

## **New Logistics Technologies and Infrastructure for the Digitized Economy**

John D. Kasarda, Ph.D.

Director

Kenan Institute of Private Enterprise

Kenan-Flagler Business School

University of North Carolina

Chapel Hill, NC 27599-3440

U.S.A.

### **ABSTRACT**

An increasingly fast-paced electronically-driven era is dramatically changing the rules of industrial competition and regional development. These rules are being shaped by new B2C (Business to Consumer) and B2B (Business to Business) e-commerce strategies emphasizing information management and supply chain networks. With speed and agility taking center stage in the new economy, modern logistics technologies and aviation-based infrastructures have become essential for many firms to compete in regional and global markets. Industrial advantage is being gained by firms that respond flexibly and rapidly to their domestic and global customers, delivering products quickly and efficiently. Development advantage is being gained by countries which fuse digital technology and air commerce through logistical infrastructure that optimizes their position in the global network of information and product flows. Aviation, digitization, globalization and time-based competition are interacting to create a new architecture of competition while positioning international gateway airports as logistical drivers of development. These airports are

generating spatial concentrations of aviation-linked commercial activities that are leading to a new urban form—the aerotropolis. After summarizing the underlying drivers of this new form of development, I provide examples of emerging and likely future aerotropoli around the world.

## 1. The Speed Imperative

A decade ago, futurist Alvin Tofler (1990) argued that by the beginning of the 21<sup>st</sup> century one indisputable law would determine competitive success: *survival of the fastest*. In Tofler's view, producing high-quality goods at competitive prices would still be necessary, but no longer sufficient for commercial success. Speed and agility would take center stage, as industry increasingly emphasized accelerated development cycles; international sourcing and sales; flexible, customized production, and rapid delivery.

How right he was. During the 1990s, the most successful companies used advanced information technology and high-speed transportation to source parts globally, minimize their inventories, and provide fast and flexible responses to unique customers' needs, nationally and worldwide. They sought international partners, just-in-time suppliers and sophisticated distributors and logistics providers. By combining flexible production systems with information systems that connected companies simultaneously to their suppliers and customers, firms reduced cycle times and customized their products to create additional value. They also offered the same speed and flexibility in the delivery process from the time the finished goods left the factory until they arrived at the customer's doorstep.

The rise of eCommerce further heightened time-based competition. As late as 1995, sales through the Internet were essentially zero. By 1999, U.S. Internet-based business-to-consumer (B2C) sales had grown to nearly \$7 billion. According to Forrester Research, 166 million packages were shipped in 1999 by Internet retailers (e-tailers), with approximately 70 percent going by express delivery (Gose, 2000). By 2003, e-tailers are expected to ship 1.1 billion packages annually, with overall global e-commerce approaching \$7 trillion in transactions in 2004 (Forrester Research, 2000).

Most of this explosive growth is expected to be business-to-business (B2B), supply-chain transactions where materials and components will be ordered through the Internet and shipped to next-stage producers. Manufacturers will electronically access an international network of suppliers in order to acquire the best-quality materials and parts at the lowest possible price. The introduction of emarketplaces (auctions, aggregators, bid systems, and exchanges) will greatly expand B2B e-commerce: Forrester Research (2000) predicts that emarketplaces will account for up to three-quarters of B2B supply chain transactions by 2004.

However, as many e-tailers discovered during the 1999 Christmas season, as valuable as the Internet is in generating sales, the Web cannot move a box. Order fulfillment frequently broke down, and the WWW---*world wide wait*--- cost e-tailers plenty.

To meet the imperative of speed in order fulfillment, e-commerce distribution centers are being built at and near airports that have extensive flight networks, a location trend that's sure to accelerate in the decades ahead. Complementing these airport-linked e-commerce fulfillment centers are flow-through facilities for perishables (either in the physical or economic sense), just-in-time supply chain and emergency parts provision centers, and reverse logistics facilities for the repair and upgrade of high tech products such as computers and cell phones. The clustering of such time-sensitive goods facilities around airports is stimulating further expansion of air cargo, air express, less-than-load (LTL) trucking, freight forwarders, and third party logistics providers along major arteries leading into and out of gateway airports. All of these functions and facilities are leveraging off each other.

Speed and agility have become so critical to the new economy that air commerce is quickly becoming its logistical backbone. Forty percent of the value of world trade already goes by air, and the percentage is steadily rising (Kasarda,

1998/1999). Further evidence that we have entered “the fast century” is offered by data showing that nearly two-thirds of all U.S. air cargo is transported via 24- to 48- hour door-to-door express shipments, with the FedEx hub at Memphis becoming the world’s leading air cargo airport (World Airport Week, 2000).

