

Abstract

With trade policies liberalized and new international markets opened, commercial aviation and airport-centric economic development (i.e., aerotropolis development) are expanding concurrently. Aerotropolis planning principles are put forth that will generate “economies of speed” and boost aviation-enabled trade in goods and services via improvements in airport area connectivity, people and product mobility, and land use. Emphasis is on reducing ‘last mile’ costs and improving logistics efficiencies by integrating aerotropolis surface transportation planning and commercial site planning to create competitive advantages for airports and the businesses and regions they serve.

Key words: Airports, Aerotropolis, Cities, Logistics, Planning, Trade

Planning a Competitive Aerotropolis

John D. Kasarda and Stephen J. Appold

Introduction

A new strategic approach to airport area development enhancing business and metropolitan competitiveness is gaining prominence around the world. This is the aerotropolis model.¹

Simply put, an aerotropolis is an urban sub-region whose infrastructure, land-use, and economy are centered on an airport. Its primary value proposition is that it offers businesses speedy connectivity to their suppliers, customers and enterprise partners nationally and world-wide, increasing both firm and regional efficiency. Aerotropolis firms, many in the high-tech and advanced producer (business) service sectors, are often more dependent on distant suppliers, customers, and enterprise partners than those located in their own metropolitan region.

By providing globally-oriented, time-critical firms with rapid long-distance accessibility, the aerotropolis helps them cut costs, increase productivity, and expand market reach, thereby becoming more competitive and participating more effectively in the international division of labor. Metropolitan region trade in higher-value goods and services is likewise accelerated and broadened through expanding airline routes which operate as a “Physical Internet” moving products and people quickly

¹ See www.aerotropolis.com and its publications links.

around the world analogous to the way the digital Internet moves data and information. An illustration of the Physical Internet is shown in Figure 1.

Insert Figure 1 about here

The routers of this Physical Internet are airports which are the concrete interfaces where the global meets the local in people and product movements. Their dual roles as airline routers and global-local interfaces are making airports business magnets and regional economic catalysts as they attract, sustain, and grow aviation-enabled firms in their environs.

By 'aviation enabled' we mean firms and industries that are able to operate primarily because of the connectivity afforded by passenger and air cargo transport. Hub airports which offer a greater choice of flights and destinations, more frequent service, and more flexibility in rescheduling (that is, they possess the fastest and broadest Physical Internet) have become particularly powerful assets to such firms and urban regions that depend as much on "economies of speed" as others do on economies of scale or economies of scope.²

The aerotropolis also contains the full set of logistics and commercial facilities that support aviation-enabled businesses, cargo, and millions of air travelers who pass through the airport annually. These include, among others, freight forwarding, third-party logistics (3PL), warehouse and distribution facilities, hotels, recreation,

² Kasarda, John D. "Aerotropolis: Business Mobility and Urban Competitiveness in the 21st Century" in *Cultures of Mobility* edited by Klaus Benesch (Heidelberg: Heidelberg University Press, 2014) John D. Kasarda and Greg Lindsey, *Aerotropolis: The Way We'll Live Next* (New York: Farrar, Strauss, and Giroux, 2011), John D. Kasarda, "Time-based Competition and Industrial Location in the Fast Century", *Real Estate Issues* 23, No. 4, pg. 24-29, Winter 1998/1999.

wellness, convention and exhibition complexes, and office buildings along with shopping, dining, leisure, entertainment and tourism venues.

In addition, the aerotropolis is attracting a range of producer service firms whose executives and professionals frequently travel to distant sites or who bring in their clients by air for short-term meetings. Included here are firms in such sectors as auditing, architecture and engineering, consulting, international finance, and marketing. Corporate headquarter functions are likewise moving to airport areas either physically in office complexes or by using airport area 4-and 5-star hotels as virtual corporate headquarters where widely dispersed executives fly in for sales meetings, board meetings, and high-level decision-making³. This optimizes long-distance connectivity while minimizing local ground transport times and costs.

With increasing numbers of the above sets of aviation-oriented businesses and commercial service providers clustering around airports, these areas are becoming leading urban growth centers where air travellers and locals alike work, shop, meet, exchange knowledge, conduct business, eat, sleep, and are entertained often without going more than 15 minutes from the terminals. An airport city evolves on and immediately around the airport serving as the multimodal, multifunctional central business district of the aerotropolis, anchoring aviation-enabled trade in goods and services and driving them throughout the metropolitan region.

Spatially, just as the traditional metropolis is made up of a central city and its commuter-linked suburbs, the aerotropolis consists of an airport city at its core and

³ John D. Kasarda, "Airport Cities: The Evolution" *Airport World*, pp. 24-27, April/May 2013.

extended corridors and clusters of aviation-linked businesses and their associated residential developments. Some of these clusters can be observed up to 20 miles (32 kilometers) from the busiest hub airports with significant economic impacts measured up to 60 miles (96 kilometers).⁴

A compressed schematic of the Aerotropolis with its airport city core is shown in Figure 2. No aerotropolis will look exactly like this illustration but many will eventually take on similar features, led by newer 'greenfield' airports less constrained by numerous prior decades of non-aviation oriented surrounding development.

Insert Figure 2 about here

The aerotropolis is thus much more a dynamic, forward-looking concept than a static, cross-sectional model where present form often reflects historic airport-area development well before aviation and airports took on their current economic functions. Its future development will be driven by further global integration and the need for speed both fostered by the continuing expansion of air routes. The upshot is that airports will shape business location and urban economic development as much in the 21st century, as highway exchanges did in the 20th, railway terminals in the 19th, and waterborne ports in the 18th. Their impact will be wider and deeper, locally and globally, as the 21st century progresses.

Building on the above context, this article offers aerotropolis planning principles that will generate greater efficiencies in airport area mobility, land use, and community development to the benefit of airports, people, firms, and regions.

⁴ John Bonnat, "Airport Edge City Development" presented at Aerotropolis Americas Conference, Dallas-Ft. Worth Airport, October 31, 2013. Mike Rosa and David Berzina, "Catalytic Effects of the Aerotropolis" presented at Aerotropolis Americas, Dallas-Ft. Worth Airport, October 31, 2013.

Following an elaboration of the aerotropolis development model, we discuss how coordinating aerotropolis surface transportation planning with commercial land use planning can facilitate trade and create additional competitive advantages for airports and the businesses and regions they serve. We then elaborate upon the value propositions aviation, airports and the aerotropolis provide regions and their firms, largely by optimizing time-cost accessibility. Our overarching thesis is that by fostering economies of speed, where time is not only cost but also currency, the value propositions of aviation, airports, and the aerotropolis are enhanced.

The Skeleton and Muscle of the Aerotropolis

Stripped to its basics, the aerotropolis is composed of three analytically separable but interdependent elements. Its *spatial* elements consist of aviation-oriented businesses and associated residential developments that concentrate near the airport and outward along its transport corridors generating physically observable form. Its *functional* elements include the spatial elements as well as businesses and business people who may be widely dispersed throughout the metropolitan region or clustered many miles from the airport, but nonetheless are highly dependent upon it for fast access to their distant suppliers, customers, or enterprise partners. Its *connectivity* elements are air routes along with highways, rail systems, and surface linkages to ports that provide the aerotropolis with internal and external accessibility.

Taken together, the connectivity, spatial and functional elements form the skeleton and muscle of the aerotropolis affecting mobility, investment, and

development efficiencies. Mobility efficiency requires that transportation infrastructure be planned and implemented so that it facilitates movements of people and products throughout the aerotropolis and to and from external markets. Investment efficiency requires that aerotropolis commercial facilities respond to unmet economic needs and local real estate market demands. Development efficiency requires that these facilities be located so that they result in highest and best use of various aerotropolis land parcels which both leverage and are leveraged by the airport and its connecting surface transportation infrastructure.

