Aerotropolis 4.0

Dr John Kasarda presents a new Aerotropolis model that integrates 4.0 economy sectors with smart technologies and sustainable development practices to create and capture value for airports and the regions they serve.

The planning and development of aerotropolises worldwide is changing. This change reflects a pivotal role that governments and the private sector envision them playing in the emerging 4.0 economy where R&D, rapidly advancing IT and automation, and continuing globalisation are interacting to spawn new generation industries and business services that rely extensively on digitisation and rapid long-distance flows of people, products, information, ideas, and capital.

The result is a modification in the mix of businesses and industries being recruited to create modern economic muscle for the aerotropolis along with much greater emphasis on developing the institutional, physical, social, and technological environments that will attract 4.0 firms and their talented workforces.

Basic aerotropolis form and function

The aerotropolis has traditionally been defined as an urban economic region whose infrastructure, land use, and economy are centered on a major airport (see www.aerotropolis.com).

Spatially and operationally, it consists of: (1) the airport's aeronautical, logistics and commercial facilities anchoring a multi-modal, multi-functional airport city at its core; and (2) outlying corridors and clusters of aviation-oriented businesses and industries that feed off of each other and their accessibility to the airport and its connecting surface transportation infrastructure.

Aviation-oriented commercial corridors and industrial clusters can be observed up to 30 kilometres from the largest air gateways with some airport economic impacts felt as far as 100 kilometres away.

Because airport cities are often confined to airport property, they cover much smaller territory than the expansive aerotropolis. They also usually operate under a single administrative organisation with authority over both aeronautical and commercial facility development.

These two features allow airport cities to be: (a) comprehensively planned and architecturally themed; (b) developed and managed to maximise benefits to the airport owners, operators, commercial investors and users; and (c) supported by an appropriate business model to be profitable.

For an increasing number of larger gateway airports, commercial (non-aeronautical) revenues constitute over half of their total revenues.

Airport city commercial development is heavily leveraged by the airport's passenger and cargo terminals. Included here are: (1) commercial facilities for air travellers and airport employees such as parking, retail shops, F&B establishments, and leisure venues both inside and outside the passenger terminals; (2) commercial facilities for those providing or supporting air transport services such as airlines, cargo service providers, and caterers; and (3) commercial facilities that are leveraged by air transport such as airport medical clinics, hotels, and offices of air travel intensive executives and professionals.

Commercial development typically commences at and adjacent to the terminals and proceeds over time toward the airport's fence. As airport property fills, airport city development can spill over the fence into adjacent areas.

Given its vast geography, aerotropolis development is much more varied and diffuse. Commercial and industrial clusters tend to be larger and constructed independently of each other.

The nature and scale of commercial and industrial facilities locating in the broader aerotropolis are shaped by the market structure and competitive strengths of the metropolitan region, available land along or near airport surface transportation corridors, the volume and type of business and leisure air travellers, and the extent to which metropolitan cores are built out.

Logistics and distribution centres, free trade zones, convention and exhibition complexes, corporate headquarters and other office buildings, business parks, and even complete airport edge cities have formed along the airport's main surface transportation corridors to the metropolitan centre and interstitial highways.

