personal income in Greater Seattle was \$40,686 compared to \$29,469 for the nation as a whole.²⁶ The cost of living in the Seattle area exceeded the national average by 17 percent in the second quarter of 2002.²⁷

Nearly 34 percent of people over age 25 in the Seattle metropolitan area have a bachelor's degree or higher.²⁸ Major universities and research institutions in the area include Seattle Pacific University, Seattle University, University of Washington, and three main community college campuses.

Market Overview

Manufacturing, high technology industries, services, international trade, and tourism drive the Seattle-area economy. King County's manufacturing base includes food processing, printing and publishing, fabricated metal products, industrial machinery, transportation equipment, textiles, and apparel. Boeing is the largest employer and leading exporter in the area. Manufacturing employment in 2001 decreased 0.3 percent, however, due to Boeing layoffs.²⁹ Ten Fortune 500 companies maintain headquarters in the Seattle metro area; these companies include Boeing, Microsoft, Washington Mutual, Costco, Nordstrom, and Safeco.³⁰ In 2002, Seattle ranked 92nd among the best places to do business in the United States, down from 15th in 2001.³¹

²⁴ U.S. Census Bureau, 2000.

²⁵ U.S. Census Bureau, 2000.

²⁶ U.S. Bureau of Economic Analysis, 2000

²⁷ Greater Seattle Chamber of Commerce. See www.seattlechamber.com/infocenter/almanac_costofliving.cfm (February 2003).

²⁸ U.S. Census Bureau, 2000.

²⁹ Washington Employment Security Department. See www.workforceexplorer.com/publication.asp?PUBLICATIONID=613 (February 2003).

³⁰ Forbes.com. (2001) See www.forbes.com/tool/toolbox/forbes500s/ (February 2003).

³¹ Forbes.com and the Milken Institute, "Forbes/Milken Best Places for Business and Careers" (2001 and 2002).

High Technology Industry

The Seattle area ranks fifth nationally for its concentration of high technology businesses according to the Seattle-King County Economic Development Council. Over the past ten years, the industry has grown on average by 4 percent.³² The Progressive Policy Institute puts the area in 23rd place in its overall score for high technology in metropolitan areas.³³ Microsoft Corporation is the area's second largest employer behind Boeing. While aerospace jobs continue to dominate the high tech sector, the areas of biotechnology, computers, electronic industries, and telecommunications are growing rapidly.

Company Interviews

Amazon.com

Amazon.com is an online retailer. The company was founded in 1995 as a source for ordering books but has expanded into many other product lines and has become the largest Internet-based retailer. As the company's website says: "Today, Amazon.com is the place to find and discover anything you want to buy online."³⁴ Charlie Bell, Amazon.com's vice president for IT infrastructure, describes Amazon.com as a technology service company, not a retailer. To quote Bell, "Amazon is not WalMart online," nor is it "a traditional software company selling bits on a disk." Traditional retailers create a brand around an experience and tend to be vertically integrated, including distribution as well as the retail experience. Amazon deviates from this model.

- **Amazon's purchasing platform and organizational structure challenge traditional business models.**

Amazon sells books on line but adds a wide range of products and services that a traditional retailer wouldn't. If you click on a book title, for example, you may be offered several used copies as well as a new copy. Borders, a competitor in the book market, has a presence inside Amazon's site, and other traditional retailers are using the platform, including Target and Circuit City.

Amazon's own customer fulfillment system can be used by other retailers on the platform so the flexibility to find the best solution goes both ways—Amazon can offer the service to others, but Amazon can also take advantage of partners' systems. An important quality-control mechanism in this flexible system is to be very transparent about who is doing what. Customers can track down who is providing every part of a transaction and follow up as necessary.

³² Economic Development Council of Seattle and King County. See www.edc-sea.org/Research_Data/economic_ecbase.cfm#hightech (February 2003).

³³ Progressive Policy Institute, "The Metropolitan New Economy Index" (2001).

³⁴ Amazon.com. See www.amazon.com/exec/obidos/subst/misc/company-info.html/ref=gw_bt_aa/103-5341933-1635061 (February 2003).

Amazon pursues vertical integration only if it is cost effective; otherwise, key activities may be contracted out. For example, most, but not all, customer service is contracted out, a great deal of it to India. Amazon does have some customer service centers domestically, however, typically in lower-wage markets with well-educated workforces; college towns are a popular choice. Amazon uses its technology to distinguish hard service issues from easy ones, so that inquiries can be sent to the appropriate customer service center. Distribution is placed wherever it is most appropriate—given the airports, customer locations, and local wage rates—and can be contracted out or internal.³⁵

What really matters and constitutes the core of Amazon, however, is the technology—or “the platform,” as Bell refers to the company’s IT. Seattle, for its part, offers a good place for this kind of company—it is a “technology mecca.” Many of Amazon’s partners also have an appetite for technology, so they are in the Seattle area as well. However, the technology also makes long distance collaboration possible. An example is Amazon’s Internet movie database—a team scattered all over the world created this service on the Amazon platform.

- **To attract companies like Amazon, state and regional leaders need to focus on infrastructure, quality of life issues, and tax structures.**

Bell highlights a number of steps urban area leaders could take to make their area more appealing to companies like Amazon. A well-educated workforce matters immensely, as does excellent IT infrastructure. Bell deems Seattle’s infrastructure acceptable, but not as good as the infrastructure in Silicon Valley or Northern Virginia. Extending infrastructure into growing markets is another potential area for public investment. Asia is a huge market, especially considering the potential in China. The quality of the IT infrastructure linking Asia to North America will be critical to future business success.

A strong cluster of technology companies is also very important, as Amazon looks for nearby strategic partners. Metropolitan areas must also possess a high overall quality of life so that technology companies are able to recruit talented staff who have many career options. Finally, Bell recommends that government tend to tax structure issues for technology companies. Many of these companies will continue to reward their employees in part through equity grants in addition to salaries. State tax structures differ greatly in how they treat stock options, and this is an important part of the public policy package.

Boeing

Boeing is a large aerospace company headquartered in Chicago, but with its commercial aircraft division located in the Seattle area. The corporation is attempting to diversify its business,

³⁵ Amazon prides itself on making decisions quickly, and the company’s drive to achieve profitability has sometimes forced quick turnarounds. In Atlanta, civic leaders talk of a state-of-the-art Amazon distribution that opened with considerable fanfare, including a ribbon-cutting ceremony headed by the state governor, only to be closed a couple of years later when the company decided that Atlanta was not the right place.

and created an air traffic management (ATM) unit in 2000. The purpose of this business unit is to identify systems and processes that will increase the capacity of air traffic control systems at major airports, thereby enhancing the market for Boeing airplanes. ATM's first major client is Beijing, China, for whom ATM is designing the air control systems for the 2008 Olympic games.

- **Boeing is using IT to better integrate bicoastal operations.**

Of particular interest to this study is the geographical spread of the company's two ATM offices: one in Bellevue, WA and the other in McLean, VA. The number of staff is evenly split between the two offices, with engineers primarily in Bellevue (because they were already there). The Virginia office provides proximity to key stakeholders and regulators, such as the FAA and other agencies and policymakers located in the Washington D.C. area.