Not only time-sensitive goods-processing and distribution facilities are being drawn to airports. Airports are also becoming magnets for corporate headquarters, regional offices, and professional services that require employees to undertake frequent long-distance travel. Airport access is likewise a powerful attraction to information-intensive industries such as consulting, advertising, legal services, data processing, accounting and auditing, which often send out professional staff to their customers’ sites or bring in their clients by air.

With intellectual capital supplanting physical capital as the primary factor in wealth creation, time has taken on heightened importance for today’s knowledge workers. So has the mobility of these workers over long distances. Research has shown that technology workers travel by air between 60 percent and 400 percent more frequently than those in the general workforce (Erie, Kasarda, McKenzie, and Molloy, 1999).

Some observers have suggested that advances in Internet access, videoconferencing, and other distributed communications technologies will diminish the need for air travel. The evidence indicates that telecommunications advances often promote additional air travel by substantially expanding long-distance business and personal networking. Indeed, innovations in telecommunications technology have generated spatial mobility at least since the days of Alexander Graham Bell--whose first words over his newly invented telephone were, recall, “Watson, come here, I need you.”

## **2. High-Tech and IT Clustering**

In an economy increasingly geared to speed, mobility and global access, frequent and extensive air service has become essential to the attraction of advanced information processing and other high-tech facilities. In the U.S., clusters of high-tech facilities and information technology companies are increasingly locating along major airport corridors, such as those along the Dulles International Airport access corridor in Northern Virginia and the expressways leading into and out of Chicago’s O’Hare International Airport. Dulles’s and O’ Hare’s experiences are being replicated across the country, with airport scale becoming a primary predictor of an area’s high-tech job growth.

Apropos the above, Kenneth Button and Roger Stough (1998) conducted a comprehensive study of the impact of hub airports on employment growth in high-tech fields. Their multiple-regression analysis (which controlled for other factors that may affect high-tech job growth) covered all 321 U.S. metropolitan statistical areas (MSAs) and generated convincing results. Button and Stough showed that the presence of a hub airport in an MSA increases the number of high-technology jobs in the area by over 12,000, and their multiple-regression model explained over 64 percent of the variation among metropolitan areas in high-technology employment growth. Additional analysis revealed that the causal link between job growth and the level of airport services flowed from air transportation to the creation of high-tech employment, and not vice versa. This finding has been corroborated by a study Michael D. Irwin and I conducted which demonstrated that airports have pervasive effects on overall metropolitan employment growth and that the causal relationship flows from extensiveness of air connections to employment growth (1991).

Numerous other studies from around the U.S. and the world are documenting the remarkable impact of airports on urban economies and land use. A sample of these effects:

- In 1999, Los Angeles International Airport (LAX) was responsible for over 400,000 jobs in the five-county Los Angeles region; 80 percent of which were in L.A. County, where one in 20 jobs was found to be tied to LAX. The airport currently generates \$61 billion in regional economic activity, which translates to \$7 million per hour.
- Dallas-Ft. Worth International Airport has become the primary driver of Metroplex's fast-growing economy. The number of companies located within the dynamic Las Colinas area, just to the east of the airport, has expanded to more than 2,000 and includes Abbott Laboratories, AT&T, Exxon, GTE, Hewlett-Packard, and Microsoft.
- In the 26-mile commercial corridor linking Washington, D.C.'s two major airports---Reagan National and Dulles International--- employment grew from 50,000 in 1970 to over 600,000 by 1996. This represents a 1,100 percent increase: in contrast, overall U.S. employment growth during this period was 59 percent. Among the companies located along the airport corridor are America Online, Computer Associates, Nextel Communications, Cisco Systems, and EDS.
- In the Philippines, Subic Bay Freeport is rapidly expanding around a former U.S. naval air base that was converted to commercial use in 1993. Since FedEx located its Asia/Pacific hub at Subic Bay in 1994, over 150 firms---employing 40,000 workers---have located there, generating almost \$2.5 billion in investment. Between 1994 and 1999, the annual value of exports from Subic Bay jumped from \$24 million in to \$559 million. In late 1998, Acer opened its largest personal computer assembly facility in the world at Subic Bay; the facility relies heavily on air freight for its supply-chain management.
- By late 1997, nearly 50,000 people were employed on the airport grounds at Amsterdam's Schiphol Airport, a 7.2 percent increase over the previous year. In 1998, nearly half of the 547 companies linked to Schiphol grew---compared with 31 percent in 1995. Schiphol alone accounts for 10 percent of the European air cargo market and 1.9 percent of Netherlands' GNP; the airport forecasts that by 2015, it will generate 2.8 percent---approximately \$14 billion.