Basic principles that apply to commercial real estate investment in general apply to airport city and broader aerotropolis commercial development. Yet, some specific principles are especially germane to planning and developing airport cities and the aerotropolis.

1. Airports cities and their extended aerotropolises are not simply major capital investments which must deliver positive financial return over many decades. They are also major “public goods.” Therefore, careful long-term planning is called for to ensure maximum value is created for users, investors, nearby communities, the metropolitan region, and the nation.
2. Airport city and aerotropolis development is part of a broader investment and commercial location system. Airport city and aerotropolis planning must be cognizant of the direction of local urban development and competing facilities in the region. Sites in the path of outward urban development from the central city will typically benefit while alternative sites in the region may

compete with them for commercial facilities investment. In some cases, sites external to the region may compete, as well.

3. Aligning key stakeholders is essential for successful aerotropolis

development. Aerotropolis development is a fundamentally collaborative venture among land owners, investors, developers, and infrastructure and aviation service providers, including government bodies and airlines.

Therefore, aerotropolis planning needs to understand not only the potential costs and market considerations which may influence the location decisions and facility investments of potential aerotropolis businesses, but also how government and airline decisions may impact these investment and location decisions.

4. Regional economic conditions and real estate market demands shape the development pace and characteristics of each airport city and aerotropolis.

Since form follows function, both airport commercial property planning and greater aerotropolis facility planning should be coordinated and supported by an ever-improving analysis of unmet regional business needs and local real estate demand in order to manage investor risk and to better position airport city and aerotropolis offerings. Aerotropolis planning is not only urban planning; it is also economic planning based on business logic. It has been our experience that airport commercial facilities and aerotropolis development projects underpinned by solid documentation of market demand usually get funded and prosper. Careful assessments of market conditions, investment

risk, and regional competitors are necessary prerequisites all too often overlooked in airport city and aerotropolis master plans.

5. In the aerotropolis model, the 3A's (accessibility, accessibility, accessibility) supersede the 3L's (location, location, location) as the pertinent commercial real estate development principle. With time, on the one hand, being cost and, on the other, currency for many aerotropolis businesses, minimizing time-cost access to the airport and other critical metropolitan nodes is a primary objective of efficient aerotropolis planning.
6. A successful airport city and aerotropolis will build on evolving economies of speed, scale, and scope in providing benefits to tenants, users, investors, businesses, and the region. Yet, those economies usually only fully exist at or near development maturity. Therefore, both urban and airport planners and managers need to construct development pathways which will generate shorter-term investment returns and continued infrastructure improvements through the earlier stages of airport commercial property and greater aerotropolis growth.
7. Aerotropolis residential communities housing airport area workers and frequent air travellers should be developed that are welcoming, provide a sense of place, and offer on-site or nearby services and urban amenities appealing to modern life-styles. These communities should be built outside flight paths but in proximity to aerotropolis job clusters and surface transportation (including public transport) to reduce commute times and costs.

8. Aerotropolis development and “smart” urban growth can and should go hand-in-hand. Redensification around airports and planned cluster development outward can be an antidote to sprawl and other haphazard development that detracts from airport area functionality, sustainability, and image.
9. The ultimate success of the aerotropolis rests on the aviation-enabled advantages it provides to firms and the value it brings to regions and their residents. These will be measured primarily in terms of business revenues, aggregate regional wealth, and quality of life generated.
10. Getting the aerotropolis right will require integrating airport planning, urban planning, and business site planning. In absence of such integrated planning, the aerotropolis will not be as economically efficient, attractive, or as environmentally and socially sustainable as it might be.

In later sections we elaborate these planning principles and guidelines. We will also introduce additional principles and guidelines to facilitate aerotropolis mobility, investment, and development efficiencies that will improve trade and the competitiveness of firms and regions. But first, let us explicate the path, process, and spatial context of aerotropolis development.

Spatial Evolution Patterns

Aerotropolises are unavoidably components of broader regional spatial development. Leveraging the airport's geographic position with respect to

metropolitan spatial evolution can generate more appropriate (and profitable) commercial development on and around the airport.

Two unfolding land-use patterns offer important orientations for airport city and aerotropolis planners. The first relates primarily to the commercial growth of the airport. The second to the path of broader urban development.

As is illustrated in Figure 3, airport cities grow outward from the passenger and cargo terminals as the levels of passenger and cargo traffic induce greater numbers and sizes of facilities to meet expanding volumes of activity, exhausting available terminal space. With air traffic growth, increasing numbers of commercial and logistics support activities achieve threshold levels and some of those activities can profitably exist further away from passenger and cargo terminals. Rising air traffic volume acts as an attraction in itself, drawing additional commercial and logistics functions to the airport area.

Insert Figure 3 about here

A list of common airport, airport city and aerotropolis commercial facilities is provided in Figure 4. These are organized by whether the facilities are people or goods oriented and by typical location including in or near the terminals (airside); landside, on or adjacent to the airport property (Airport City) and further beyond the airport boundaries (Aerotropolis). As one progresses outward from the terminals to the airport city to the aerotropolis, most facilities in the inner zone are replicated in the broader zones, frequently at a larger scale.

Insert Figure 4 about here

Every airport city and aerotropolis unfolds differently over time, depending upon their airline routes, passenger demography and volume, cargo demand, airport and airport area land availability, surface transportation infrastructure, regional industry structure and economic conditions, local labor resources, real estate markets, and other factors. Therefore, the mix and location of commercial facilities can vary significantly as can airport city and aerotropolis physical form.

At the same time, because airport cities and aerotropolises are parts of broader spatial-economic entities, the path of urban development will have a significant effect on the timing, nature, and process of airport city and aerotropolis development. Figure 5 illustrates a prototypical order of urban development from the city outward toward the airport responding to the magnetic pull of aviation.

Insert Figure 5 about here

While airports often exert a substantial gravitational pull on firms making location decisions, so do many other factors, including a need for access to the metropolitan area's central business district. Office buildings, business parks, and airport edge cities thus develop along major highway corridors linking the metropolitan central city to the airport, allowing tenants access to the airport as well as needed inputs the central city offers to their business processes.

Such development may even "leapfrog" the airport to underutilized land on its other side, accelerating the outward aerotropolis growth pattern illustrated in Figure 5. This often results in a concentration of urban white-collar functions in the airport area as is the case for Amsterdam Schiphol, Chicago O'Hare, Dallas-Ft. Worth, and Washington Dulles. Chicago's O'Hare area has the second largest

concentration of Class-A office space in the entire U.S. Midwest and the Washington Dulles region has more private sector office space than the District of Columbia.

Corporate headquarters are especially gravitating to airport areas. More than 50 percent of Fortune 500 corporate headquarters are located within 10 miles of U.S. hub airports. This compares to 29 percent of all business establishments.⁵

Major hub airports located greater distances from the metropolitan downtown tend to generate significant employment clusters of their own. Fostered by these clusters, Chicago O'Hare Airport has 450,000 jobs within a radius of 5 miles; Dallas-Ft. Worth 395,000 jobs, and Washington Dulles almost 240,000 jobs.⁶

Newer gateway airports are almost always located on the periphery of the metropolitan area as they replace older ones closer to the downtown that are unable to expand. This frequently leads to complaints about surface travel time to the new airport from the downtown and elsewhere, especially if the airport opens prior to the completion of connecting expressways and passenger rail. Yet, with air routes functioning as the economic driver and the airport as the physical interface of the global meeting the local, airport city and aerotropolis development processes commence at and around the new airport, often organically.

