

A TOCUMEN LOGISTICS HUB, AIRPORT CITY and AEROTROPOLIS:

Land-use Guidelines and Development Actions

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NOTE: The following report, prepared under contract with the International Civil Aviation Organization (ICAO), is intended for use as strategic guidance in the planning of logistics and commercial development on and around the Republic of Panamá's Tocumen International Airport (PTY). It is not itself a planning document or business plan. Nor does it represent an official plan of ICAO, PTY or its surrounding municipalities and land-owners . The report was prepared prior to completion of a major update to PTY's master plan, currently being conducted by ICAO. All information and recommendations contained in this report pertaining to PTY should therefore be regarded as provisional, pending completion of ICAO's master plan update whose assessments and recommendations regarding aeronautical and non-aeronautical infrastructure , facilities, and land use may override or otherwise significantly alter those put forth herein. This document and its contents are privileged and confidential, meant only for the use of ICAO, PTY, and its strategic partners.

Preface

The New Airport Planning Model

A new strategic approach to airport planning and associated commercial land use is gaining prominence around the world. This is the aerotropolis model¹

Simply put, an aerotropolis is an airport-based city offering its businesses speedy connectivity to their suppliers, customers and enterprise partners nationally and world-wide. Many of its businesses are far more dependent on distant suppliers and customers than those located nearby.

The Aerotropolis also contains the full set of commercial facilities that support aviation-linked businesses and millions of air travelers who pass through the airport annually. These include, among others, logistics and distribution facilities, hotels, convention, trade, and exhibition complexes, office building, shopping, dining, and recreation venues.

As an increasing number of businesses and commercial service providers cluster on and immediately around airports, they become destinations in their own right (forming airport cities) where air travelers and locals alike work, shop, meet, exchange knowledge, conduct business, eat, sleep, and are entertained without going more than 15 minutes from the airport. The

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

aerotropolis' multimodal transportation infrastructure (air, highway, rail, and links to ports) connects its businesses and people to markets near and far, undergirding its growing local, regional, and global economic significance.

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."² Aerotropolis planning therefore spans land-use planning and transportation planning. More specifically, with respect to aerotropolis planning, land use planning includes reconciling the business site planning needs of individual firms making significant capital investments, the airport planning objective of ensuring maximal access at the lowest possible cost, and the urban planning goals of overall economic efficiency, aesthetic appeal, and environmental sustainability. With respect to transportation planning, aerotropolis planning includes designing systems for efficient, secure logistics and personal mobility.

An aerotropolis differs from a busy airport in that the concerns listed above are addressed together to create a seamless system of transport, replacing the chaos, confusion, and congestion evident at and around many airports. Air

²Paraphrased slightly from [112nd] H.R.658 : FAA Air Transportation Modernization and Safety Improvement Act, 2011.]

journeys neither begin nor end on the tarmac. Passengers and cargo often spend considerable time, and sometimes expense, in getting to and from airports and in negotiating airport obstacles, creating "last mile" and "terminal" costs. Because "terminal" and "last mile" costs can be substantial whereas the marginal costs of flying an extra mile are often insignificant, those regions and nations which successfully minimize those costs are often able to enhance their economic competitiveness and therefore their attraction as a location for business investment.

Aerotropolis planning, therefore, differs from conventional airport planning by considering "inside the fence" terminal, mutually beneficial "outside-the-fence" development, and "last mile" costs holistically. The battle for air freight – and thus the industries using air freight – is increasingly won on the ground. The same is true for passenger travel. For example, more than half the time spent on air journeys between Chicago's Loop and Manhattan's midtown is famously spent on the ground, locked in freeway gridlock, terminal congestion, or backed up on the taxiways. Particularly for flights of moderate length – the most common trajectory for business travel – such delays are not only onerous but they can also significantly impact the competitiveness of firms and decrease a region's attractiveness as a business location destination. This is because shippers and passengers are increasingly making travel mode and route choices on the basis of the entire (surface and air) journey.

That reality reveals a second shortcoming of most airport and regional planning. Although integrated airport land use and transportation planning is a valued ideal, in practice, that ideal is rarely achieved.

Stated a bit differently, while the aerotropolis represents an integrated coalition among airlines, a region, and its airport, planning remains silo-ed in aviation network planning, regional planning, and airport planning. Far less than optimal outcomes result for the airport and the region and nation it serves.