Several of the largest airport edge cities such Amsterdam Zuidas, seven minutes from Schiphol Airport, South Korea's Songdo International Business District, linked by a 12-kilometre bridge to Incheon International Airport, and Las Colinas near Dallas/Fort Worth International Airport, have become globally significant commercial nodes.
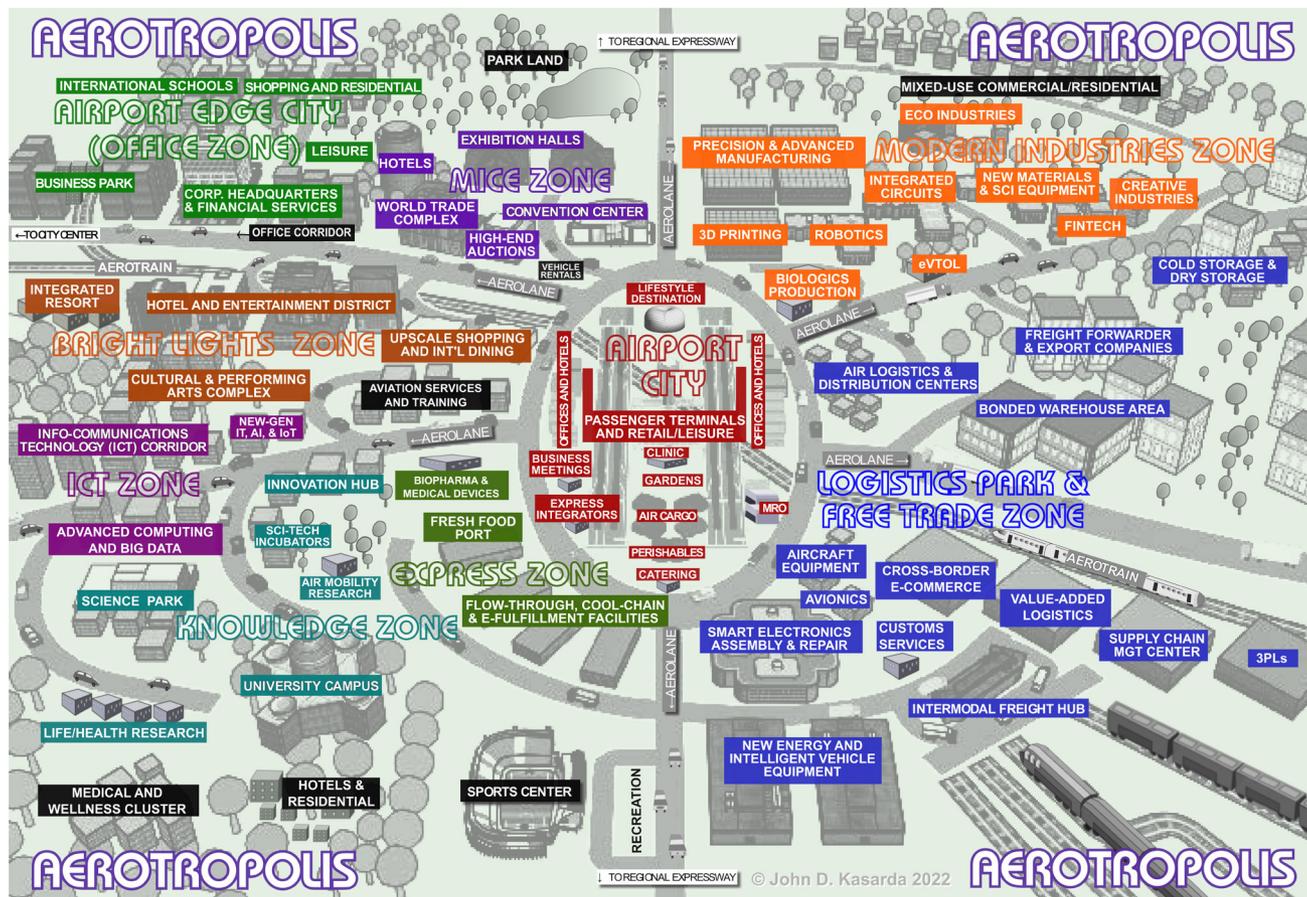
Las Colinas, for instance, hosts the world corporate headquarters of eight Fortune 500 firms as well as over 150 foreign firms.

The 4.0 Aerotropolis

The 4.0 Aerotropolis builds upon and advances the form and functions of the traditional aerotropolis, as is illustrated in the compressed generic schematic.

With the airport city continuing to serve as its multi-modal central business district, the 4.0 Aerotropolis consists of at least eight broader functional zones: a knowledge zone, ICT zone, modern industries zone, express zones, logistics park and free trade zone, meetings incentives conventions and exhibitions (MICE) zone, bright lights zone, and an office zone that may evolve into a more complete airport edge city.

Depending on the economic structure of the metropolitan region and the market that the airport serves, other specialised zones may be developed. At the core of the airport city, passenger terminals are fully equipped with advanced technologies that ease and speed flows of passengers and baggage from kerb to aircraft. These include robotic assistants powered by AI that can speak multiple languages, biometric authentication and big data computer vision algorithms to facilitate immigration and security checks, along with self-service baggage drop-off that automatically measures luggage dimensions and weight and delivers baggage directly to the aircraft with real time tracking to the passenger's smartphone.