To paraphrase Dutch planners who have studied these processes: (1) the airport leaves the city, (2) the city follows the airport, (3) the airport becomes a city, and (4) an extended aerotropolis emerges outward from the airport city. This will be

⁵ Stilwall, Justin D., and John Hansman. *The Importance of Air Transportation to the U.S. Economy: Analysis of Industry use and Proximity to Airports*. ICAT-2013-03 Vol. Cambridge, MA: MIT International Center for Air Transportation, May 2013.

⁶ Stephen J. Appold and John D. Kasarda, "The Airport City Phenomenon: Evidence from Large U.S. Airports" *Urban Studies*, 50, (6) May 2013, pg. 1239-1259.

the likely evolutionary path of a number of newer airport hubs such as Denver, Guangzhou, Incheon, Kuala Lumpur, and Munich.

It is important to recognize that preferred metropolitan residential locations (“favored quarters”) in proximity to the airport or with good transportation access can have a substantial impact on both airport city and aerotropolis success because they appeal to nearby higher-income workers while reducing their commuting time and costs. Thus, where feasible, planners and developers should site executive-quality housing complexes near the airport (but outside high noise contours), that include extensive commercial and public service amenities. This may prove to be a strategic mechanism for attracting "white collar" facilities (such as office buildings for managers, executives, and professionals) to the airport area.

Regarding these amenities, planners and developers always need to be aware that for economic activities less tied to aircraft movement, competing locations in the metropolitan region are usually available, some far more appealing to lifestyles of younger managers and professionals than a typical airport area. This is why quality mixed-use housing developments near airports containing good schools, upscale shopping, fine dining, vibrant night life, and cultural and leisure venues could well be a differentiating competitive factor for the airport area attracting “white-collar” and other knowledge-intensive workplaces.

Local labor supply has also been shown to be a critical factor in airport city and aerotropolis development. Airport cities and aerotropolises such as Helsinki, Hong Kong, and Incheon have been able to overcome an initial local labor supply disadvantage by carefully controlling commercial land prices, ensuring adequate

commuter transportation, and by providing desirable housing close to the airport at attractive prices. Some airport area residential developments even subsidize community public amenities in order to attract higher income workers and tenants (as did Gale International's strategy to attract workers and tenants to its US \$35 billion New Songdo City development near South Korea's Incheon International Airport). Other large commercial real estate development projects have found it necessary to subsidize initial anchor facilities that bear a greater portion of investment risk by being pioneers. Subsequent follow-on commercial tenants can compensate for foregone initial revenues that were necessary to seed early-stage commercial facility development.

We will return to this when we address firm site selection decisions. Suffice it to reiterate that commercial facilities that will make up the airport city and greater aerotropolis cannot be planned independently from metropolitan region land-use and development patterns. Nor can commercial facility investments by airport management or aerotropolis site developers be planned independently of potentially reinforcing or competitive facilities elsewhere in the region, since these other facilities may either support or detract from such investments. Uncoordinated investments such as multiple convention and exhibition complexes can split demand, possibly resulting in neither venture being viable. Coordinating broader land use planning with transportation planning is likewise crucial for efficient, sustainable aerotropolis development.

Coordinating Land-Use and Transportation Planning

Apropos the above, the U.S. Federal Aviation Administration defines an aerotropolis as a 'planned and coordinated multimodal freight and passenger transportation complex which provides efficient, cost-effective, sustainable, and intermodal connectivity to a defined region of economic significance centered around a major airport.'⁷ Aerotropolis planning therefore spans commercial land use and transportation planning in concert with urban planning.

More specifically, aerotropolis planning includes reconciling (1) the business site and profitability objectives of individual firms making capital investments, (2) airport and surface transportation planning objectives of ensuring maximal access to the airport and business sites at the lowest possible cost, and (3) the urban planning objectives of overall economic efficiency, aesthetic appeal, and social and environmental sustainability. With respect to transportation planning, aerotropolis planning also includes designing systems for efficient, secure cargo logistics and for efficient, safe personal mobility.

Figure 6 illustrates the golden ring of Aerotropolis planning which crosses (and integrates) airport, urban, and business site planning domains. Aerotropolis planning is unique in that business, urban, airport, and surface transport objectives are addressed together to foster personal and logistics mobility along with economically and socially desirable urban development. Such integrated planning can serve as an antidote to the chaos, congestion and unsightliness that has resulted from organic, haphazard development around so many major airports, detracting from the operational functionality and image of these areas.

⁷ Paraphrased slightly from [112nd] H.R.658 : FAA Air Transportation Modernization and Safety Improvement Act, 2011.]

Insert Figure 6 about here

Integrated surface transportation planning near the airport is particularly important because people and product air journeys neither begin nor end at the passenger and cargo terminals. Passengers and cargo often spend considerable time and expense in getting to and from airports and in negotiating immediate airport area obstacles, creating “last mile” and “terminal” costs. Terminal costs refer to the time, money, and effort required for travelers and shipments to make their respective ways through the airport. “Last mile” costs refer to the time, money, and effort required for travelers and shipments to make their respective ways to (or from) the airport.

Because “terminal” and “last mile” costs can be substantial whereas the marginal costs of flying an extra mile are often insignificant, airports and surrounding areas which successfully minimize these costs are often able to enhance operational efficiencies and therefore their attraction as a location for business investment.

Aerotropolis planning thus differs from conventional airport and urban planning by considering “inside the fence” terminal, mutually beneficial “outside-the-fence” development, and “last mile” costs holistically. We learned years ago that the battle for air freight – and therefore the success of firms using air freight – is increasingly won on the ground through good surface accessibility and accelerated customs clearance processes at the airport.

The same is true with passenger travel. For example, in the United States, more than half the time spent on air travellers’ journeys between Chicago's

downtown and New York City's downtown is often spent on the ground, stuck in freeway gridlock, terminal congestion, or backed up on airport taxiways.

“Last mile” road congestion near the airport (and downtown) can create especially adverse air-journey conditions. Particularly for flights of moderate length—the most common trajectory for air travel—such delays are not only onerous but they can also significantly impact the competitiveness of local firms and decrease a city's economic and residential appeal. This is why many shippers, freight forwarders, business service providers, and frequent air travelers are increasingly making location and travel mode choices on the basis of the time and cost of the entire (surface and air) journey.

That reality reveals a serious shortcoming of most airport area planning. Although integrated land use and transportation planning is a valued ideal, in practice, that ideal is often not achieved. While the aerotropolis represents the functional integration of the airport, its airlines, surrounding municipalities and the broader region, master planning all too often remains silo-ed (fragmented) in airport planning, air route planning, surface transportation planning, and land-use planning at various local government or territorial levels. Far less than optimal outcomes result for the airport, airlines, surrounding municipalities, and the broader region.