As will be highlighted throughout this report, aerotropolis surface infrastructure and land use planning are critical for the aesthetic, operational, and functional reasons. First, as the air gateway to Panamá City and the Republic, PTY and its immediate environs set the initial and the final impressions of foreign travelers to the country. Second, all air journeys are intermodal with the first and last legs always via a surface mode. Third, surface infrastructure helps anchor cargo users, freight forwarders, and other airport-oriented businesses. As a result,

- Suitable airport and airport area land use can increase the efficiency of Tocumen's passenger and cargo transportation and improve the appearance and property values of airport and airport area land.
- Improved road and perhaps future rail infrastructure can expand the catchment area of PTY, attracting more passengers and cargo thereby supporting more flights.

- New freight rail intermodal facilities connected to Panamá Canal expansion can anchor logistics and freight-dependent firms. Some of these also have air transportation needs, creating a possibility for modal cross-subsidization. Most importantly, multimodal logistics infrastructure could support the Republic's growth of high-tech manufacturing and high-value perishables – a long envisioned goal of Panamá's leaders.
- Commercial development on Tocumen (including Tocumen's Airport City on 300 hectares of land recently acquired) can generate substantial non-aeronautical revenues for Tocumen SA allowing it to support continuous modernization and infrastructure improvement of the airport while keeping its cost to airlines competitive through commercial development cross-subsidization.
- Commercial development outside the fence can also generate additional passengers and cargo for Tocumen while providing amenities and attractions to Tocumen's passengers and value to cargo processing.

Taken together, these results and other positive outcomes that the strategic guidelines in this report are meant to help achieve will go a long way to increasing Tocumen's benefits for its users and the greater Republic. It is my belief that following these guidelines will not only help Tocumen become a more efficient, profitable, and attractive airport, but also leverage its aeronautical and non-aeronautical development to substantially strengthen what have been identified in the republic's Strategic Five-year Plan (2010–2014) as the four motors of the economy: Logistics, Luxury Tourism, Agriculture, and Financial Services.

In the four chapters that follow, I provide (1) the competitive logic and business rationale for following the new aerotropolis planning model and

provide explicit cases of its implementation around the world, (2) its infrastructure and facility plan development guidelines with explicit focus on Tocumen and its nearby areas, (3) business plan guidelines for Tocumen to follow, and (4) recommended actions.

In generating this report, I followed the scope of work in the ICAO contract which detailed the contents as follows:

A. A New Business Model for Tocumen Airport Development

1. Rationale and competitive logic for a new business model based on a Tocumen air logistics hub and airport city/aerotropolis
2. Key features of air logistics hubs, airport cities and aerotropolises evolving in the U.S., Europe, Asia, and the Middle East
3. Economic impact and job creation at and around their airports
4. Air logistics hub/aerotropolis successes and failures, and reasons
5. Airport-driven commercial components (both inside and outside the airport fence)
6. Tocumen air logistics hub and airport city/aerotropolis potential – its credibility and viability, including transferability of the successful experiences in the U.S., Europe, Asia, and the Middle East

B. Tocumen Infrastructure and Facilities Design Guidelines

1. Air logistics hub and Aerotropolis infrastructure design and configuration
2. New central cargo area and facilities design
3. Intermodal interfaces (air, highway, rail, and links to Panamá's ports)
4. Electronic data interchange (EDI) and IT system guidelines
5. Infrastructure and facility expandability, reconfigurability and phased growth

6. Designing for future tenant and business user needs of your air logistics hub and airport city
- C. Tocumen Air Logistics Hub/ Airport City Business Plan Guidelines
1. Creating an attractive business environment at and around the airport
 2. Tocumen air logistics hub/airport city critical success factors
 3. Business resource needs (e.g., free trade zones, accelerated permitting)
 4. Functional capabilities required and marketing principles
 5. Recruitment of additional passenger and air cargo service
 6. Tocumen Air Logistics Hub/ Airport City target industries
- D. Tocumen Air Logistics Hub/ Airport City Implementation Plan Guidelines
1. Infrastructure phasing and development timetable
 2. Providing appropriate investor incentives
 3. Coordination and harmonization with key actors, governments, and organizations throughout Panamá
 4. Placemaking and branding the new Tocumen Airport City and broader Aerotropolis as a destination, including airport city design standards
 5. Institutional and management guidelines for Tocumen air logistics hub/airport city development & operation, including strategic investment and development partners
 6. Recommendations and action steps for the successful development of a Tocumen air logistics hub, airport city, and broader Aerotropolis

Some modifications were made in the titles and order of the subsections to make the chapters flow better. All content, however, remains consistent with the ICAO scope of work for this project.