AEROTROPOLIS

INTERNATIONAL SCHOOLS | SHOPPING AND RESIDENTIAL | PARK LAND | ↑ TO REGIONAL EXPRESSWAY

AIRPORT EDGE CITY (OFFICE ZONE) | LEISURE | EXHIBITION HALLS

BUSINESS PARK | CORP. HEADQUARTERS & FINANCIAL SERVICES | HOTELS | MICE ZONE

← TO CITY CENTER | OFFICE CORRIDOR | WORLD TRADE COMPLEX | CONVENTION CENTER | HIGH-END AUCTIONS

AEROTRAIN | VEHICLE RENTALS | LIFESTYLE DESTINATION

INTEGRATED RESORT | HOTEL AND ENTERTAINMENT DISTRICT | BIOLOGICS PRODUCTION

BRIGHT LIGHTS ZONE | UPSCALE SHOPPING AND INT'L DINING | AIRPORT CITY

CULTURAL & PERFORMING ARTS COMPLEX | AVIATION SERVICES AND TRAINING | OFFICES AND HOTELS | PASSENGER TERMINALS AND RETAIL/LEISURE

INFO-COMMUNICATIONS TECHNOLOGY (ICT) CORRIDOR | NEW-GEN IT, AI, & IoT | AEROLANE

ICT ZONE | INNOVATION HUB | BIOPHARMA & MEDICAL DEVICES | BUSINESS MEETINGS | CLINIC

ADVANCED COMPUTING AND BIG DATA | SCI-TECH INCUBATORS | FRESH FOOD PORT | EXPRESS INTEGRATORS | GARDENS | AIR CARGO | MRO

SCIENCE PARK | AIR MOBILITY RESEARCH | EXPRESS ZONE | PERISHABLES | CATERING | AIRCRAFT EQUIPMENT

KNOWLEDGE ZONE | FLOW-THROUGH, COOL-CHAIN & E-FULFILLMENT FACILITIES | AVIONICS

UNIVERSITY CAMPUS | SMART ELECTRONICS ASSEMBLY & REPAIR | CUSTOMS SERVICES

LIFE/HEALTH RESEARCH

MEDICAL AND WELLNESS CLUSTER | HOTELS & RESIDENTIAL | SPORTS CENTER | RECREATION | NEW ENERGY AND INTELLIGENT VEHICLE EQUIPMENT

AEROTROPOLIS | ↓ TO REGIONAL EXPRESSWAY | © John D. Kasarda 2022

AEROTROPOLIS

MIXED-USE COMMERCIAL/RESIDENTIAL | ECO INDUSTRIES

PRECISION & ADVANCED MANUFACTURING | MODERN INDUSTRIES ZONE

INTEGRATED CIRCUITS | NEW MATERIALS & SCI EQUIPMENT | CREATIVE INDUSTRIES

3D PRINTING | ROBOTICS | FINTECH | eVTOL | COLD STORAGE & DRY STORAGE

FREIGHT FORWARDER & EXPORT COMPANIES

AIR LOGISTICS & DISTRIBUTION CENTERS | BONDED WAREHOUSE AREA

AEROLANE → | LOGISTICS PARK & FREE TRADE ZONE

CROSS-BORDER E-COMMERCE | VALUE-ADDED LOGISTICS | AEROTRAIN

SUPPLY CHAIN MGT CENTER | 3PLs

INTERMODAL FREIGHT HUB

AEROTROPOLIS

Airport city office buildings, hotels, and meeting facilities are ubiquitously fitted with the latest smart technologies as are all cargo processing facilities. Sculpture gardens, themed leisure areas, and public art contribute to placemaking and traveller relaxation while enriched arrays of shopping, dining, and passenger services further enhance their airport experience.

Pioneered by Jewell Changi Airport, expect to see more eye-catching lifestyle destination structures near passenger terminals, emphasising nature themed environments and housing a plethora of retail, leisure, and entertainment venues.

The airport city remains the maximal convergence node of 4.0 Aerotropolis multi-modal connectivity. When this multi-modal convergence includes high-speed and/or intercity trains, the airport city and its greater aerotropolis can draw on a substantially extended labour catchment area to staff high-end functions such as corporate headquarters.

It should be no surprise that most airport cites that host non-aviation sector corporate headquarters (such as Schiphol CBD, Frankfurt Airport City, and Paris CDG's Roissypole) are served by high-speed and/ or rapid intercity rail.

In many instances, existing resident talent, even in the entire metropolitan region, is insufficient to staff the range of Aerotropolis 4.0 firms envisioned. This is especially so for facilities shown in the ICT Zone, Knowledge Zone, Modern Industries Zone, and Office Zone of the schematic. Transforming the local labour force to meet 4.0 economy talent requirements, though important, can be a a long-term process. Thus, in addition to substantially extending the aerotropolis labour catchment area and upgrading local labour skills, global talent recruitment will likely be necessary. The 4.0 Aerotropolis must offer conditions where diverse, well-educated, inventive people will want to live, work, learn, create, be entertained, and raise and educate a family.