To integrate its bicoastal operations, Boeing ATM employs video conferencing a great deal (almost everyday). Video conferencing has been very helpful in enabling split team members to see each other, watch body language, and develop a better sense of teamwork, and it helps keep work moving efficiently. The ATM unit inherited the video conferencing capacity when they leased an office from a failed dot.com firm. They did not have to weigh the investment in this IT, but they certainly make use of it.

Electronic conferencing and web-based document sharing do not replace meeting face-to-face, however. The leadership/management team continues to travel to the other office a few days every month so that employees feel they are important, part of a team, not forgotten. Employees get together in person throughout the year on a quarterly basis, in addition to the management team visits.

Software and systems development is greatly enhanced by IT as engineers from Boeing locations around the globe contribute to design solutions. But customer oriented jobs usually need to be staffed near the client, and staff members need local expertise. For this reason, Boeing ATM has hired local marketing/lobbying specialists in Hong Kong and Brussels.

Federated Department Stores/The Bon Marche

Federated Department Stores is headquartered in Cincinnati and has \$18 billion in annual sales and 125,000 employees. Over the past 25 years it has absorbed 30 different department store chains into five, including Bloomingdale's and Macy's; these five chains have stores located all over the United States. One of the chains, The Bon Marche, was formerly headquartered in Seattle and has stores throughout the Pacific Northwest.

- **IT is streamlining Federated's operations.**

Internet-enabled IT has resulted in many changes at Federated. Where there used to be 30 different systems developers there is now just one. Universal product codes, stock keeping units,

and manufacturers' approved prices are all computerized, standardized, and marked at the factory. This enables Federated to purchase The Bon or Sterns, and continue to distribute and retail merchandise without skipping a beat. Automation has also eliminated many functions: letters of credit, bills of lading, and warehousing are all things of the past. Across Federated, 5,000 people used to do credit and calling. Today, 2000 people handle this function for all Federated units from a call center in rural Ohio outside Cincinnati.

All Federated's computing is outsourced and managed by IBM Global Solutions, whose super computers have enormous capacity. Federated uses IT innovations from small companies such as Signature Token Technology, which provides a kind of signature encryption. Signatures are written on glass over a scanner at point of sale; after three repetitions a signature template is created and stored, and forgery is thereafter impossible.

- **IT has encouraged the centralization of Federated's intellectual capital to only a few locations.**

Federated has three main centers of operation.

- Financing and credit operations reside in Cincinnati
- Technology operations are based in Atlanta
- Merchandising takes place in New York

The fashion, wholesale, and merchandising center of the United States remains New York City and Federated must have a presence there. The other two functions could take place anywhere, but the CEO and staff are located in Cincinnati because the CEO lives there, and a powerful Atlanta-based senior vice president seized control of the corporation's technology function and built that staff up in Atlanta. One result is that Federated has accumulated high-skill jobs in these areas, and eliminated them from medium and large retail chains formerly headquartered in other regions in the United States. This points to an important trend. Very large firms are absorbing large and medium size ones, and eliminating local high-skill jobs. In this respect, IT encourages the centralization of intellectual capital to a few best locations.

Starbucks

Starbucks is a worldwide vendor of coffee drinks sold from over 5,500 stores located in a number of countries around the globe. The company started out in a single establishment in Seattle, and is now opening three to four stores per day. In addition to managing this far-flung network of retail establishments, the company is also involved in buying, shipping, roasting, and distributing coffee beans. The stores offer a variety of other products, from pastries to newspapers to coffee-brewing equipment and cups. A very sophisticated set of IT tools supports this operation.

- **Sophisticated use of IT helps Starbucks gather the data needed to select sites, design stores, and evaluate store performance.**

Starbucks headquarters staff of 3,500 occupies a redeveloped building in an industrial district south of downtown Seattle. Part of the headquarters staff is involved in putting new stores in place. The company has created a vertically integrated “store production machine” that carefully selects sites and tailors the product line in individual stores, as well as larger market units (regions, countries), based on demographics, psychographic profiles, GIS data, and other factors. An internal real estate group acquires sites; company architects design the stores; and company construction managers get them built. A store management team then takes over the staffing and management of the stores.

With over 5,500 stores operating, a great deal of data is available to help the company select the next set of sites, and establish expectations for the performance of individual stores. Roving staff train the in-store staff and provide management oversight. Careful analysis of the data from the existing stores allows the company to test new products and services, and roll the successful experiments out in entire markets. A modular approach to database design allows use of simple and less expensive database tools in smaller markets, while more elaborate systems are used as needed in very large markets such as the United States. No two stores are exactly alike in product mix or the amount and arrangement of seating, although there are enough design constants so that you know you are in a Starbucks.

Measurement systems track sales after a store is opened to see if they “got it right” at the planning stage. Starbucks maintains that competitors who just follow them around and put a store across the street will fail because they do not understand the rest of it—tailoring the product offerings to that particular place. The key to all of this is obviously good internal data, plus an analytical process inside the company that helps managers learn from the data. In the view of the company’s Information Architect James Snook, it’s ultimately about good analysis—Starbucks is an information-driven company.

- **Technology is at the heart of Starbucks’ latest products and services.**

“Starbucks Express,” is an example of an experimental approach to new product development. Using the web, a customer can establish one or two standard pre-orders, perhaps a double tall skinny latte and a *New York Times* or a grande mocha and a cherry danish. The customer then just calls his or her favorite store, requests Option A, and provides a time of arrival at the store. The order pops up on the barista’s screen and a little machine prints a sticky label with the order and the customer’s name for the cup. The drink and other items are on the counter waiting for the customer when he or she arrives, with the charge already made to a credit card. This system was tried first at the ATT Wireless campus in Redmond, and then was replicated across the street at Microsoft; it is now available in 12 stores in the Seattle area. Starbucks’ intends to roll the system out throughout a pilot city before deciding whether to offer this service nationwide.

Starbucks’ many roving staff members are one of the factors that led to a decision to invest in a wireless local area network (LAN) encompassing the area in the immediate vicinity of 1,800 to

2,000 sites around the U.S. Using the network, anyone with the right Voicestream account and an appropriate device (a Palm-type PDA with a wireless connection, say, or a web-enabled cell phone) will be able to get on the Internet to check email or stock quotes using a “thin client” model. This will work over a relatively slow connection. This is not a revenue opportunity for Starbucks since Voicestream provides the service, but if it brings more customers to Starbucks or gets them to buy more coffee, then it will be a commercial success. Since the stores are becoming ubiquitous, the company suspects the initiative will attract a lot of mobile customers who need to check into their corporate intranet periodically during the day. At a minimum, it improves connectivity for Starbucks own employees.

Snook summarizes the company’s philosophy as “get big but think small.” Such thinking, including innovation and experimentation and an excellent, constantly evolving IT system, have kept the company growing rapidly for 30 years.

Terrabeam

Terrabeam is a two-year-old “start-up” company that uses laser technology to beam broadband Internet access through the windows of buildings. This technology brings high-quality connectivity into spaces which for a variety of reasons cannot get access using wires or fiber optic cables. Terrabeam’s technology also supports time-limited events. For example, Microsoft wanted to train a large number of people in the use of its latest operating system, so it rented Safeco field, the stadium utilized by the Seattle Mariners baseball team; Terrabeam brought in a very large broadband “pipe” for an 18-hour event. After 9/11, Terrabeam helped Merrill Lynch regroup at a New Jersey site and had the company up and running with broadband access in less than a week.