Chapter 1

The New Airport Planning Model

1.1 Macro Context and Panamá's Challenges

Panamá is estimating to strive (with good successes) to gain competitive regional advantage in a rapidly transforming global economy. Once determined primarily by cost and quality of goods and services produced, competitive advantage in the new economy is increasingly being shaped by connectivity, speed, and agility of moving people and products.

Panamá has done well in leveraging its splendid natural environment and relatively low cost of living in attracting tourists and second home owners. It has leveraged its flexible regulatory environment to grow a strong service sectors, including banking, insurance, logistics, and free trade zones. It has also leveraged its expanding canal to bolster construction employment and related support services. It has fared less well in aviation-dependent high-tech manufacturing and high-value perishables sectors that typically create better-paying jobs and more prosperous communities. As a result, both the Republic's agricultural and manufacturing exports are not as strong as they could be, but

remarkable potential exists given Panamá's strategic location and Tocumen International Airport's assets.

Development has also largely occurred in a strip fashion hugging the region's coastal areas where tourists, second home owners, and higher income residents seek the amenities its fine beaches offer. Despite the Republic's land-use planning efforts, much of Panamá's commercial development has occurred in a spontaneous, haphazard, and sometimes unsightly manner, detracting from the natural assets that the nation holds and posing negative consequences for its physical (and social) environment. Surface transportation constraints have made Panamá a much larger country than it is in terms of time and cost of traversing its territory and connecting more rural areas to its ports and Tocumen airport.

A number of reports have been prepared over the past ten years, describing the challenges and opportunities the region faces in diversifying and upgrading its economy. The reports point to some encouraging signs such as (1) increased emphasis on education and workforce skill acquisition which is the foundation of national competitiveness, (2) new transportation infrastructure being developed, especially the Panamá Canal expansion that commenced in 2007 and is expected to be completed in 2014 at a cost of \$5.3 billion, and refurbished ports and airports (including Tocumen's expansion) which have potential to attract business and industry, boost trade, and drive economic

development throughout the Republic with improved connecting highways, and (3) growing clusters of tourism and logistics facilities complementing an already powerful financial services sector.

Those reports all correctly emphasize that the Republic cannot compete solely on the basis of climate, location, natural beauty, and relatively low cost of living. New engines for economic development must be implemented that substantially grow Panamá's jobs as well as provide the leveraging infrastructure for greater trade, and to attract more time-critical sectors such as microelectronics, pharmaceuticals, and high-value perishables.

It is likewise important that Panamá's traditional tourist and logistics industries be bolstered. Only with concerted, coordinated efforts simultaneously addressing the needs of Panamá's emerging and existing industrial bases can community prosperity be achieved that will create employment opportunities and greater prosperity for those at all rungs of Panamá's socio-economic ladder.

Critical issues are at stake. Will Panamá diversify successfully into high tech assembly and high-value agricultural and other perishables sectors? Will both the Republic's more traditional tourist, logistics, and goods-processing sectors be able to compete effectively in the globally integrated, speed-driven marketplace? Will Panamá better capitalize on its expanded canal and expanded and modernized Tocumen Airport, as well as on its planned multimodal surface

and sea transportation infrastructure to attract more investment and create higher quality jobs? Finally, will commercial development on and near Tocumen Airport be economically efficient, attractive, and environmentally sustainable, becoming an enduring magnet for firms, tourists, workers, and residents alike?

All these issues, of course, are inextricably interwoven. Taken together, they will help determine the economic fate of Panamá. It is therefore imperative that they be addressed with both strategic vision and coordinated action. This requires, first, a solid understanding of the new drivers of 21st century business competitiveness, job creation, and economic development. Second, Tocumen SA, in partnership with surrounding developers and government officials, must implement an integrated set of strategies, policies, and programs to harness and leverage these new competitive drivers for the entire Republic's economic advantage.