Integrating airport planning, surface transportation planning, and commercial land use planning is important for aesthetic as well as for efficient operational outcomes. First, the appearance of the airport and its immediate environs sets the initial and the final impressions of many distant travelers not just to the airport area and nearby municipalities, but also for the entire metropolitan region. Marketing

and place-making impacts of these visual impressions are huge. Second, as previously noted, virtually all air journeys are intermodal with the first and last legs almost always via a surface mode affecting the total time and cost of the journey. Third, surface infrastructure helps anchor air cargo users and other airport-oriented businesses acting as spatial organizers much as did docks for sea going ships and railroad terminals in earlier eras. As a result,

- Appropriate airport and airport area land-use planning can increase the efficiency of passenger and cargo flows and improve the appearance and property values of the airport and its surrounding territory.
- Improved road and rail infrastructure can expand the catchment area of the airport, attracting more passengers and cargo thereby supporting more flights which drive aerotropolis development.
- Freight rail intermodal facilities connected to ports can anchor logistics and cargo-dependent firms. Some of these also have air transportation needs, creating a possibility for cross-modal subsidization.
- Seamlessly integrated multimodal air infrastructure can support the region's growth of high-tech manufacturing and modern business services thereby diversifying and strengthening its economy.
- Commercial development on airport property can generate substantial non-aeronautical revenues allowing airport management to support continuous terminal upgrading and infrastructure improvement while keeping its costs to airlines competitive through commercial revenue cross-subsidization. Approximately half the total revenue of major airports today comes from nonaeronautical sources.
- Commercial and logistics development beyond the airport can also generate additional passengers and cargo while providing amenities to air passengers and value to cargo processing. The latter two can influence the choice of an airport as a passenger and cargo transit hub.

- Aerotropolis commercial and logistics development, if properly planned, clustered, and supported by more efficient surface transportation infrastructure, can provide the metropolitan region with new economic growth nodes which attract investment, create jobs, and contribute to redensified land uses that counter sprawl.⁸

When combined, the above outcomes can go a long way to enhancing the airport's benefits for its users, surrounding communities, and the metropolitan region. The ultimate success of the aerotropolis model, however, rests on the value proposition it provides to metropolitan regions and site advantages it offers firms. This is its economic and business logic.

The Aerotropolis Value Proposition

Successful development of the aerotropolis –that is, the spatial and functional orientation of economic activities to commercial aviation- depends on the ability of air transport to increase wealth. With the world’s economy shifting into fast forward as it further integrates, commercial aviation is performing a critical role in bringing substantial opportunities for wealth creation not only to many firms but also to many places.⁹

Air transport allows firms to take advantage of distant resources they otherwise could not and specialize in their comparative strengths. Trade in goods and services increases global and regional wealth by expanding export multipliers and by allowing regional resources to be used more efficiently.

⁸ See Aerotropolis planning principles on www.aerotropolis.com

⁹ Cristea, Anca D. Buyer-seller relationships in international trade: Evidence from U.S. states' exports and business-class travel. *Journal of International Economics* 84 (2) (7): July 2011. 207-20.

Commercial aviation creates efficiencies for firms and their regions by reducing the costs of long-distance connectivity, mainly by economizing on time. The aerotropolis leverages these efficiencies locally and regionally. It is an urban 'pipe' that maximizes the flows of people, goods, and communication by minimizing the frictions of space and distance. This improves business processes and facilitates firm and regional trade thereby (1) boosting employment and regional income, which (2) accelerates regional economic growth that (3) induces demand for facilities, and (4) generates returns on real estate investment in the aerotropolis and beyond.

These value propositions of aviation and the aerotropolis apply as much to leisure services and tourism as to goods-handling and producer service industries. In addition to being a major industry itself, leisure travel contributes to a higher quality of life. Air travel to visit friends and family helps maintain social ties while facilitating the efficient working of the labor market by reducing the reluctance to migrate to opportunity. And tourism, by some accounts the world's largest industry and one of the fastest growing, is bringing immense revenue to many places. Thus, along with facilitating producer service exports and comparative advantage in production and goods trade, the aerotropolis serves as a gateway and regional anchor for expanding leisure activities and tourism, including medical tourism.

In essence, speedy long-distance connectivity afforded by air transport, complemented by efficient aerotropolis development, lead to regional economic gains from trade in goods and services beyond those that could otherwise be

realized.¹⁰ Such “catalytic effects” can be immense as is the case for Dubai and Singapore. So important is aviation connectivity to the remarkable growth of their commercial, logistics, and tourism sectors, that both may be described as global aviation hubs with city-states attached. Air transportation has transformed each into a full-fledged aerotropolis which, in turn, has reinforced Dubai’s and Singapore’s centrality in global aviation networks.

Whereas air transportation is fast, it is also expensive. Speeding physical movement, however, reduces the need for capital investment (in inventory, storage space, etc.). Speed to market (response time) over long distances is particularly critical to high-tech industries and high-value perishables sectors.¹¹ Accordingly, only a small volume (less than 1 percent by weight) but large portion of the value (approximately 35 percent) of international trade moves by air.¹² Improving air connectivity (measured by the number of markets served times the frequency of service to those markets, sometimes weighted by the size of the markets served) has thus become an important component of nearly every metropolitan region’s high-value export and sectorial portfolio diversification strategy.

Terminal and “last mile” costs are often substantial, though, placing a drag on response times and trade. Much of the time and money cost of transportation occurs at and near terminals. Airports are critical but costly points of intermodal transfer. Any savings in time and costs at these intermodal interfaces has substantial system

¹⁰ Stephen J. Appold and John D. Kasarda “Catalytic Effects in the Context of Product Cycle Theory” *Airports in Cities and Regions Research and Practise*, pg. 15-29, KIT Scientific Publishing, July 2010.

¹¹ Rajan Suri, *It’s About Time: The Competitive Advantage of Quick Response Manufacturing* (New York: Productivity Press, 2010).

¹² International Air Transport Association (IATA), “The Value of Air Cargo.” Accessed November 15, 2013, <https://www.iata.org/cargo.aspx>.

wide efficiency effects in reducing the frictions of trade. The same applies to people and product mobility within the aerotropolis and to and from aerotropolis commercial nodes to other key nodes in the region.

Distance matters much less than time-cost accessibility. Thus, in the aerotropolis planning model, the relevant metric is not spatial distance but time and cost of moving people and products to, from, and through important nodes, internally and externally.

Regions can increase their trade efficiencies and resulting total economic output, employment, and income by reducing the time and costs of passenger and air cargo movement on the ground. That process begins at the airport passenger and cargo terminals and extends outward throughout the aerotropolis and broader region.

Time and cost reductions may result from improved ground transportation (e.g., airport expressways and airport commuter rail), land use controls (e.g., reserving land near airports for aviation-intensive businesses), state-of-the-art ICT infrastructure (e.g., high-speed telecommunications), and institutional reforms (e.g., accelerated customs clearance). All are instrumental to creating economies of speed. This means reducing time at the airport (or at least the disutility of time at the airport) and reducing time getting to and from the airport. Creating economies of speed also requires reformed government practices including reducing bureaucratic red tape and accelerating site development permitting and environmental review times which affect firm siting decisions.

Aerotropolis Firm Siting Decisions

All firms require physical space and connectivity. For time-sensitive firms with national and global reaches, land with convenient access to a well-connected airport is often essential.

Site selection is a complex hierarchical decision beginning with the perceived need for capital investment. That need is generally based on the pending introduction of a new product or the perception that existing physical capacity is insufficient for existing or anticipated demand. Firms may also be likely to invest in new locations when their existing facilities are nearing the end of their economic lives. The basic investment decision is held to trigger a two-stage search for a new site: first, an optimal region is chosen based on considerations of market size, labor skills, and other firm needs along with land, labor and transportation costs, and then a specific site within the region is selected.

Four factors regularly appear with respect to aerotropolis business siting:

1. Air service
2. Labor force
3. Urban centrality and
4. Market

These factors typically interact.¹³ Although there are historical exceptions, skilled labor tends to cumulate in urban central places, and air service tends to be more extensive where there are large numbers of well-paid people, particularly those working in professional and business services.

¹³Button, Kenneth. *Transport Economics*. 3rd ed. Cheltenham, UK; Northampton, MA: Edward Elgar, 2010.