- **Quality technology and quality staffing go hand in hand.**

Terrabeam is a young company and is still doing a lot of development work. It is also talking with various partners about innovative application of the technology to support training, distance learning, or regional systems in historic cities in Europe. With so much creative energy going into this work, the IT staff have attempted to create an IT system that uses off-the-shelf but “best of breed” technologies. In addition, the IT manager staffed the IT department with very experienced people out of larger corporations, many of whom he had worked with before. The IT and staffing strategies are complementary, and not necessarily the least-cost solution, but they keep the company’s focus where it needs to be in a developmental phase. The company will soon be “ISO”-certified, which is very unusual for a company this young; this is evidence that the “best of breed” and experienced staff strategies are working.³⁶ Some of the experienced managers hired for the IT department are now being moved into other key management positions in the company, an interesting side effect of the IT manager’s staffing strategy.

³⁶ The International Organization for Standardization (ISO) is an international standards organization; products marketed in Europe typically must meet ISO quality standards (see <http://www.iso.ch/>). Meeting ISO quality and environmental standards requires extensive documentation and compliance with rigorous production-process standards.

Unigard

Unigard is a 100-year-old insurance company relying on independent agents who offer contracts to the company. Its IT system is based on mainframe computers, with networked personal computers at each workstation. The company has moved from workstations linked directly to the mainframes to embrace the addition of a graphical front end that runs on personal computers. However, the company's extensive investment in mainframe technology, and the large amounts of data that must be manipulated, mandates that the firm stay with the modernized mainframe environment as long as possible.

- **Organizational design and IT systems have evolved concurrently at Unigard.**

Thirty years ago, Unigard had division offices all over the U.S. Over time, greater centralization accompanied the automation of key functions, such as cash payments and decisionmaking about personal insurance contracts. Commercial insurance lines, however, have remained somewhat less centralized; commercial-line adjusters need more local knowledge to assess risks than they do in personal insurance. Policy administration has been heavily automated—including rating, underwriting, and the complicated process of meeting regulatory requirements.

In general, the headquarters staff at Unigard relies extensively on a rules-based IT system to decide whether to accept the majority of proffered contracts, and allocates expensive analyst time to reviewing the more difficult cases. Rules-based computer systems identify risk factors, but humans evaluate the risks in the current environment; the more routine the contract the more likely that a rules-based system will make the decision for the company on whether to accept the contract. For small business policies, a rules-based system makes the decision on whether to accept the contract or refer it to someone else, and a web-based interface is used by independent agents to enter data from the business seeking insurance.

- **IT has helped Unigard remedy process inefficiencies.**

Unigard is introducing imaging-processing systems for documentation. This has improved workflows within the company. But many efficiencies have resulted not so much from automation as from the *process* of switching from a paper-based system to image processing. In designing the image-processing system, the IT department had to ask a lot of questions about workflow, and in doing so, discovered some inefficiencies that could be eliminated.

The former process for accepting contracts is a good example. Under this process, no policy number was assigned, and therefore no information was entered into the IT system, until an application for coverage was accepted. While the decision regarding acceptance was pending, however, the company would often get multiple calls from an agent. Employees would have trouble tracking down the paper work because it was not "in the system" and nobody knew who had it at a

particular time. Now, thanks to insights gleaned from the process of designing the image-processing system, staffers assign a policy number and enter data into the system as soon as a potential contract enters the company, and the contract can be easily tracked as it moves through the process. Records of rejected contracts can easily be eliminated. In this reform, the specific technology change proved less important than the simple fact of change: Change forced the company to address issues it probably should have looked at earlier.

IT is also used to facilitate Unigard's customer service functions. Unigard is a 8 a.m. to 5 p.m. company for its full-time employees, but maintains a 24-hour, seven-day-a-week presence for customers because it uses a third-party contractor with a big telecenter to provide customer support.

C. Greater Cleveland

Context

Cleveland is located in Cuyahoga County on the shores of Lake Erie in Ohio. Greater Cleveland ranked 16th among the nation's metropolitan areas in 2000, with nearly three million people.³⁷

Population

The population of Greater Cleveland grew 3 percent from 1990 to 2000.³⁸ In 2000, the per capita personal income in Cleveland was \$30,909 and the cost of living for the fourth quarter of 2001 was 5.3 percent higher than the national average.³⁹

Nearly 29 percent of those over age 25 in the Cleveland metropolitan area have a bachelor's degree or more.⁴⁰ Major universities and research institutions in the area include: Kent State University, University of Akron, Case Western Reserve University, and Cleveland State University.

Market Overview

Greater Cleveland and the state of Ohio have been struggling with limited job growth and increasing job losses as manufacturing companies leave the area. Ohio's job growth has lagged the national average since February 1996, and as of 2001, Cuyahoga County had lagged the statewide average for 44 of the last 47 quarters.⁴¹ Cleveland is attracting neither the businesses nor the

³⁷ U.S. Census Bureau, 2000

³⁸ U.S. Census Bureau, 2000

³⁹ U.S. Bureau of Economic Analysis, 2000. Also: ACCRA Cost of Living Index, 2001.

⁴⁰ U.S. Census Bureau, 2000

⁴¹ Council for Economic Opportunities in Greater Cleveland, "State of Poverty in Ohio" (2002). See www.ceogc.org/research

young, talented workers it needs. In 2002, Cleveland ranked 172nd among the best places to do business in the United States, down from 165th in 2001.⁴²

Key industries in the greater Cleveland area include biomedical, insurance, services and instruments, controls, and electronics. There are 11 Fortune 500 companies headquartered in the Cleveland metro area, including OfficeMax, Eaton Corporation, KeyCorp, Parker Hannifin Corp., National City Corp., and Sherwin-Williams Co.⁴³

High Technology Industry

Cleveland is not known as a high technology center; but many of the manufacturing firms for which the area is known are state-of-the-art operations employing advanced technology in their manufacturing processes, and embodying advanced technology in their products. Creation of that advanced manufacturing technology requires substantial investments in information technology as well. Some 67,000 to 77,000 information technology work in the region.⁴⁴ The Progressive Policy Institute ranks Cleveland 36th place among the 50 largest metro areas on the strength of its technology cluster.⁴⁵

Company Interviews

Parker Hannifin Corp

Parker Hannifin (PH) is an engineering/manufacturing company that makes systems to control motion and flow, and has \$6 billion in annual sales. Its international headquarters, formerly in downtown Cleveland, is now in a new office park building in an eastern suburb.

- **Parker Hannifin is working to standardize IT functions throughout the company.**

Bill Eline, vice president and chief information officer for the company, defines IT as the strategic deployment of information for corporate wide use. At PH, IT helps position the company as the leader in the \$20 billion global market for motion and flow control. As a centralized function, the corporate IT department selects and implements the best approaches to information, ordering, and coding for use in the 80 PH locations around the world. At the same time, the company leaves creativity and marketing to the greatest extent possible at the local level.