Regarding new commercial realities, it is already clear that an increasingly fast-paced, globally networked economy is changing the rules of competition and business location. These rules are being altered by a catalytic convergence of digitalization, globalization, aviation, and time-based competition. Speed, agility, and connectivity have become the mantra of many of the world's most successful firms. Despite record oil prices and financial difficulties many airlines (excluding Copa, of course) and other transportation service providers are

currently facing, few knowledgeable people predict anything but growing importance of these three factors and, therefore, a heightened role of aviation in the future.

All the above is creating a new economic geography with commercial airports driving and shaping business location and urban development in the 21st century as much as highways did the 20th century, railroads in the 19th and seaports in the 18th. Airports are becoming key nodes in time-critical manufacturing, distribution, and commercial systems and engines of a local economic development, attracting air commerce-linked businesses of all types to their environs. These include, among others, perishables and cool-chain facilities; just-in-time manufacturing and distribution; e-commerce fulfillment and third-party logistics firms; hotel, tourist, and exhibition complexes; and office buildings that house air-travel intensive professionals such as consultants, auditors, and multinational corporate executives.

As more and more aviation intensive businesses cluster near airports and along transportation corridors radiating from them, a new urban form is emerging—the Aerotropolis—stretching up to 20 kilometers outward from some airports. With the airport serving as a multimodal transportation and logistics nexus, strings and clusters of business and technology parks, industrial parks, distribution centers, university and medical/wellness centers, information and

communications technology (ICT) complexes and tourist attractions are forming around the airports and along connecting surface transportation corridors. Even places and cities located as far as 60 minutes drive from some airports are experiencing accelerated economic growth, as will be documented later.

Such development is occurring because of the connectivity and accessibility advantages commercial airports (especially these that have developed supporting multimodal logistics infrastructure) provide to business and business people in the new economy. As I will show, airport development and economic development are going hand-in-hand around the world.

Well planned, aeronautical expansion and commercial land-use development at Tocumen Airport have excellent potential to attract business to its airport city site and surrounding aerotropolis. As noted, 300 hectares of recently acquired airport property has been identified for commercial tenants. A large amount of developable land along its northern taxiway near its cargo complex offers opportunities for direct air freighter access to many future logistics and other time-critical good processing facilities. Other opportunities also exist for a new state-of-the art northern cargo zone serving larger air freighters and logistics facilities closely associated with air cargo.

Surrounding the airport is Panatropolis consisting of approximately 2,000 hectares of developable and preserved land that is being planned by private

developers for logistics, commercial, and residential development. Coordinated development should complement Tocumen's planned Airport City and boost its passenger and cargo numbers. Numerous other commercial developments are underway near Tocumen that will be described in Chapter 2.

Broader regional efforts are taking place to upgrade connecting highways and Panamá's three major ports as well as potential to develop an inland port and intermodal rail/truck complex. The objective would be to create an integrated quadramodal (air, truck, rail, seaport) complex that will make an extended airport region an even more powerful magnet for business and industry.

With this opportunity in mind, the International Civil Aviation Organization (ICAO) commissioned this report to provide the vision, strategic guidelines, and action-specific recommendations for Tocumen International Airport (PTY) to become a catalyst for business recruitment and local and national economic growth through land-use and commercial development that is economically efficient, attractive, and environmentally sustainable. Pivotal to the vision, strategy and actions, is developing PTY into a significant multimodal air logistics hub that will drive airport-linked industrial and commercial development on its property and substantially beyond airport perimeters, creating a Panamá Aerotropolis.

To set the context for this vision and strategy for a Panamá Air Logistics Hub and Aerotropolis centered on Tocumen, the remainder of this chapter will (1) elaborate their underlying business rationale and competitive logic, (2) provide concrete examples of air logistics hub/ Aerotropolis success elsewhere, and (3) discuss the credibility and viability of successfully transforming PTY into a successful air logistics/airport city complex that powers aerotropolis and national economic development.

Following this introductory chapter covering the above issues, three additional chapters offer, in order, the (1) infrastructure and facility planning guidelines, (2) business plan guidelines, and (3) implementation plan guidelines to assist those who will design, develop, and manage future phases of the PTY and its surrounding areas to generate the greatest local and national economic impact. Critical success factors will be presented as well as target industries specified. To attract newer, higher value-adding businesses and industry, it is stressed that the relative importance of traditional tax incentives by government will be superseded by logistical capabilities of the airport and its connected areas offering firms quick and efficient access to national and global suppliers, customers, and tourists.