The impact of airport-induced job growth on land use in the vicinity of airports is substantial. An analysis of employment growth in the suburban rings of U.S. metropolitan areas showed that areas within four miles of airports added jobs two to five times faster than the overall job-growth rate of the suburban ring within which the airport was located (Weisbrod, Reed, and Neuwirth, 1993). Most of the employment was concentrated around the airport or along a major access corridor within 15 minutes of the airport.

### **3. The Rise of the Aerotropolis**

Emerging corridors, clusters, and spines of airport-induced businesses are giving rise to new urban forms as much as 15 miles from major airports. These represent the beginnings of the aerotropolis. In response to the new economy's demands for speed and reliability, the aerotropolis is based on low density, wide lanes, and fast movements. In other words, form is following function.

Although aerotropoli have so far evolved largely spontaneously---with previous development often creating arterial bottlenecks---in the future they will be improved through strategic infrastructure planning. For example, dedicated

expressway links (aeroplanes) and high-speed rail (aerotrails) will efficiently connect airports to nearby and more distant business and residential centers. Special truck-only lanes will be added to airport expressways, as well.

The new metric for determining land value and use (and corresponding urban structure) will be time-cost access to the airport. Firms of various types will bid against each other for accessibility predicated on the utility each gives to the related combination of time and cost of moving people and products to and from the airport.

To many, this new structure will appear simply as additional sprawl along main airport corridors. Yet the aerotropolis will actually be a highly reticulated system based on time-cost access gradients radiating outward from the airport; in short, the three "A's" (accessibility, accessibility, accessibility) will replace the three "L's" (location, location, location) as the most important commercial real estate organizing principle.

Air-commerce clusters and spines are already taking on distinct spatial form around international gateway airports such as New York's Kennedy, Los Angeles International, London's Heathrow, Paris's Charles de Gaulle, and Amsterdam's Schiphol. In the United States, even smaller, specialized air-cargo airports--such as Alliance Airport, near Ft. Worth, Texas, and Rickenbacker Airport, in Columbus, Ohio--are generating mini-aerotropoli in the form of low density cluster and spine development. Commercial growth surrounding Southern California's Ontario Airport---which cornerstones a major logistics complex 40 miles east of Los Angeles, offers an excellent contemporary illustration of an aerotropolis in evolution. In Brazil, one can observe an emerging aerotropolis centered around Viracopos Airport in Campinas, located 60 miles east of Sao Paulo, where high tech and logistics industries are clustering.

Aerotropoli are also emerging in distinct patterns around new international airports in Asia. One example is Lantau Island, where the newly opened Hong Kong International Airport is spawning highly visible business and residential clusters directly linked to the airport. In late 1999, the Walt Disney Company announced that it would locate its third international theme park (Hong Kong Disneyland) on Lantau Island to take advantage of the international airport and its high-speed rail and expressway links to Hong Kong. This siting decision is not unlike those Disney made earlier for Tokyo Disneyland, near Narita International Airport, and EuroDisney, near Paris's Charles de Gaulle Airport.

A major planned aerotropolis is under development at Incheon, Korea, where the government is creating a 24-hour aviation city on Yongjong Island, about 40 miles west of downtown Seoul. The new international airport (scheduled to open in 2001) will anchor an expansive urban agglomeration composed of commercial, industrial, residential, and tourism sectors. Its centerpiece will be Media Valley, Korea's version of Silicon Valley. Designed as a center for global high-tech industries, Media Valley is being constructed adjacent to the airport on a 3.6-million-square-meter site that will include a large techno-park and a university research center.

As of mid-1999, 625 companies---including 49 companies from Canada, Israel, Japan, The Netherlands, Taiwan, and the United States, among others---had submitted letters of intent to move into Media Valley. Arthur D. Little predicts that by 2003, a total of 1,300 companies will be located in Media Valley's campuslike setting, and by 2005 slightly over 2,000 (Business Korea, 2000).

A new town is being developed to serve as a residential base for those employed at Media Valley and in other sectors of this emerging aerotropolis. Dedicated expressways will give both Media Valley employees and the new town residents high-speed access to Incheon Airport.

By 2004, the airport, currently nearly 90 percent complete, will be complemented by a seaport and a teleport now under construction. The plan is to form a consolidated “triport” for 21<sup>st</sup> century transportation, distribution, and information processing.

An even more ambitiously planned aerotropolis radiates northward from the Kuala Lumpur International Airport in Malaysia. This massive new airport will provide the aviation foundation for Malaysia’s Multimedia Super Corridor (MSC), a high-tech government, commercial, education, and residential zone about the size of the city of Chicago. Promoted internationally as the future information technology center of Asia, MSC will contain two new cities (Putrajaya, the relocated government capital, and Cyberjaya, or Cyber-city, each of which will house about a quarter of a million residents), along with a multimedia university to train IT workers. MSC’s advanced infrastructure will be complemented by laws and policies designed to create the ideal commercial environment for developing and merging 21<sup>st</sup>-century audio, video, and data transmission technologies.