Every new IT investment decision starts with the question, "Will it work globally?" PH built its current IT system beginning in the 1990s by establishing strategic relationships with three companies in distinct areas:

⁴²Forbes.com and the Milken Institute, "Forbes/Milken Best Places for Business and Careers" (2001 and 2002).

⁴³ Forbes.com, 2001.

⁴⁴ McKinsey and Company for NORTECH, Cleveland, "Catalyzing Northeast Ohio's Information Technology Cluster" (2001).

⁴⁵Progressive Policy Institute, "The Metropolitan New Economy Index" (2001).

- IBM (product data management, data center hardware and operating systems)
- AT&T (Wide Area Network)
- J.D. Edwards (software for multi-currency, multinational requirements outside of the USA and Canada)

PH manages finance and marketing systems functions like payroll internally and cost effectively at its two data centers in Cleveland, OH and London, UK. Standard software systems undergird the PH “growth through acquisitions” strategy. IT enables conversions to occur quickly, which is essential for doing commerce. In a recent Australian acquisition, PH experienced an immediate \$350,000 savings by standardizing IT systems. “The moment of acquisition is the time to make the conversion, all at once.”

Y2K hastened the switch to the newest IT standards as has the Euro conversion in Europe. However, about half the North America operations still run non-standard corporate systems.

- **IT enables employees to work from remote locations, and allows the company to outsource certain functions to other firms and other countries.**

Teamwork and proximity go hand in hand, according to Eline. Real accomplishments happen face-to-face. IT cannot replace that, but it can extend the reach of personal trust through video and teleconferencing, which can make the times between personal visits longer.

PH prefers to keep IT-related functions within the company, instead of outsourcing them. Globalization has actually permitted PH to keep the help-desk function within the company, for example. When the help desk closes for the evening in Europe, call support is automatically routed to the firm’s Australian division where it is daytime.

IT requirements have not changed the kind of employee PH looks for, however: PH seeks employees who are “at least B+ people” with good personalities who are flexible, loyal, team-oriented, multilingual, and neither afraid of nor in love with technology. Eline observed that IT permeates teenagers’ everyday life, as they use the web to do school research and instant messaging to stay in touch with friends. This means that employees come to PH already oriented to using IT in personal and business transactions.

- **Computers are radically changing the companies’ manufacturing process.**

PH employs computers and computer-controlled tools to design and manufacture its products. The factory floor is increasingly automated. Meanwhile, the web has enabled e-commerce. Customers place about 55 percent of PH’s orders directly on the company’s e-commerce site, PH Connect, or via Electronic Data Interchange. Electronic orders go to a warehouse where the stock is pulled and shipped within 24 hours. PH is creating a process in PH Connect that will allow customers to pass orders directly to the manufacturing floor. Although

developed independently, third-party freight companies such as United Parcel Service's shipping and tracking technology has created a fourth—unplanned—strategic partner for PH's business. UPS ships, tracks, and enables the customer to track orders that can be delivered globally within 24 hours.

IT is being applied to the "old economy" manufacturing section of the company with striking impact. Fewer workers labor on the factory floor. Those that remain require different kinds of skills using and programming computer-controlled equipment. Customers exert increasing control in what they order, with a smaller inside sales staff handling order entry. The ordering, shipping, and billing process is largely automated, which has increased speed and reduced per-unit costs. And yet the human factor remains. PH still has sales representatives that visit customers' production facilities and monitor on-site inventories of PH parts. This "breadman service" (where a PH representative comes to the customer's door) is enhanced by wireless hand-held PDA devices that scan barcodes of products and inform the production facilities, in real time, of the need for various parts and products.

Diebold

Diebold Inc. is the main manufacturer of ATM/cash machines in the U.S. The company used to make safes for banks and has moved to this higher-technology product line. Diebold has grown rapidly internationally, especially in Europe. International sales now account for 50 percent of the company's revenue.

- **IT is changing Diebold's internal operations and hiring processes.**

Greg Geswein, Diebold's CFO, is relatively new to the company and was brought in to help upgrade its IT systems and processes. From 1997 to 1999, a new enterprise resources program (ERP) system was introduced into the company that did not work out as hoped. Geswein would like to see a single, integrated computer system tying together procurement, manufacturing, and other functions in lieu of the "mish mash" of systems they have now. An integrated system would make acquisitions of new subsidiaries easier, and improve the function of the HR department. In sum, Diebold wants to transform its business. The company plans to form a strategic alliance with Oracle Corporation, in which Oracle would become Diebold's IT department and therefore manage and host Diebold's data and Internet functions. Geswein estimates it will take 18 months to establish that arrangement.

IT changes the way Diebold works. IT serves as a utility now—it is a basic part of the business, like electricity. Web-based procurement, for example, eliminates paper and is a self-serve technology. IT also permits teleconferencing and video conferencing. For example, Diebold maintains international management councils which meet in-person quarterly, but more frequently via video conference. The organization believes that informal interaction in team settings builds trust and sharing and drives innovation.

IT has changed what Diebold looks for in employees. Gerswein explained that the firm does not need utility maintenance and repairmen, or people stuck in mainframe technology; Diebold instead wants employees who understand the art of the possible. Unfortunately, the location and image of the company's international headquarters in North Canton, OH, about 70 miles south of Cleveland, pose a problem for recruitment. Lacking a large nearby university or big city, the site does not immediately appeal to high technology people, even though it serves as the hub of the firm's intellectual capital. At the same time, employees who *are* attracted to a smaller, less costly, Midwestern community, may not fit the new Diebold requirements: Diebold seeks talent that is mobile and creative, and able to deal with the diversity of such an international company.

PolyOne Corporation

PolyOne is a new company formed by merger of Geon (an operating company) and Hanna (a holding company) into a \$3.3 billion firm that manufactures polymers and related plastics products.

CIO Ken Smith's job is to standardize the information and technology capabilities in the new firm in creative and innovative ways to affect:

- Customer interface
- Supply-chain management
- Manufacturing

- **IT infrastructure is critical to company operations.**

PolyOne located its new headquarters near the western edge of metro Cleveland in Lorain County adjacent to its manufacturing facility. This resulted in an unanticipated problem. The local telecommunication provider could not provide all of the necessary digital telecommunications necessary to support the needs of a global company. With 83 different servers with locations speaking six basic languages and employees using video and teleconferencing extensively, PolyOne needed a wide range of broadband capacity to operate, and produce its polymer-based products competitively.

- **Despite PolyOne's increasing use of IT, the company deems new employees' technological prowess less important than other skills.**

Ken Smith believes the skillsets for PolyOne's IT staffing exist in greater Cleveland, and that employee loyalty and stability are advantages of the region. For this reason PolyOne consolidated its data processing and IT functions in Cleveland from two locations—Atlanta and Cleveland. PolyOne uses a "behavioral interviewing" approach in which multiple group interviews probe applicants' competencies, including interpersonal skills and creative thinking. Smith prefers to hire locally, so as to secure an asset for life. He'll sacrifice technical skills for work ethic and team approach. Smith looks for people who are not too independent or arrogant (such as a recent college

graduate who announced that he wouldn't do programming). He characterized the PolyOne system as based on merit, not pedigree, and faulted some of the Atlanta-based IT staff for their willingness to take their skills to the highest bidder and switch employers readily.