The report concludes with 30 recommendations and action steps to be followed by Tocumen SA and others responsible for PTY, Panatropolis, and the

greater airport region to successfully develop the air logistics hub, airport city, and broader aerotropolis. Those recommendations and action steps focus on required hard and soft infrastructure as well as the commercial aviation (both passenger and cargo airlines) enhancement and airline recruitment strategies to be pursued to provide greater global connectivity. The recommendations will also address infrastructure and facility phasing and marketing strategies along with the public and private sector options for developing, operating, and managing an expanded air logistics/commercial complex at Tocumen while promoting and coordinating extended Panamá Aerotropolis development.

1.2 Business Rationale and Competitive Logic for 21st Century Air Logistics Hub and Aerotropolis Development

In his influential book, *The World Is Flat: A Brief History of the Twenty-first Century*, Thomas Friedman makes it clear that an increasingly fast-paced, globally networked economy is changing the rules of competition and business location. With speed, agility, and connectivity becoming the mantra of many of the world's most successful firms, airports and their surrounding areas have become key nodes and magnets for time-critical manufacturing, distribution, and corporate enterprises that require quick access to distant suppliers, customers, clients and partners nationally and globally. Aviation networks operate as the

new physical Internet connecting supply chains and business people quickly and efficiently across distant markets. As a result, as I noted, airport development, business development and regional economic development are going hand-in-hand around the world.

Driving much of this development process is the growing importance of fast-cycle logistics, especially that which utilizes air cargo. In fact, the 21st century is becoming the “Fast Century”. Customers from international markets are demanding speedy and reliable delivery of products, often with distinctive features. An industrial advantage is thus being gained by firms that respond flexibly and rapidly to their domestic and global customers, delivering lower cost, higher-quality (often customized) products quickly and efficiently.

For example, high-tech manufacturers must be able to access national and global networks of suppliers of materials, components and sub-assemblies in order to obtain the best-quality components at the lowest possible price. Likewise, contract drug and medical testing often requires 24-hour turnaround from source to test site and often back to source, the latter usually done electronically. The value of fresh fish and fresh cut flowers is tied to speed of delivery from sea or farm to customers often thousands of miles away.

At the same time, increased flows of information worldwide are leading to rapid changes in customer demands. Companies that can detect these

changes, design and produce the desired products, and deliver them more quickly than their competitors capture market share. Since speed also reduces warehousing and inventory costs, stock-outs and remaindered goods, the speed advantage becomes a cost advantage as well.

Fast-cycle logistics as a new competitive tool is being further validated by marketing research which shows that, worldwide, consumer tastes and product demands are changing much more swiftly today than was the case in prior decades. Indications are that such shifts will accelerate even faster in the decades ahead, resulting in situations where products that are “hot” one month may become obsolete just a few months later. Such is already happening in the fashion clothing industry and with digitized devices like iPhones where delivery time to the retail shelf (or now directly to the customer) frequently separates market winners from losers.

The implications of these trends for fast-cycle logistics strategies are already evident. Adapting to growing market demands for flexibility and speed, companies such as Apple, Benetton, Boeing, Dell, GlaxoSmithKline, Nokia, Siemens, and Walmart are re-engineering their sourcing and distribution systems to become much more agile and customer responsive. They now compete not only on price and quality but also on the basis of speedy, reliable delivery, and after-sales support (sometimes including repair and return) of their products.

They manage complex networks that encompass the entire value chain of suppliers, distributors, and customers across national borders.

Mandating such changes are rapid and relentless worldwide technological, political, and economic transformations. Modern transportation, telecommunications, and goods-producing technologies have spread throughout the globe. Trade policies are being liberalized and new markets opened. Communist and former socialist countries such as China, Russia, Poland, and Vietnam have entered the capitalist marketplace with vigor. Huge wage differences between advanced industrial and developing countries have resulted in much wider geographic dispersion of component manufacturing sites, places of assembly, and of final sale. With rising workforce skills in developing nations and rapid cross-border technology transfer, countries such as Brazil, China, India, Malaysia and Poland have achieved much greater levels of economic output and now produce highly sophisticated products.