The size and commercial scope of an airport's catchment area has a critical impact on the development of air service. Airlines serve markets not airports. This, along with economies of scale in certain aspects of airport operation, economies of density along key trunk routes, and economies of cross-subsidization tend to hold air services at particular locations despite their airports sometimes being costly, outdated, and congested. The rise and decline of the competitiveness of regions and their corresponding markets have driven changes in air service, with portions of Asia and the Middle East offering the most spectacular evidence.

As prosperity diffuses throughout the global economy, we can expect air service to increase broadly but expand the fastest in rapidly growing regions. Conversely, as certain regions lose their niches in the global economy, they frequently lose air service – with dramatic effect in some U.S. cities, such as Pittsburgh, Cincinnati, St. Louis, Cleveland, Kansas City, and other places. (The list of de-hubbed U.S. airports is actually quite long.) Some of these regions have made large expenditures for passenger terminals and other infrastructure investment which are now severely underutilized.

The reason that many of them may remain so in the future is that high-income economies could be approaching the saturation point for robust air transportation growth while the economics of aviation frequently encourages airline and hub consolidation. Moreover, collectively, firms are becoming better at getting returns from commercial aviation. For several decades, in the United States and elsewhere, each additional unit of GDP produced, required a rising amount of air transportation. Now, that rise appears to be increasing at a decreasing rate.

That doesn't mean that commercial aviation won't grow in absolute volume. But as middle-class incomes in developed economies stagnate and as businesses require relatively fewer flights to generate profits, and as air cargo's mode share remains uncertain, the growth of commercial aviation in developed economies may slow and possibly even plateau at some point.

Rapid aviation growth, as noted, will likely be restricted mostly to developing countries with strongly expanding economies. It is not a coincidence that these countries are also taking the lead in airport city and aerotropolis development. It is also not a coincidence that many struggling regional economies in developed nations are facing difficulty in moving their airport city and aerotropolis ambitions forward.

This suggests that sustained aerotropolis development continuously attracting business investment is reciprocally based on a growing or at least sustainable regional economy. Airport commercial facility planning and aerotropolis business recruitment strategies should be integrated with a realistic regional economic development plan that takes regional assets and corresponding regional growth prospects into account. In essence, not all airports or their regions can support viable airport city and aerotropolis development.

Considering international site selection decisions, just as subsidized highways provided a low-cost means for firms to relocate to ever-widening metropolitan peripheries, the substantial decline in long-haul transportation costs has been instrumental to the emergence of globally widening systems of supply, production, and distribution business sites. Without low-cost long-distance transportation, global supply and distribution channels would not be practical for many goods.

China certainly could not have become the “factory of the world” in absence of low-cost long-haul transportation. In particular, without today’s wide-body jet aircraft, China would not be the dominant location for smart phone and other digital product assembly.

Many other places could not have become significant sites for financial institutions, corporate headquarters, biopharmaceuticals, optics and medical instruments without extensive aviation services which make up a small portion of their firms’ overall costs. For example, the total logistics costs for microelectronics devices such as smart phones and for biopharmaceutical products (both of which are typically shipped internationally by air) are just a few percentage points of their total delivered cost to the point of purchase. While extreme, some economists have begun to consider production location patterns in which moving certain goods is nearly costless.¹⁴

Increasing economies of scale in production (much of which is internal to establishments) imply that, in some cases, a single establishment can supply a large majority of global demand for a particular product. Such economies of scale in production often create a need for widely dispersed supply and distribution systems as component manufacturing location efficiencies and final consumer demand are spread across the globe, albeit unevenly. The emergence of complex international supply chains for laptop and notebook computers, smart phones, aerospace equipment, and other products in what is sometimes termed the global disassembly

¹⁴ Edward L. Glaeser and Janet E. Kohlhase (2004) “Cities, Regions, and the Decline of Transport Costs,” *Papers in Regional Science*, 83: 197-228.

line, with each component producer located where it is believed optimal (with its distribution chains which are equally broad), has been well-documented.¹⁵

Many U.S. firms, such as Apple, have “off-shored” much of their production to Asia, even for the North American market.¹⁶ In these cases, production costs frequently decrease by tapping lower wage labor. However, logistics costs usually increase because of the longer distances products are shipped. Firms minimize total landed cost – the combination of production and logistics costs. This oftentimes results in widely dispersed global supply chains converging at a single assembly site or just a few final assembly locations.

A good illustration of economies of scale in production making it advantageous to converge aviation-dependent global supply chains at a single site is shown in Figure 7 for Foxconn’s assembly of Apple’s iPhone 5 in Zhengzhou, China. This site, adjacent to Zhengzhou International Airport, produces over 70 percent of Apple’s iPhones worldwide. Some 240,000 Foxconn workers were employed there in 2013, anchoring the development of a Zhengzhou Aerotropolis.¹⁷

Insert Figure 7 about here

Despite higher transport costs, overall logistics costs did not rise proportionately. This is because logistics costs have two primary components – the costs of transportation and the costs of holding inventory (broadly conceived).

Particularly for the high value-to-weight products such as electronics and

¹⁵ Yossi Sheffi, *Logistics Clusters: Delivering Value and Driving Growth* (Cambridge MA: MIT Press, 2012).

¹⁶ Jackson, James K. 2013. *Outsourcing and insourcing jobs in the U.S. economy: An overview of evidence based on foreign investment data*. Congressional Research Service. Washington, D.C.: Congressional Information Service, Library of Congress.

¹⁷ Information provided by Foxconn and the City of Zhengzhou to John Kasarda during May 2013 site visit.

biopharmaceuticals, which form the backbone of the air cargo market, it is often profitable to use more expensive air freight in order to save on inventory costs while reducing response time. Much of the savings are indirect and work through the smaller optimal order size afforded by economies of speed as response replaces inventory. Such motivations are reinforced by the volatility of markets, the perishability of goods, a need for supply chain visibility, a desire for increased security, or, as with emergency shipments, the containment of disruptive costs by rapid replacement delivery.

Time is not only cost, it is also currency in today's "must have it now" world. Speedy, predictable delivery, as e-commerce retailers have found, can generate increased sales, making logistics a value-adding service to be optimized rather than a cost to be minimized. By emphasizing time-definite delivery (on time, just-in-time, every time), integrated air express carriers like FedEx and UPS have boosted revenues and taken major market share from traditional air cargo airlines, despite charging substantially higher prices. They have optimized air-ground logistics. The aerotropolis development model is likewise about optimizing air-ground logistics. In this regard, many e-commerce and time-critical distribution firms have located around Memphis and Louisville airports, the respective world hubs of FedEx and UPS, contributing to their competitiveness along with aerotropolis development.

In addition to the basic time, cost and opportunity factors shaping firm location, investment, production and distribution decisions, other factors have salient, sometimes detrimental, influences. Government policies can have significant impacts on firm costs. Direct and indirect taxes, although necessary for providing

collective benefits such as infrastructure and human capital upgrading, impose costs. While taxes and regulations often result in net benefit to regions, the tax burden in some locations may be too high, diminishing their attractiveness to firm siting; so too can corruption and excess bureaucratic red tape common in many developing countries.

Commercial real estate money tends to be impatient. Lengthy and uncertain approval processes increase the time and cost of establishing facilities. Regions sometimes have been able to increase their competitiveness as a business location by considering their development aims and options carefully and offering pre-approved sites for desired investors. (Shovel-ready industrial sites and speculative flex shell buildings have long been a staple of regional economic developers in the U.S.) Doing so reduces construction lead time and decreases firm start-up costs, important aspects of economies of speed.