Eaton Corporation

Eaton Corporation is a global, \$7.3-billion diversified industrial manufacturer based in Cleveland. The company is a leader in fluid power systems; electrical power quality, distribution, and control; automotive-engine air management and fuel economy; and intelligent truck systems for fuel economy and safety.

- **At Eaton, IT and business decisions go hand and hand.**

Don Bullock, Eaton's CIO, observed that today's IT decisions must be made simultaneously with critical business decisions such as manufacturing and engineering design. He noted three significant phases of Eaton's IT development in recent years:

- *1980s and early 1990s*: Centralized mainframe computing for business systems with shop floor computing controls.
- *1996 to 1998*: Shift to client server platforms and new enterprise applications, resulting in the early stages of an interconnected enterprise.
- *2000*: Implementation of the next wave of technology. This year saw robust utilization of the Internet and digitized business processes to achieve increased efficiencies for manufacturing and support operations, including:
 - Linkages of suppliers and customers via electronic commerce, taking friction and cycle time out of the supply chain
 - Improved demand forecasting, and continuously improving production and inventory processes
 - Superior availability of information to customers and other constituents about the company, its products, and its services. Prior to the advent of the Internet, this capability was not readily available at an economically viable pricepoint. The Internet has also provided insight into customer information requests, buying habits, preferences, and purchase cycles
 - Better information sharing with other channel partners

Eaton's vision for e-business in a "bricks and mortar" world lies in leveraging new technologies to achieve business objectives. By using tools such as the Internet to trade, communicate, and collaborate, Eaton is rethinking every customer, supplier, and employee interaction to improve service, cost, quality, and speed.

A prime example of how Eaton seeks to boost its competitive advantage in today's high tech marketplace can be found within Eaton's Industrial and Commercial Controls business segment.

Beginning in 1995, the business launched an effort to improve efficiency by electronically enabling business processes through the development of a software program called Bid Manager. The tool quotes project business in the electrical distribution and controls industry Eaton serves.

But Bid Manager goes beyond pricing. It enables Eaton engineers, customers and distributors to correctly configure products in Eaton's Cutler-Hammer line, such as circuit breakers, panelboards, switchboards, generators, and motor-control centers. If an individual makes a design mistake, Bid Manager will immediately notify that person of his or her error. Bid Manager also allows Eaton employees to propose alternate designs that may save customers thousands of dollars.

Perhaps more importantly, Bid Manager enables customers to deal directly with a number of Eaton's manufacturing facilities. Using the Internet, customers can remotely submit their product designs along with their order directly to the appropriate facility for production. In the last five years, Eaton has been able to drive productivity rates by 35 percent or more in many of its product lines by giving the customers of Eaton's Industrial and Commercial Controls business the ability to place their orders directly through Bid Manager.

A challenge, however, in managing IT is recognizing when to make specific investment decisions amidst a backdrop of continuous technological change. The pace of change results in a high degree of uncertainty surrounding investments in information technology. The complexity of integrating many individual point solutions from across the company increases the risk.

- **Eaton looks both inside and outside of the company to meet business and IT needs.**

In IT, Eaton's strategy is to retain intellectual property and program management within the firm, but consider development and maintenance of software applications via outsourced arrangements and purchased applications. To make investment and outsourcing decisions, Bullock obtains guidance and advice by:

- Benchmarking with peers and working groups
- Utilizing consultants
- Hiring and maintaining excellent technologists who exercise judgment and intuition when making technology-investment decisions

In hiring, Smith seeks skillsets that bridge IT and core-business competencies, since basic IT skills are increasingly embedded in the professional training of new employees. Future IT talent must be able to identify and articulate a risk-adjusted technology solution to address a business or manufacturing problem. They also need to remain abreast of emerging technologies and their relevance, as well as their risks. Other desirable traits include:

- High tolerance for risk
- Adaptability to change
- Balancing entrepreneurial independence with cross-boundary cooperation

- Analytical problem-solving
- A mindset oriented toward continuous improvement as well as continuous dissatisfaction with the status quo
- Creative approaches to developing solutions

National City Corporation

National City Corp (NCC) is a six-state financial services business with \$100 billion in assets and twelve lines of business (that include banks and credit cards) headquartered in downtown Cleveland. NCC operates in a fast changing banking industry and, according to Jon Gorney, executive vice president, decided three years ago it was underinvesting in technology. At that point the company realized it needed to become far more web-focused and to attract new kinds of employees and skillsets in the IT field. IT now pervades each line of business.

To accommodate its enhanced IT emphasis, the corporation built a new development center 10 miles south of Cleveland, modeled after facilities in Seattle's high tech sector with its foosball and ping pong tables, common spaces, food, and a teaming emphasis. Before building this facility, NCC conducted group interviews and hired 150 recent college graduates from within and outside the region to take on fast-track projects for their online and web-based services. The new employees are diverse in age, lifestyle, and ethnicity.

- **IT is altering NCC's organizational structure and location decisions.**

Some bank functions like check processing must still be done physically, and entail actually moving paper around from bank to bank. Check-processing facilities are therefore located regionally. Immediately after September 11, however, checks could not be moved around nationally, which caused a major disruption. This prompted new thought about check-processing. NCC realized IT could enable check-imaging storage and retrieval that could facilitate virtual processing—and the bank is moving in that direction. Web-based and online banking, as well as other IT innovations, are rapidly changing the way NCC thinks about and conducts many aspects of its business.

Call centers, on the other hand, can be located anywhere and have been for years. NCC has had great success in a small Pennsylvania town where the main manufacturer left. Employees there are very stable and loyal. This contrasts with a call center in Columbus, OH where turnover and wages were much higher. The big change on the horizon is the possibility of outsourcing this function to India. Gorney recently returned from visiting call centers there and found that college graduates work at call centers in India and view this as a long-term career, not a stepping stone to higher position.⁴⁶ NCC believes it may be possible to increase call center skill levels and reduce

⁴⁶ While many Indian call center workers study and adopt regional American accents, the real change needed for their entry into the American help-service market is for them to speak slower. The average Indian speaks 180 words per minute and the average American 120. Call center computers bring up weather and sports team information so there can be banter about local issues during the call.

costs by contracting with Indian providers. Gorney recognizes the impact this would have for the employees in the small Pennsylvania town and other local economies, however—significant factors in making this decision.

NCC already outsources to India software applications support. About 150 programmers work for NCC through a subcontractor; each employee flies to Cleveland for a 90- to 120-day orientation.

In short, IT accelerates the pace of organization change and provides customers more control. NCC is reconfiguring internally by creating a futures group, a process improvement group, and the National City Institute—an internal college that offers training in organizational change and new skillsets.

Key Bank

- **IT allows Key Bank to utilize Internet-based applications for both employees and customers.**

Robert Rickert, executive vice president and CTO, recounted that Key Bank for years made do with an old IBM network that was unable to support Internet applications. Five years ago, in 1997, the company replaced it with a Cisco router-switch system, enabling it to conduct Internet-based transactions for both employees and customers. This has paid off tremendously, laying the groundwork for electronic commerce and banking. Key Bank wants to reduce the number of service employees by getting customers to use online services, ATM machines, or the phone, so that they interact with a bank teller only as a last option. The company is spending money now to create a consolidated enterprise-wide database of customers. This will enable them to target markets with greater precision.