International customers have also become far more sophisticated and demanding. They have available an unparalleled variety of products from all over the world. They are able to assess and identify value, and are therefore highly selective in purchasing. They expect quality, competitive pricing, and reliable delivery. They also want customization of the products they buy, and

they want these customized products right away, not in two to six months. For many purchases, not even two to six weeks is fast enough.

1.3 E-Commerce and Order Fulfillment

The rise of e-commerce further heightened time-based competition and the importance of airports. As late as 1995, sales through the Internet were essentially zero. By 1999, U.S. Internet-based business-to-consumer (B2C) sales alone had grown to nearly \$7 billion, skyrocketing to over \$140 billion in 2010, a 200 percent increase compared to a 28 percent increase in total U.S. retail sales (U.S. Department of Commerce, 2010). According to Forrester Research, 166 million packages were shipped in 1999 by Internet retailers (e-tailers), with approximately 70 percent going by expedited delivery. By 2003, e-tailers were shipping 1.1 billion packages annually. This grew to nearly 2 billion packages in 2006 and exceeded 3 billion in 2010.

These statistics reflect the growth on on-line sales. Online retail sales in the U.S. alone according to Forrester Research exceeded \$150 billion in 2010, excluding travel; travel adds approximately another \$120 billion more. By 2013, U.S. online sales of \$229 billion are anticipated with \$158 billion in travel, according to Forrester Research. Many of the products that Forrester sees as

growing in popularity are likely shipped by air such as health products and consumer electronics.

Despite the death of thousands of “dot coms” between 2001 and 2004, it is near consensus among economic and business forecasters that e-commerce will flourish in the future. 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 quickly shipped to next-stage producers. Manufacturers already are able to 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 e- marketplaces (auctions, aggregators, bid systems, and exchanges) is greatly expanding B2B e-commerce: Forrester Research estimates that e-marketplaces currently account for up to two-thirds of B2B supply-chain transactions, depending on the industry, capturing 42 percent of online industrial trade and an average 28 percent of all business-to-business trade. Many suggest that with the widespread introduction of Enterprise Resource Planning (ERP), these e-commerce figures will go much higher in the near future. According to e-marketer, B2B e-commerce which stood at \$551 billion in 2003 reached \$1.3 trillion in 2008 and continued to rise.

The expansion of the B2B e-commerce and direct-to-customer Internet orders has placed a particular premium on speed and reliability in the delivery process. To meet these new imperatives in order fulfillment, e-commerce distribution centers are being built near air express hubs that have speedy, reliable shipping networks. Air express hubs actually extend the business day for e-commerce and other forms fulfillment by allowing shippers drop off orders for expedited national or global delivery as late as 11:00PM. Dozens of such e-retailers have located their fulfillment centers near Memphis International Airport to leverage FedEx's world-wide air express services. The same trend holds for Louisville International Airport and Indianapolis, where numerous companies have also sited e-commerce and other fulfillment centers near these air express hubs. This trend fits exceptionally well with Copa's plans to make Tocumen an air express and courier hub.

Complementing airport-linked fulfillment centers are flow-through facilities for perishables (either in the organic 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 notebook computers and mobile phones. The clustering of such time-critical goods facilities near air-express airports is stimulating further expansion of air cargo, less-than-load (LTL) trucking, freight forwarders, and third party logistics providers (3PLs) along major highways with quick accessibility to these airports.

Speedy, reliable delivery of products over long distances has become so critical to the new economy that air commerce is quickly becoming its logistical backbone. According to the International Air Cargo Association, nearly forty percent of the value of world trade now goes by air, and the percentage is steadily rising. Air logistics, which includes air cargo, air express, and their supporting logistics services represented a \$270 billion industry in 2010. It is expected to nearly triple by 2025, while international air-express shipments are expected to increase at least four-fold during this period (Boeing Company, 2010).

Already, air cargo and air express are the preferred modes of international shipping of higher value to weight B2B transactions in microelectronics, medical instruments, mobile telephones, high-end fashion clothing, pharmaceuticals, optics and small precision manufacturing equipment, as well as many perishables such as seafood and fresh cut flowers. (See the global supply-chain model of iPhone 4 in Exhibit 1.1) Even lower value to weight B2B product distribution including apparel, shoes, and seasonal toys are becoming time-sensitive and increasingly shipped by air.