In China, where some 51 airports and their surrounding areas are introducing airport city and aerotropolis principles, local, provincial, and the central government agencies are supporting such development through land supply policies, free trade zones, tax incentives, and accelerated permitting¹⁸. A striking example is Zhengzhou, China. Less than 22 months passed from the time Apple contractor Foxconn announced that it was considering moving the majority of Apple's iPhone assembly from Shenzhen (late 2009) to the time Zhengzhou put an incentive package together, created a special bonded zone for the iPhone assembly site, had the site permitted at all government levels, and the massive factory complex built and fully

¹⁸ Zhou Jianjun "The Current Situation of China's Airport Economy" Civil Aviation Management Institute of China, May 2013.

operating, including dormitories and services for the 200,000+ workers.¹⁹ This is an exemplary case of competing on the basis of economies of speed. So impressed was Foxconn with “the Zhengzhou speed” that it soon began assembling other digital products in its vast enterprise supply chain at this location.

Site physical and access features are also critical for numerous industries. Some of these have sufficiently stringent site requirements, possibly a large footprint or need for rail, water or air access, that they may be forced into regions which are sub-optimal due to a lack of appropriate sites in the best possible region.

The more closely that a firm’s needs can be specified (including optimizing time-cost access to its upstream and downstream value chain) and the attending operational costs measured, modeled and understood, the more effective are both site searches and firm recruitment efforts likely to be. The availability of extensive information in electronic form means that the site selection process has changed substantially over the past two decades. In fact, websites have largely replaced brochures and traditional media marketing in the firm site selection and recruitment processes. It is therefore important that aerotropolis and other regional business recruitment websites be “information-rich.”

Firm needs cannot always be measured precisely, however. Producer services such as finance, marketing, auditing, and consulting have lists of must-haves. These firms and their executives often make assessments based on airport connectivity along with quality of life intangibles in their location decisions. Responding to the latter, many localities around the world have embarked on sustained campaigns to

¹⁹ Information provided by the City of Zhengzhou to John Kasarda during May 2013 site visit.

upgrade their built, social, and cultural environments as one means to appeal to modern firms and their professional workers.

Creating these environments in the aerotropolis is an important planning challenge that has roots in the “New Town” movement. Aerotropolis planning is, in considerable part, urban planning. Incorporating the best of city and suburban physical and social design into 21st century aerotropolis realms would reinforce their aviation connectivity in attracting producer service and other knowledge-intensive firms which consistently rank both air access and life-style amenities high in their establishment location decisions.

Summary and Concluding Remarks

Airports have moved beyond mass transit hubs to become strategic trade infrastructure and catalysts for regional economic development. They are attracting and supporting higher value manufacturing and producer service firms that depend on air connectivity for speedy access to their distant suppliers and customers.

Even if goods move by ocean vessel or ground, the long-distance nature of most trade necessitates those who initiate, negotiate, and coordinate the flow of goods to travel by air. Hence, the origins and destinations of business air travel tend to correspond to overall patterns of trade.

Air routes operate as the Physical Internet for aviation-enabled trade in goods and services with airports serving as the routers and global-local interfaces. These global-local interfaces are physically manifest in aerotropolis form, consisting of a multimodal, multifunctional airport city core centered on passenger and cargo

terminals and outwardly extending spines, nodes and clusters of aviation-linked businesses and residential development.

As 21st century firms become more dependent on aviation and airports, functionally, if not spatially, appropriate aerotropolis planning and development offer a propitious way forward for metropolitan regions to improve efficiencies in their trade-based economies and overall global competitiveness. They can plan and invest in aerotropolis development to make their resources (natural endowments, available capital, and, particularly, labor) more productive. The optimal level of those investments depends upon the nature of region's resources (including market size and labor skills), the geography of location, and the scale and efficiency of airport and aerotropolis operation. All of these factors affect firm siting decisions and corresponding regional economic growth.

Optimal outcomes of aerotropolis investments depend on aligning multiple stakeholders who cross numerous public and private-sector domains. Optimality also necessitates bringing together those who come from various planning domains.

Regarding the latter, planning an aerotropolis is a complex task, requiring the merging of airport planning, urban planning, and business site planning (and their key components) as illustrated in Figure 8. Each calls for a separate skill set. For example, in business site planning, all aerotropolis parcels designated in master plans and their proposed commercial facility uses must be based on solid market analysis, including forecasted demand for particular types of commercial facilities. Impressive conceptual renderings alone will do little to attract investors.

Insert Figure 8 about here

Land-use planning near the airport must recognize likely airport expansion needs as well as the safety needs of air passengers and area residents in terms of obstacle avoidance and third-party risk minimization. Noise disamenity, by far the largest environmental concern, should be better handled than it now is. While aviation law typically contains provisions for the establishment of noise buffers surrounding airports, noise outside that zone often imposes considerable costs and causes a significant volume of complaint and political resistance to airport expansion. Airports must be more civic oriented in purchasing the social right to grow rather than simply steamrolling over nearby communities.

Aligning interests of surrounding communities with those of the airport is a tricky task which has stalled more than a few aerotropolis initiatives. The alignment challenges become even more difficult when additional stakeholders such as the airlines, business community, and pertinent administrative agencies at multiple government levels must be brought on board. Recommending and eventually deciding upon an appropriate aerotropolis governance structure, including sharing costs and financial returns, is a related thorny challenge planners and stakeholders must address.

Some costs such as providing improved multimodal transportation infrastructure can be highly expensive and complicated. Since passenger and cargo air transport are always multimodal when encompassing origin and destination, ground transportation needs to be better integrated with air transportation. Too often, airport-connecting highways are congested or otherwise inadequate and

passenger rail connections non-existent. The majority of the time spent travelling to distant sites may be more on the ground than in the air. Highway congestion increases the total costs of travel and decreases firm and aerotropolis efficiencies.

Efficient connecting passenger rail can reduce these costs and also has the potential to increase the catchment areas of airports. Frankfurt Airport's direct high-speed rail connections to the major cities along the Rhine River helps funnel passengers, workers, and others to the airport. This adds support for Frankfurt Airport City investments such as "The Sqaire," a 2 million square-foot Class-A office and hotel complex only 8 minutes by enclosed walkway to Frankfurt Airport's check-in counters.

Commercial and residential development in the broader aerotropolis also must be better coordinated with air and ground transportation. In this respect, economic efficiency and environmental sustainability often point in the same direction because both concerns aim towards the minimization of ground transport. Unfortunately, land use planning tools tend to be weak and, more importantly, often do not sufficiently take either ground or air transportation into account. Where there is demand for new commercial facilities, it will serve both business and the public interest to locate air-intensive activities near the airport, improving their time-cost accessibility while reducing highway travel distances and total engine emissions.

The physical form of an aerotropolis depends on several important factors. Along with space availability, functional needs are critical. These depend upon the economic structure of the region and the volume and mix of air traffic. If local ground transportation is adequate and sufficient buildable space exists in center

cities, airports may augment center city growth, as is the case in Frankfurt.

Conversely, if the center city is less suitable for further development and the airport is well-connected with regional ground transportation, an airport city may grow even in the absence of a strong need to be located at an airport *per se*, as is the case with much major office development at Amsterdam Schiphol. Because of its excellent passenger rail connections with short walk to work places, the central area of Schiphol airport is better connected to suburban labor sheds than downtown Amsterdam.

Symbolic needs are likewise important. Airports and their environs, as important regional gateways, should visually reflect and promote the assets and strengths of their region²⁰. On a more human level, urban developments are increasingly driven by identity needs. For many economic sectors, these are primary considerations. Tourism, for example, depends upon a favorable psychological reaction to the experience.