Key Bank also has a high-security virtual private network that enables employees to log onto the network from home or from the road. While telecommuting is an option, Key Bank does not encourage it for all employees. They do encourage it for the sales people, who do not have actual offices or desks, to encourage them to be out with the customers.

- **Innovative IT applications are enhancing Key Bank's security.**

Key Bank has long sought to enhance security, but that priority gained urgency after Sept. 11. Prior to 9/11, Key Bank secured records by backing up computer tapes; by the end of last year, the firm had moved to data mirroring (synchronized writing to disk systems in remote locations for disaster recovery). Today, back-up data is automatically stored at the Key Corp. in Albany, as well as at IBM (with which the company contracts for disaster recovery) in Gaithersburg, MD.

Cardinal Commerce

Cardinal Commerce, a start-up business, provides proprietary software for the financial services and credit card industry that authenticates cardholders and prevents Internet fraud. The 20-person firm resides in an eastern suburb close to its founder's residence. The firm could move elsewhere, but finds it can locate qualified software developers and skilled professionals in the Cleveland metropolitan area.

Science Applications International Corp (SAIC)

Based in La Jolla, CA, SAIC is a \$6-billion high technology science-application concern. The energy division of SAIC is located in a southern suburb of Cleveland.

Jim McCall, senior vice president, echoed the prevailing view that IT pervades every aspect of everyday business activity and compared its ubiquity to a phone or water utility. He offered an example of how IT enables corporate growth through acquisition. When BP acquired Amoco (after Sohio and Castrol and before Arco) it realized cost savings of \$3 to 4 billion after 18 months. Management anticipated such savings and drove SAIC hard to provide the IT needed to achieve them in an 18-month time frame.

- **IT is helping to produce cost savings for the company, and enables greater remote connectivity.**

McCall discussed the promise and applications of wireless technology to achieve savings in operations, and for interconnecting organizations across geography. He described how BP tanker drivers fill up at automated terminals using smart cards, which track the fuel volume loaded, set the delivery schedule, and provide a map to an on-board computer. Information that the company currently transmits between BP stations by private satellite network now travels via the Internet because transactions are now secure. Similarly, wireless Blackberry PDA are providing compact, instantaneous communication between company personnel. One SAIC global executive lives in Atlanta but reports to La Jolla and communicates via Blackberry.

D. Greater Atlanta

Context

Atlanta is located in both Fulton and DeKalb counties in northern Georgia. Greater Atlanta ranked 11th among the country's largest metropolitan areas in 2000, with more than 4 million people. Between 1990 and 2000 the area's population increased by nearly 39 percent.⁴⁷

⁴⁷ U.S. Census Bureau, 2000

Population

In 2000, Atlanta's per capita personal income was \$33,013,⁴⁸ 27 percent above the national average, and the cost of living in the fourth quarter of 2001 was .2 percent above the national average.⁴⁹ Thirty-one percent of people over age 25 in the Atlanta metro area have a bachelor's degree or higher.⁵⁰ Major universities and research institutions in the area include: Emory University, Georgia Tech University, Georgia State University, the University of Georgia, the Medical College of Georgia (Augusta), and Clark-Atlanta University.

Market Overview

The service, government, manufacturing, and retail trade sectors lead the region in employment. Service businesses employ more than a quarter of the workforce, with retail trade providing the next largest share of jobs, at 18 percent of the workforce.⁵¹ In 2002, Atlanta ranked 63rd among the best places to do business in the United States, down from 16th in 2001.⁵² Twelve Fortune 500 companies maintain headquarters in metro Atlanta, including Home Depot, United Parcel Service, the Coca-Cola Company, and Delta Airlines.⁵³

High Technology Industry

With three well-known universities in the area, the emergence of the Atlanta region's substantial high tech sector is not a surprise. The Georgia Institute of Technology generates many technologies that become the basis for startup companies, and the medical research at Emory University has a similar catalyzing effect on biotechnology. Georgia State University contributes to the technology and talent base in the area as well. One of the nation's largest Internet service providers, EarthLink, is headquartered in Atlanta. IBM and Nortel are among the many national technology corporations with a presence in the area. Several venture capital firms support technology development, as do specialized law and accounting firms. The Progressive Policy Institute ranks Atlanta 13th place among the 50 largest metro areas in terms of the overall strength of its technology cluster.⁵⁴

⁴⁸ U.S. Bureau of Economic Analysis, 2000

⁴⁹ ACCRA Cost of Living Index, 2001.

⁵⁰ U.S. Census Bureau, 2000

⁵¹ Georgia Department of Labor, "Georgia Employment and Wages 2000 Averages." See ftp://quicksourc.dol.state.ga.us/Industry_Information/Georgia_Employment_and_Wage/ES202_Publications/2000/ew00.pdf

⁵² Forbes.com and the Milken Institute, "Forbes/Milken Best Places for Business and Careers" (2001 and 2002).

⁵³ Forbes.com, 2001.

⁵⁴ Progressive Policy Institute, "The Metropolitan New Economy Index" (2001).

Company Interviews

Delta Technologies

Delta Technologies is the information technology division of Delta Airlines. The division supports all aspects of Delta's operations, from ticketing to baggage handling and passenger check-ins to maintenance, corporate planning, and accounting. Delta is headquartered in Atlanta, on the edge of the airport, in several multistory brick towers.

- **“Publish and subscribe” technology is improving company operations.**

In a 1998 contribution to LANTimes Online, Philip Gill describes “publish and subscribe” technology as event-driven “middleware” that responds to a change in the status of some object or system and sends out a message providing information about that change. Users who subscribe to information about that object are automatically notified of the change in status. For example, Federal Express uses this technology to inform destination facilities of packages that will shortly be sent their way as bar codes are scanned in a sorting facility. Rather than relying on historical models to predict volume at a destination, real-time information is provided.⁵⁵ Gill notes that this technology permits organizations to integrate separate applications that may be running on different types of hardware/software platforms.

Delta Technologies is one new subscriber to the new technology. Vice President and Chief Information Architect Barbara Sanders indicates that Y2K inspired the company to review its IT systems, and use the necessity of dealing with the Y2K date issues not just for remediation, but for a major system upgrade. The company decided to rebuild its customer interface with new plasma displays that are now in use at the Jacksonville and Atlanta airports, and a new “publish and subscribe” philosophy for providing information to its own employees and to customers. A gate agent can subscribe to a specific flight; various panels then begin to appear on that agent's computer screen, allowing the agent to check on which passengers have checked in, who has boarded, the status of the flight, and so on. This is the “upper-deck” domain; a “lower-deck” domain covers baggage handling, fuel, food services, and airplane cleaning. Events are “emitted” when the system detects state changes.

Customers can subscribe and get updates live on screen or via e-mail, and eventually perhaps on pagers or cell phones, so the system can tell them which gate to go to for a connection. This system integrates a number of formerly separate applications that did not communicate with each other. Once the system was implemented, major cost savings were realized. The airline can now load a 767 in half the time it used to require, and the job is done with half the staff.