#### **4. The Fifth Wave of Development**

Hong Kong’s Lantau Island, Malaysia’s Multimedia Super Corridor, and South Korea’s Incheon-Aviation City demonstrate that airports will cornerstone dynamic new forms of 21<sup>st</sup> century urban and regional development. Put in historical perspective, they really represent the fifth in a continuum of transportation infrastructure-induced development waves that have catalyzed and shaped commercial development over the centuries.

The world’s first great commercial centers grew up around seaports. The next wave of economic development occurred along networks of rivers and canals that formed the backbone of industrial revolutions in Europe, the America’s and Asia. Railroads generated a third wave of economic development as they opened up inland areas to manufacturing and trade: major goods processing and distribution centers emerged at rail hubs and terminal points. For example, in the U.S., the South’s largest city, Atlanta, first developed as a railway hub and was originally known as Terminus.

The fourth wave of economic development was fostered by the shift to cars and trucks to move people and goods. Freeways, beltways, expressways, and interstate highways generated a massive dispersion of housing and firms. Large suburban malls and commercial centers, industrial parks, and office complexes sprouted as far out as 70 kilometers from major city centers. Some of these fourth-wave “edge cities” now have more retail and office space than the downtowns of their metropolitan areas.

As I noted above, we have already commenced the fifth, and perhaps most opportune economic era – The Fifth Wave – where aviation, digitization, globalization, and time-based competition will predominate. The combined thrust of these interacting forces is creating and shaping new economic growth nodes, as gateway airports supplant seaports rail, and highway systems as logistical drivers of development and as primary job and wealth generators.

This is all happening because companies have learned that they cannot meet the challenges of the speed-driven, globally networked economy without dramatic changes in how they organize their flows of information, materials and finished goods. Digitized infrastructures and air logistics have become central to their strategies as they leverage the power of information networks and global supply chains to their competitive advantage. Governments, too, are recognizing that in order to help their industries complete, boost exports, and attract foreign investment they must provide modern logistics infrastructures that enable local and regional firms to rapidly and flexibly source and sell on the global stage.

Thus, whether it is futurists such as Alvin Toffler or leading economists and management professionals such as Lester Thurow and Peter Drucker, and, whether they are talking about enterprises or nation-states, they are all saying the same thing: logistics is the next frontier of competition. Strategic advantage will be gained by those companies and development advantage by those countries that fuse digital technology and air commerce through logistical infrastructure that optimizes their position in the global network of information and product flows.

## 5. References

Business Korea (1999), "Miracle on Han is Moving Down River: Incheon Nurtures its Strategic Central Location," July, pp. 18-22.

Button, Kenneth, Stough, Roger (1998). "The Benefits of Being a Hub Airport City: Convenient Travel and High-Tech Job Growth," (Fairfax, VA: The Institute of Public Policy, George Mason University) November.

Erie, Steven P., Kasarda, John D., McKenzie, Andrew, Molloy, Michael A. (1999). "A New Orange County Airport at El Toro: Catalyst for High-Wage, High-Tech Economic Development," (Irvine, CA: Orange County Business Council) September.

Forrester Research (2000). *E-Marketplaces Will Lead US Business eCommerce to \$2.7 Trillion in 2004*, Cambridge, MA.

Gose, Jose (2000). "Thanks to E-Commerce, Warehouses Aren't Just for Storage Anymore," *Barron's*, March.

Irwin, Michael D., Kasarda, John D. (1991). "Air Passenger Linkages and Employment Growth in U.S. Metropolitan Areas," *American Sociological Review*, August, 56(4): 524-37.

Kasarda, John D (1998/1999). "Time-Based Competition & Industrial Location in the Fast Century," *Real Estate Issues*, Winter Issue, pp. 24-29.

Neuwirth, Roanne M., Reed, John S., Weisbrod, Glen E. (1993). "Airport Area Economic Development Model," (paper presented at the PTRC International Transport Conference, Manchester, England.

Toffler, Alvin (1990). *Powershift: Knowledge, Wealth, and Violence at the Edge of the 21<sup>st</sup> Century*.

World Airport Week (2000). "Traffic Continues to Increase at World's Airport," May, p.5.

### **BRIEF BIOGRAPHY OF THE AUTHOR:**

**JOHN D. KASARDA** is Kenan Distinguished Professor of Management at the University of North Carolina's Kenan-Flagler Business School where he also directs the Kenan Institute of Private Enterprise.

[John\\_Kasarda@unc.edu](mailto:John_Kasarda@unc.edu)