All sectors share that characteristic to some degree where community design and the quality of the built environment often becomes a symbolic marker of the status of the firms which locate there. Las Colinas, Texas, an aerotropolis development just east of Dallas-Ft. Worth International Airport, may be exemplary in this regard hosting the world headquarters of nine of the Fortune 1,000 firms.²¹

The physical environment and the pre-existing built environment will channel and limit the possibilities for airport city and broader aerotropolis

²⁰ John D. Kasarda 2010, "The Way Forward" in John D. Kasarda, Contributing Editor, *Global Airport Cities*, pg. 15-36 (London: Insight Publishing) available on www.aerotropolis.com

²¹ Booming business! Las Colinas. 2013. Available from www.lascalinas.com (accessed December 2013).

development. Many airport areas are hemmed in by prior development that hampers their ability to achieve the most economical and socially-desirable form. The problem can be exacerbated by the relative prices that commercial and residential uses can pay for land. In low-density metropolitan peripheries, for example, housing often commands the highest per square foot price for land. When relatively inexpensive airport area land is available, residential encroachment can become an issue hindering future air traffic generation and air route growth, thereby weakening the engine for aerotropolis development.

The “preferred residential quarter” can also impact aerotropolis development. In some regions, the quarter favored by the well-to-do flying public coincides with the location of its major airport. In others, it does not, affecting the type, scale, and pace of aerotropolis development.

Finally, the governance structure mentioned earlier, including its political, institutional, public and financing aspects, will be instrumental to aerotropolis development success. Regions with a history of cross-jurisdiction cooperation, public private partnerships, and strong urban planning traditions appear to be able to steer existing and projected growth into more socially desirable forms that also function more efficiently.

The bottom line is that aerotropolis planning is still in its infant stage. Aerotropolis infrastructure and commercial development is far more geographically expansive, often crossing numerous jurisdictions and planning areas, than previous forms of transit-oriented development. Planning challenges are multifaceted, complex, and increasing as we experience, learn more about, and confront this

newer form of aviation-oriented urban development.²² Yet, planning to get the aerotropolis right can bring huge competitive and social returns to business and community. Allowing it to evolve organically, as it inevitably will in absence of planning, will likely limit those returns.

²² Environmental and social challenges surrounding aviation and the future of aerotropolis development are addressed in John D. Kasarda and Greg Lindsay *Aerotropolis: The Way We'll Live Next* (New York: Farrar, Straus and Giroux, 2011) and John D. Kasarda, "Aerotropolis: Business Mobility and Urban Competitiveness in the 21st Century" Chapter 1 in Klaus Benesch, ed, *Cultures of Mobility*, Heidelberg: Heidelberg University Press, 2014.

**Figure 1:
Aviation's Global Physical Internet
(59,036 Routes in 2012)**



Source: Airline Route Mapper and UNC Kenan Institute

**Figure 2:
Aerotropolis Schematic with Airport City Core**

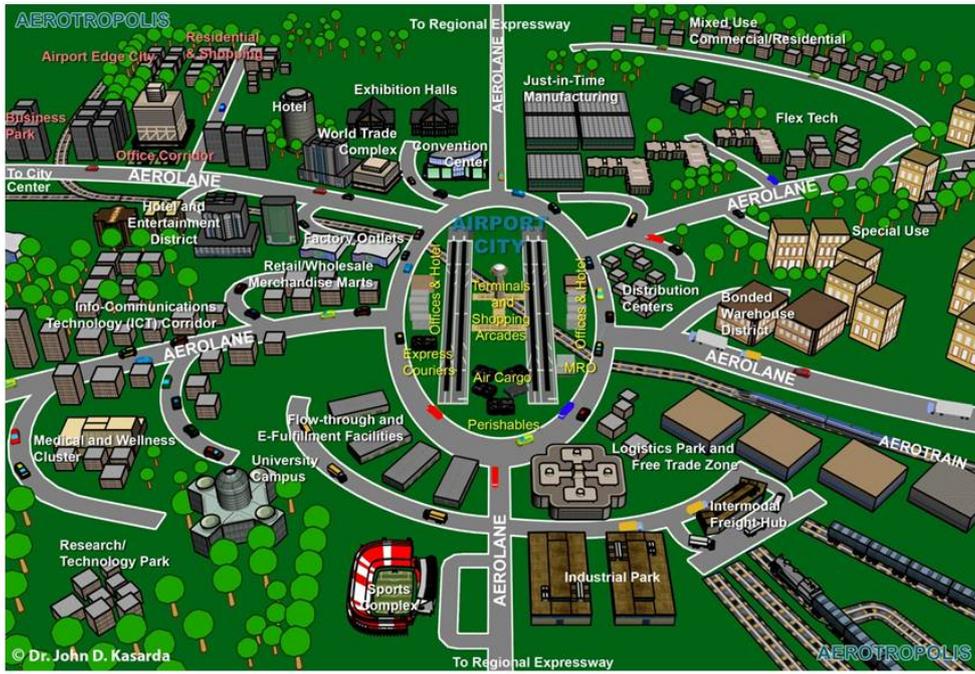
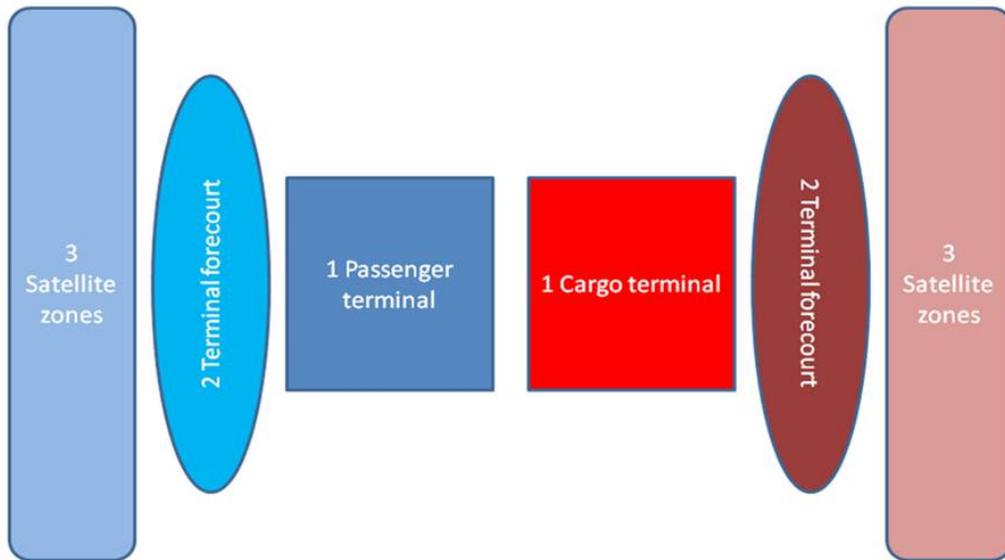