⁵⁵ Philip J. Gill. “New twist on an old technique: Publish-and-subscribe services take aim at applications developers.” *InternetWeek with LANTimes*, March 16, 1998. See www.lantimes.com/98/98mar/803bna3a.html (May 2002).

- **New IT systems are forcing integration of work processes.**

Implementing a massive system-change like Delta's requires big changes on the human side as well. All of the work processes involved had been conducted in separate "silos" before; the new IT strategy forced their integration. To accomplish this, a new executive vice president was brought in early on. The IT group started to design the change in 1996 and had it rolled out starting in 1999. The project began by just observing what was going on at gates and asking why things were done in certain ways. Then, as the new system was introduced, the IT group had to get people to change the way they performed certain tasks. The new system was rolled out sequentially in three classes of airports, and Delta was just getting to the third tier airports in 2002. There are many human process changes with a system change this big. Comments Sanders:

You can't just buy a scheduling or accounting package and plug it in and get big cost savings. You have to think through and implement the necessary process changes. The entire business model must be partnered with IT.

Sanders thinks Delta has a few good examples where they have carried out a systems and human process change correctly, and maybe a 100 where they have not. For that reason she expects a lengthy career implementing further system adjustments that will enable further quality improvements and cost savings.

UPS

United Parcel Service, a former bicycle messenger service founded in 1907, now describes itself as a package-delivery business transforming itself into a supply chain solutions company.⁵⁶ The company maintains 1,700 sites around the world where packages are received, shipped, and distributed. Their familiar brown trucks leave these centers on local routes each day, and a large fleet of UPS aircraft flies out of many airports to regional sorting centers.

- **Technology is the key to getting the job done efficiently.**

In addition to delivering the packages, UPS facilitates the flow of goods, information, and funds throughout the world. Its new services include inventory management; post-sales services, such as repackaging for resale and warranty repairs; transportation network management; information technology to inform companies about the status of shipments; customs brokerage; freight forwarding; order fulfillment; and financial services. As these services have been rolled out, the company has undertaken a number of related lines of business. These include marketing hardware and software systems to enable customers to take full advantage of the rich information resources available through UPS IT; consulting to help customers design logistics systems; and

⁵⁶ UPS officials declined to be interviewed for this study. Despite the company's reluctance to allocate any time from its key IT leaders, we felt that the company exemplifies many of the trends that are the focus of the study. The material in this section is therefore derived from the company's annual report for 2001 and the corporate website at www.ups.com.

financial services to enable the transactions that result in goods being shipped via UPS. A Cleveland interview confirmed the appeal of this new strategy at UPS; Parker Hannifin's vice president for international business calls UPS an "unplanned strategic partner" because of its shipping and tracking technology.

In Europe, UPS has entered into a strategic alliance with ChevronTexaco to allow customers to drop off packages at gasoline stations.⁵⁷ This is an experiment akin to Starbucks offering wireless Internet access at coffee stores. Like retailers, UPS is thinking about the routine behaviors of its customers, and finding ways to make it easier for them to choose UPS over competitive services.

- **In choosing its new headquarters location, quality of life was paramount.**

UPS moved its corporate headquarters to Atlanta from Greenwich, CT 11 years ago based on quality of life issues. Greenwich housing costs were too high for many headquarters employees. The company carefully selected Atlanta from competing locations based on the availability of a major hub airport, lower housing costs, and generally high quality of life. One handicap to locating in Atlanta is that there were not a lot of major IT industries in the area, but since the company has IT centers elsewhere, this was not a major stumbling block.

TechLINKS Media

TechLINKS is a magazine based in Atlanta and produced by a company that is a virtual organization linked by IT. The goal of the magazine is to help technology-based businesses prosper throughout Georgia by linking three key segments of society: business, education, and government.

- **Highlighting IT innovations is TechLINKS business.**

TechLINKS helps people network by publishing directories of interested parties from the three key societal segments, and highlighting organizations and individuals doing something innovative with IT. Each small town in Georgia with a local IT alliance will eventually get written up in the magazine, as will small towns with a broadband access projects or an e-business initiative. When one small town's leaders indicated that they had difficulty contacting technology industry leaders and venture capitalists in Atlanta, the editor of the magazine rented a bus, contacted the appropriate public and private sector leaders, and took them to the small town for a networking event.

- **IT keeps TechLINKs employees connected.**

The organization's main office is in Atlanta, but the staff includes four full-time people and 12 part-time employees, and a large stable of independent writers who serve as reporters. These

⁵⁷ Eric W. Pfeiffer, "Friendly Foes." *Red Herring*, April 15, 2002. See www.redherring.com/vc/2002/0415/2271-2.html (June 2002).

collaborators are located in several different cities. The editor stays in contact with the desktop publishing expert and a number of reporters largely through email and a project management application specifically designed for management of virtual organizations. The project management application was developed by a Georgia company that the editor discovered through his relentless networking. The editor says that he may see each staff member in person only a few times per year, and that the software is a tremendous aid in managing a virtual organization.

D. Minneapolis/St. Paul

Context

Minneapolis and St. Paul (the Twin Cities) sit along the Mississippi River in Minnesota. Thirteen counties located in both Minnesota and Wisconsin comprise the Minneapolis-St. Paul metropolitan area. Minneapolis-St. Paul ranked 15th among the nation's largest metropolitan areas, with a population of approximately 3 million.⁵⁸

Population

In 2000, Minneapolis-St. Paul's per capita personal income was \$36,666,⁵⁹ 24 percent over the national average, and the cost of living in the third quarter of 2001 was nearly 9 percent above the national average.⁶⁰ Thirty-eight percent of people over age 25 in the Minneapolis-St. Paul region possess a bachelor's degree or more.⁶¹ Major universities and research institutions in the area include: University of Minnesota, Metropolitan State University, Minneapolis Community College and Technical College, and St. Paul Technical College.

Market Overview

In 2002, Minneapolis-St. Paul ranked 79th among the best places to do business in the United States, down from 50th in 2001.⁶² Fifteen Fortune 500 companies call the Minneapolis-St. Paul metro area home, including Target, U.S. Bancorp, General Mills, UnitedHealth Group, and Best Buy.⁶³

High Technology Industry

The Progressive Policy Institute ranks Minneapolis as the 9th largest center of high tech industry in the United States.⁶⁴ Two of the best known technology companies in the area are Ceridian and Imation, but as the interviews that follow indicate, there are smaller technology

⁵⁸ U.S. Census Bureau, 2000

⁵⁹ U.S. Bureau of Economic Analysis, 2000

⁶⁰ ACCRA, Cost of Living Index, 2001

⁶¹ U.S. Census Bureau, 2000

⁶² Forbes.com and the Milken Institute, "Forbes/Milken Best Places for Business and Careers" (2001 and 2002).

⁶³ Forbes.com, 2001.

⁶⁴ Progressive Policy Institute, "The Metropolitan New Economy Index" (2001).

companies in the area such as Onvoy, and many companies in other industries that are at the frontier in innovative applications of information technology.

Company Interviews

Ellerbe Beckett

- **IT optimizes connectivity among geographically disperse sites and employees.**

Ellerbe Beckett is an architecture firm with about 700 employees at six sites, four in the United States, plus one each in Cairo and Dubai. The company's technology director is standardizing IT systems and equipment across sites so that employees can visit a site other than their home and easily log on and get to work. The IT system also facilitates equipment sharing and moves of equipment.