This includes everything from providing quality international schools and branches of respected graduate research universities to developing attractive, livable, green mixed-use commercial and residential areas, the latter designed to neighbourhood scale.
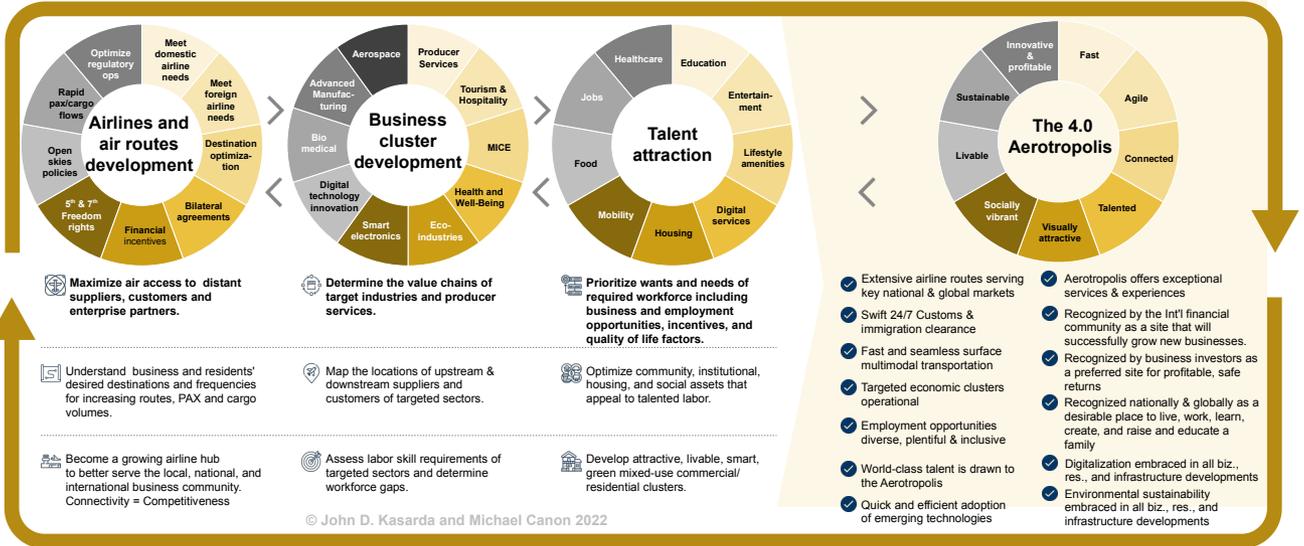
A frequent complaint I have heard from younger talent residing in aerotropolises, is that they find them limited in lively social gathering areas and nightlife compared to metropolitan downtowns. This is why the 4.0 Aerotropolis schematic contains a Bright Lights Zone that will appeal to creative young professionals as well as to tourists and visitors.

4.0 economy professionals also tend to be technologically savvy and environmentally conscious. Successfully recruiting them means that ubiquitous digitisation should characterise the aerotropolis complemented with environmentally sustainable practices in all business, residential, and infrastructure developments.

Attracting new-generation industries and business services, technology, and talent that distinguish the 4.0 Aerotropolis should not distract advocates from recognising that, first and foremost, a successful aerotropolis requires a well-connected airport which moves growing volumes of air traffic, passengers, and cargo quickly and efficiently.

Without sufficient air connectivity and supporting aeronautical infrastructure and facility operations, the engine that powers the aerotropolis will sputter. This includes not only runways, terminals, and air traffic control facilities but also soft infrastructure (e.g., Customs and immigration processes) along with the types of logistics and goods handling facilities and their supporting services identified in the 4.0 Aerotropolis Logistics Park and Free Trade Zone.

Strategic Path to a 4.0 Aerotropolis

Airlines and air routes development

Optimize regulatory ops · Meet domestic airline needs · Meet foreign airline needs · Destination optimization · Bilateral agreements · Financial incentives · 5th & 7th Freedom rights · Open skies policies · Rapid pax/cargo flows

Business cluster development

Aerospace · Producer Services · Advanced Manufacturing · Tourism & Hospitality · Bio medical · MICE · Digital technology innovation · Health and Well-Being · Smart electronics · Eco-industries

Talent attraction

Healthcare · Education · Jobs · Entertainment · Food · Lifestyle amenities · Mobility · Digital services · Housing

The 4.0 Aerotropolis

Innovative & profitable · Fast · Sustainable · Agile · Livable · Connected · Socially vibrant · Talented · Visually attractive

Maximize air access to distant suppliers, customers and enterprise partners.

Understand business and residents' desired destinations and frequencies for increasing routes, PAX and cargo volumes.

Become a growing airline hub to better serve the local, national, and international business community. Connectivity = Competitiveness

Determine the value chains of target industries and producer services.