1.4 The Importance of Air Passenger Service

It's not just impatient boxes that cluster around airports. As the world's service economy also shifts into fast-forward, these airports are becoming magnets for regional corporate headquarters, trade representative offices international banks, and professional associations that require executives and staff to undertake frequent long-distance travel. Airport access is likewise a powerful attraction to information-intensive sectors such as consulting, advertising, legal, medical, and specialized financial services, data processing, accounting and auditing, which often send out professionals to distant customers' sites or bring in their clients by air. This has been particularly the case at commercial airline hubs which offer greater choice of flights and destinations, more frequent service, and more flexibility in rescheduling.

With the shortest time between two distant locations being a non-stop flight, the accessibility commercial air passenger hubs has become essential to attracting business meetings and conventions, trade shows, exhibitions and merchandise marts. Such long-distance accessibility has made them attractive locations for large venue tourism and entertainment venues (e.g., theme parks, Formula 1 race tracks, etc.).

High-tech workers and airports also increasingly reinforce each other. With intellectual capital supplanting physical capital as the primary factor in 21st

century wealth creation, time has taken on heightened importance for today's knowledge workers as has the mobility of these workers over long distances. Research (Erie, Kasarda, McKenzie, and Molloy, 1999) in the U.S. has shown that high-tech workers travel by air 400 percent more frequently than workers, in general, giving rise to the term “nerd birds” for aircraft connecting U.S. techie capitals such as Austin, Boston, Raleigh-Durham and San Jose.

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 that lead to future face-to-face meetings. (See Business Week, August 20–27, 2007 cover story “The Future of Work” for illustration of this.) In point of fact, every significant advance in telecommunications technology has led to greater travel beginning with Alexander Graham Bell's first words over his newly minted telephone: “Watson, come here, I need you.”

Others have suggested that prolonged global economic downturns exacerbated by catastrophic events such as 9/11 and the constant threat of terrorism, along with contagious disease outbreaks such as swine flu (H1N1) will permanently diminish air commerce, in general, and passenger travel, in

particular. This does not seem likely since the business imperatives giving rise to the growth of air commerce and business travel (speed, mobility and global access) are increasing in importance. From 2004 to 2006, air cargo and air passenger travel rebounded strongly from their 2001 to 2003 cyclical dips, as they have from their 2008-09 dips (see Exhibit 1.2).

There are also those that contend that rising jet fuel prices or greenhouse gases (to be addressed in the final chapter, in depth) will limit future growth in commercial aviation and, hence, airport-linked development. This has not happened thus far and, in my opinion, is unlikely to slow forecasted aviation growth. Moreover, significant advances are in the works on more fuel efficient jet engines which reduce emissions while aircraft manufacturers, airlines, and airports have commenced all-out efforts to reduce aviation's carbon footprint.

According to figures released by Boeing at the June 2011 Paris air show, the 4.9 billion passengers traveling annually world-wide in 2010 are forecasted to grow to over 13.3 billion by 2030, with air cargo projected to grow at even faster, more than tripling in this time period. With rising income levels around the world (especially in large emerging markets such as Brazil, China and India) leisure travel is expected to mushroom along with business travel. There is thus every reason to believe that the 21st century will indeed become known not just as the Fast Century but also as the Aviation Century.

1.5 Economic Impact and Job Creation at and Around Airports

Nowhere is the impact of airports becoming greater than the centerpiece of the new economy – high-tech. With this sector's supply-chains and employees increasingly geared to speed, connectivity, mobility, and global access, extensive air service has become essential to the location of many information and communications technology (ICT) firms and other high-tech facilities. Clusters of ICT and high-tech companies are therefore locating along major airport corridors, such as those along the Washington, D.C. Dulles 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 U.S., and throughout the world with centrality in aviation networks (i.e., serving as an airline hub) becoming a primary predictor of an area's high-tech job growth.

Regarding overall economic development, numerous studies from the U.S. and around the world document the remarkable impact of larger airports on urban economies. To note just a sample which will be elaborated later:

Los Angeles International Airport (LAX) is responsible for over 400,000 jobs in the five-country Los Angeles region; 80 percent of which are in LA County, where one in 20 jobs was found to be tied to LAX. The airport generates \$61 billion in regional economic activity, which translates to \$7 million per hour.

An August 2007 study on the economic impact of overseas flights alone on LAX revealed that such flights add \$82.1 billion annually to LA firms and account for 363,700 jobs in the LA area.