Collaboration also matters more and more. The firm maintains specialized teams at various sites who get involved in projects housed at other sites. In addition, Ellerbe Beckett employs numerous subcontractors, while the owners or developers of the projects Ellerbe Beckett is working on review plans frequently, so the system accommodates about 2,600 users. The system works so smoothly that clients often think they are dealing with a far larger firm given the range of services and expertise the IT network brings together. Both clients and buildings are getting more sophisticated, making the technology a competitive advantage on projects such as data centers, hospitals, and sports stadiums, three of the firm's specialties.

Web technology enhances collaboration. While the infrastructure demands of web-based collaboration tools are modest, these technologies make international projects possible that would not be otherwise, and all projects work more smoothly. Faxes are not reliable in some countries. People lose copies. But these problems go away once you start sending files over the Internet. Distant teams can work together. Change orders get processed within hours instead of days.

- **The company invests “aggressively” in technology to improve workflow.**

Computer modeling, for example, allows architects and clients to see what a space will look like. Clients find this capacity invaluable. The company tried 3D virtual reality, but the necessary helmets seemed awkward, so it decided to stick with computer monitor displays that everyone finds comfortable. Most architecture firms contract out for computer modeling, and make the imaging available at the end of a project. Ellerbe Beckett, by contrast, has moved the modeling capacity in-house and offers this service as part of the design process rather than just as an add on at the end.

The technology director indicates that floor plans and elevations are the two basic drawing types in architecture, but multiple layers of design data run through every plan. These multiple layers are still not fully integrated; this is the frontier area for IT in architecture currently. In this sense, integrating disparate aspects of a firm's work remains a critical challenge and purpose for IT.

- **Accessing, and accommodating, IT infrastructure still poses challenges.**

Ellerbe Becket's technology director indicates that accommodating new technology in older buildings is difficult. Most of the firm's technically sophisticated clients want new buildings.

Getting the fiber into a building, and getting it lit, poses major problems. The phone company wants to see an opportunity to convert an entire building to fiber, perhaps because a major firm like a Target plans to lease 30 floors. Ellerbe Becket, by contrast, only occupies four floors and can't get fiber-based service even though dark fiber is in the street outside. Ellerbe Becket's difficulty securing the highest broadband services parallels those of Unigard in the Seattle area and TechLinks in Atlanta.

Onvoy

Onvoy is a privately owned IP-based telecommunications company using a fiber optic network to deliver telephony, Internet access, and video services to businesses. The company emerged out of the merger of two prior companies, one focused on communications services and the other on Internet applications. They offer solutions that integrate four key aspects of a business:

- Production
- Inventory
- Process
- Service arrangements

Many businesses modernize the front end of their IT with a graphical interface and don't understand why they don't gain productivity. The key is integrating these four functions well.

- **Onvoy's technology puts customers in charge of systems changes.**

Onvoy's system revolves around an IP network; this architectural choice makes it possible to put customers fully in charge of office changes and modifications of available functions at particular work stations through online menus.⁶⁵ The chief operating officer draws an analogy to fast food chains that hand you a cup to fill with the beverage of your choice. It is more efficient to put the customer in charge of space and function changes than to send out a technician from a telecommunications company who often interrupts the workflow of an organization and cannot participate fully in planning changes. It is also better to make these changes with software rather than physical connections in the old-fashioned communications closets. Online troubleshooting also makes it easier to diagnose and fix problems. Onvoy offers in this respect both an internal system for the company itself and a set of customer services.

⁶⁵ IP refers to "Internet protocol;" IP is a set of rules for moving packets of data across the Internet; each packet contains the sender's and receiver's IP address, thereby allowing gateways or servers to direct each individual packet towards its destination. For more information, see: http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci214031,00.html.

Cities turn out to be big anchor tenants for services like these. By the terms of their contracts, cities can influence the success of competitors. If they buy telecommunications services with a one- or two-year contract and a requirement to accept the lowest price bid, the incumbent provider is the only one likely to succeed. A longer-term contract would be more advantageous to a "next generation" company like Onvoy. This is a very important policy issue for a startup company, and existing policies for public procurement may not have been crafted with the needs and advantages of next generation technology companies in mind.

The State of Minnesota under former Gov. Jesse Ventura provided some incentives for extending services into rural Minnesota. Gov. Ventura also created a Technology Enterprise Board with public and private representatives. Onvoy's CEO sits on this board.

- **Right-of-way access matters intensely to telecommunications companies like Onvoy.**

Another public policy issue affecting telecommunications companies in the Minneapolis region is right-of-way access along the ubiquitous freeways and expressways of the area. Much of the fiber optic network in the region runs along the freeways. Access rights to the right-of-way has become a major policy issue because many companies, both large and small, need to string cable to provide a healthy competitive environment.

Wells Fargo Services

Wells Fargo Services is a check and electronic transaction processing organization. The organization is housed in a nearly 25-year-old building in downtown Minneapolis. It was established to process checks for a multi-state north-central region. The building is "essentially a factory processing widgets," according to a senior executive of the organization.

- **Companies' success depends on forecasting customer preferences as new technologies emerge.**

Wells Fargo must process transactions in whatever medium customers demand. Despite the availability of credit and debit cards for many years, as well as that of several online options, only recently has the volume of checks topped out. Now, the bank has to figure out what investments to make based on forecasts of customer behavior five years out. Already the bank is getting more efficient at processing checks and cheap used equipment is readily available as the entire industry shifts towards electronic payment mechanisms.

The availability of used equipment makes it tempting to continue to improve image-based check processing capacity. However, as customers shift rapidly and permanently to credit, debit, and online transactions, the bank needs to figure out the best way to provide equivalent services in these media. The security requirements, fraud protections, and need for backup copies of individual transactions still exist. Not so far down the road, many more online services will be available, and

bio-security devices such as retinal scanning or fingerprint reading will be in use. The same problem of forecasting what customers will prefer to use will remain.

- **Infrastructure needs and workforce concerns influence the companies' location decisions.**

The center in Minneapolis is one of several in the Wells Fargo system, and several satellite centers support this facility in its north-central multi-state region. The existing telecommunications infrastructure allows a wide set of choices for this kind of center. The bank looks for places with a well-educated, stable, and affordable workforce. When they find such a place, they work hard to keep an operation there even if it means retraining people to take on a different kind of operation.

The center's management worries about several competitive factors in Minneapolis. The unemployment rate remained very low until just recently, and retaining staff may become harder as the economy picks up. Traffic congestion is a problem. And the bank's move toward digital transactions makes the reliability of the power supply a big issue. Uninterruptible power supplies are already backed up by generators, but these backups remain expensive to operate and the firm would greatly prefer to see investments by the local utility to guard against power failures.

The major issue for this facility right now is that the building that houses it does not readily support new technology. For that reason, the unit has decided to move to a suburban location where a new facility can be constructed. Management, however, worries about how many employees will follow the center ten miles out. A number of the current workers do not have automobiles, and must use transit to commute. The company is working with the local transportation agency to create a plan to take advantage of their empty back-hauls, producing a win-win situation for both the bank and the bus operation.