Figure 3:
Airport Cities Grow outward from Terminals as Activities Fill Capacity



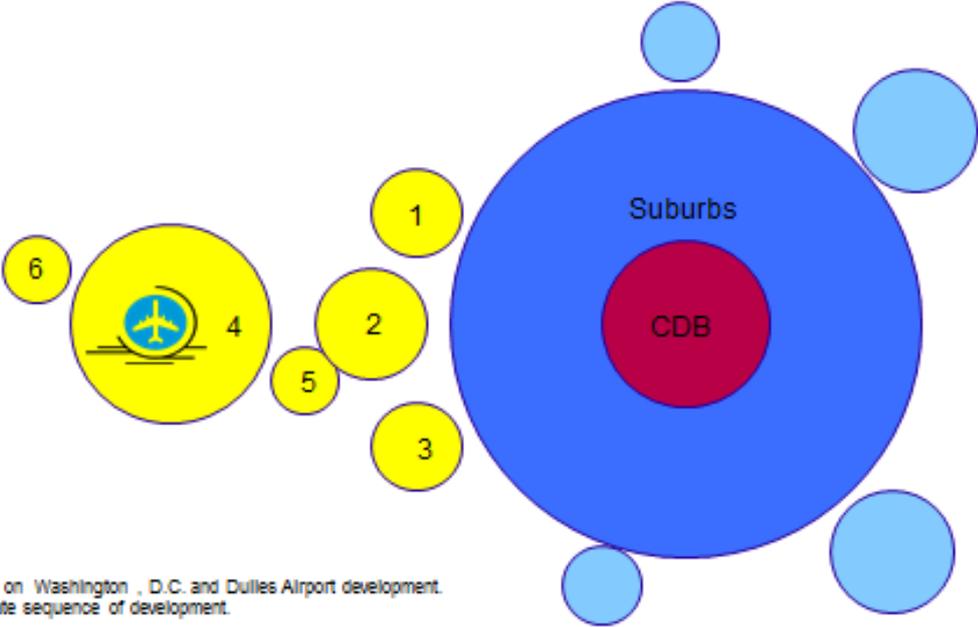
Note: Based loosely on Schiphol Airport development

Figure 4. Common Airport City and Aerotropolis Commercial Facilities

	People-oriented	Goods-oriented
Passenger and Cargo Terminals (airside)	<ul style="list-style-type: none"> • Retail (including upscale boutiques) • Restaurants (higher-end and themed as well as fast food) • Leisure (spas, fitness, recreation, cinemas, etc...) • Culture (museums, regional art, musicians, chapels) 	<ul style="list-style-type: none"> • Air express and courier • Cold storage and cool chain • General air cargo • Aircraft maintenance, repair and overhaul (MRO)
Airport City (landside)	<ul style="list-style-type: none"> • Hotels and entertainment • Office & retail complexes 	<ul style="list-style-type: none"> • Logistics and distribution • Wholesale merchandise marts
Aerotropolis (beyond airport property)	<ul style="list-style-type: none"> • Convention & exhibition centers • Business and technology parks • Producer services (finance, auditing, consulting, etc.) • Corporate headquarters • Information and communication technology firms • Wellness and medical facilities • Large mixed-use residential developments 	<ul style="list-style-type: none"> • Free trade zones and special economic zones • Logistics parks and distribution centers • Precision and time-critical manufacturing • Biomed and pharmaceuticals • High-tech electronics repair • High-value agricultural and food products • Medical instruments • Aviation-related industries

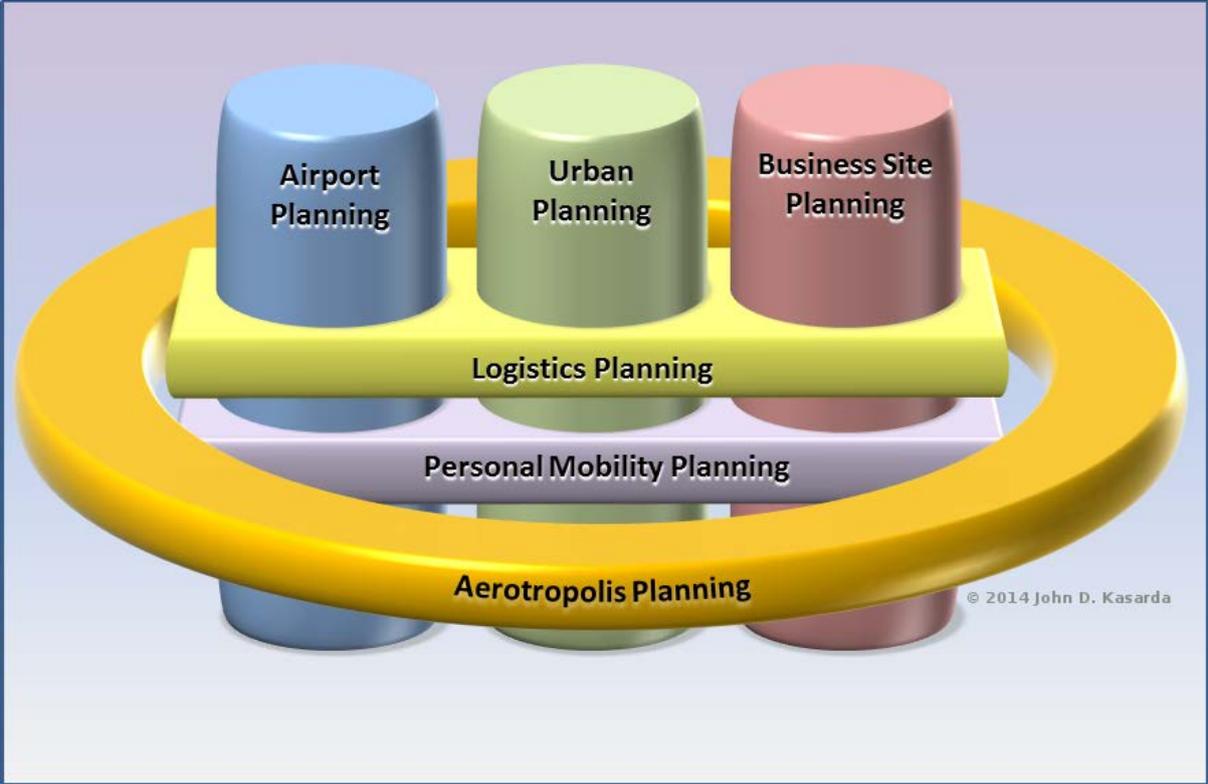
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Figure 5:
Cities Grow out to Airports as Air Transport Exerts Pull



Based loosely on Washington, D.C. and Dulles Airport development.
Number indicate sequence of development.

**Figure 6:
The Golden Ring of Aerotropolis Planning**



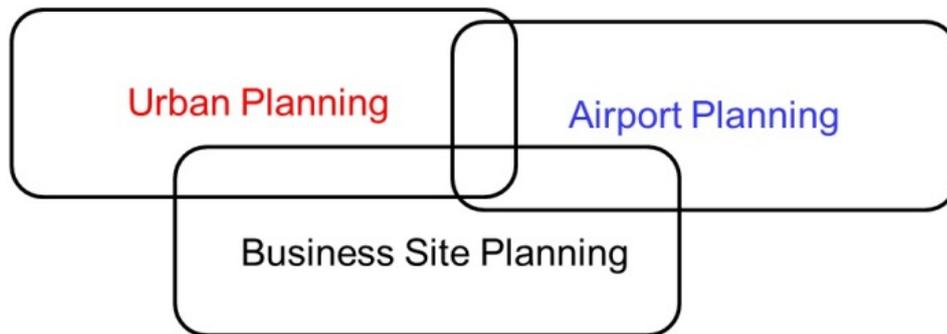
**Figure 7:
Global Supply Chain - Apple iPhone5
Zhengzhou , China Assembly Complex**



Figure 8 Integrated Aerotropolis Planning

- Ground transportation planning
- Land-use planning
- Community design

- Infrastructure and facility planning
- Air traffic generation & new routes
- Airport commercial strategies



- Market demand, competitor and risk analyses
- Regional positioning and cluster optimization
- Time – Cost accessibility

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