Map the locations of upstream & downstream suppliers and customers of targeted sectors.

Assess labor skill requirements of targeted sectors and determine workforce gaps.

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Prioritize wants and needs of required workforce including business and employment opportunities, incentives, and quality of life factors.

Optimize community, institutional, housing, and social assets that appeal to talented labor.

Develop attractive, livable, smart, green mixed-use commercial/residential clusters.

- Extensive airline routes serving key national & global markets
- Swift 24/7 Customs & immigration clearance
- Fast and seamless surface multimodal transportation
- Targeted economic clusters operational
- Employment opportunities diverse, plentiful & inclusive
- World-class talent is drawn to the Aerotropolis
- Quick and efficient adoption of emerging technologies
- Aerotropolis offers exceptional services & experiences
- Recognized by the Int'l financial community as a site that will successfully grow new businesses.
- Recognized by business investors as a preferred site for profitable, safe returns
- Recognized nationally & globally as a desirable place to live, work, learn, create, and raise and educate a family
- Digitalization embraced in all biz., res., and infrastructure developments
- Environmental sustainability embraced in all biz., res., and infrastructure developments

Feedback Loop for Continuous Reinforcement /Improvement

Even with a powerful airport engine, a 4.0 Aerotropolis is unlikely to form organically. I therefore further present a strategic path for its development highlighting the key requirements and steps to optimise its three primary causal factors – (1) Air services expansion, (2) business cluster development, and (3) talent attraction, along with specifying the ideal features of a 4.0 Aerotropolis.

The strategic path shows air route development attracting modern aviation-oriented businesses. Such business development, in turn, lures talent, with all three being essential to the prosperity of the 4.0 Aerotropolis.

Reinforcing feedback loops operate. For example, business cluster development generates the additional passengers and cargo that attract airlines and sustain expanded route networks. Likewise, the features of the 4.0 Aerotropolis shown around and below it in the schematic are instrumental to meeting the wants and needs of airlines, innovative businesses, and talented labour.

Who's pursuing Aerotropolis 4.0?

Whereas no aerotropolis exhibits all 4.0 features described herein, there is a distinct worldwide trend incorporating many of them into master plans and development. To note just a sample.

Beijing's new Daxing Airport and its adjacent economic zones are merging smart airport and sustainable city practices with new generation aerospace, life sciences and R&D to become a pioneering area of innovation and living.

The 415 square kilometre Zhengzhou Airport Economy Zone has developed clusters of biomedicine research, new energy vehicles equipment, silicon wafers, and smart electronics along with big data infrastructure. Its electronics information cluster now has over 100 enterprises while its 20+ business incubators host more than 300 sci-tech start-ups.

The Incheon Aerotropolis has been trendsetting not only in developing autonomous vehicle, biotechnology, and robotics industries along with remarkable integrated resorts appealing to affluent foreign tourists, but also in smart, sustainable urban development best represented by the Songdo International Business District.

Taoyuan Aerotropolis in Chinese Taipei is the cornerstone of the island's Asian Silicon Valley initiative, while Australia's Western Sydney Aerotropolis has been master planned for advanced manufacturing, creative industries, and life sciences with a university consortium fostering 4.0 economy skills. The new aerotropolis being planned in Thailand's Eastern Economic Corridor is following similar 4.0 principles.

Dubai has likewise been a 4.0 Aerotropolis trendsetter with its medical and wellness, aerospace, ICT, advanced financial services, and new media clusters, whereas Saudi Arabia's Neom Aerotropolis is ambitiously being planned to be at the forefront of space commerce, hydrogen fuelled aircraft, and hypersonic flight as well as several visionary manufacturing and producer services sectors.

Munich Airport, among the leaders in smart technology applications, is developing LabCampus, a 500,000 square metre innovation district for incubating next-gen mobility technologies and creative commercial ideas. Elsewhere in Europe, the Paris CDG region has positioned itself as a global pacesetter in aerospace research and contributing to sustainable, socially inclusive aerotropolis development.

In the US, the Denver Aerotropolis is a premier location for biosciences. Its CityNow initiative scheduled for buildout in 2026 will be a living lab for technology innovations to achieve carbon neutrality.

On the US east coast, a 4.0 Aerotropolis is rapidly evolving around Orlando International Airport led by the 45 square kilometre Lake Nona development adjacent to the airport whose clusters include graduate research universities, global centres for financial innovation, medical, and human performance, and the 2,000 creative employee Imagineering Campus of the Walt Disney Company, with an electric vertical take-off and landing (eVTOL) hub under construction.

About the author

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