Dallas-ft. Worth International Airport has become the primary driver of Metroplex's fast-growing economy. Major commercial development has occurred around the airport's peripheries and outward. For example, 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-Mobil, GTE, Hewlett-Packard, and Microsoft.

Memphis International Airport (world headquarters of FedEx) is responsible for over 160,000 jobs in the metropolitan area. One of four jobs in the region is tied to the airport, which has an annual economic impact in 2009 of \$29 billion. Air cargo and air express operations account for 95 percent of the airport's economic impact and regional job generation. I will return to Memphis later in this chapter.

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 1 million in 2010. Among the companies located along the airport corridor near Dulles are America Online, Computer Associates, Nextel Communications, Cisco Systems, and EDS. So substantial has development been

around the airport that the metropolitan Washington Airport Authority recently purchased 400 acres outside the fence but adjacent to its 400 acre air cargo complex for joint development with a private master developer.

Ontario California International Airport, which is the west coast regional air express hub for UPS, with a strong FedEx presence as well, has been the engine of major growth in Southern California's Inland Empire. Over 10 million square feet of logistics and distribution space have been added annually around the airport and along nearby I-10 and I-15 Interstates. Now class A office clusters and tourist attractions are following.

Indianapolis International Airport is FedEx's second largest hub. The hub has had a growing impact on the Indianapolis Region. So successful has this hub been that FedEx just completed a \$214 million expansion of its operations there adding over 600,000 square feet to its existing 1.9 million square foot facility. FedEx now employs over 5,000 workers in Indianapolis, up from just 368 employees when the hub opened in 1998.

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 regional hub at Subic Bay in 1995, over 200 firms—employing 54,000 workers—have located there, generating almost \$2.5 billion in investment. Between 1995 and 2008 the annual value of exports from Subic Bay

jumped from \$24 million to almost \$1 billion. Wistron Infocom Corporation (formerly part of 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. Nearer to Manila, the former U.S. Clark Air Base is attracting tens of thousands of information and communications technology and other high-tech manufacturing jobs.

In Penang, Malaysia air cargo has created a “Silicon Island” contributing immensely to job creation near the airport. Dell Inc. manufactures 100% of its laptops in Malaysia. The company relies heavily on air express in its Malaysian facility sourcing and exports, having over 2,000 employees alone there, with \$5 billion in its sales originating from Penang. Its firm clustering impact has also been huge as 70 Dell suppliers have either manufacturing centers or distribution centers at Penang, providing parts and components.

Viracopos Airport in Campinas, Brazil, is a major regional air express hub with a substantial FedEx presence; 10 percent of all Brazilian air imports arrive through air cargo facilities there. Viracopos has greatly contributed to Campinas becoming the second fastest growing high tech area in all of Latin and South America, with investments in microelectronics and information and communications technology (ICT) totaling US\$9 billion in the past 12 years. Fifty Fortune 500 companies have located high tech manufacturing facilities in

Campinas, including IBM, Motorola, Lucent/ Alcatel, Samsung, and Texas Instruments making it the Silicon Valley of South America.

The impact of airport-induced job growth on land use in the vicinity of airports is likewise substantial. Recent research at UNC's Kenan Institute of employment growth in the suburban rings of U.S. metropolitan areas showed that areas within six miles of airports are adding jobs much faster than the overall job-growth rate of the suburban ring within which the airport was located. While most of the employment is concentrated near the airport or along major connecting highways within 15 to 20 minutes of the airport, research at Massachusetts Institute of Technology's International Center for Air Transportation documents that impacts occur up to 60 miles from airports with air connections significantly facilitating a region's access to suppliers, markets, ideas and capital (EconSouth, 2003).

1.6 Selected Airport Cities and Aerotropolises in Evolution

To gain a better understanding of the essential elements of airport cities and aerotropolises developing around the world, I will highlight their existing and planned commercial components, beginning with a selection from the U.S. To obtain an understanding of the types of commercial development at and around airports that Tocumen may expect in the long-term (as well as some in

the shorter term), I describe logistics/Aerotropolis development at and around selected major airports. I then turn my attention to smaller air logistics hubs and aerotropolises in evaluation of pertinence to Tocumen.

1.6.1 Dallas-Fort Worth

DFW is the cornerstone of Dallas-ft. Worth Metropolis, the fastest growing region of Texas (see Exhibit 1.3). Its regional economic impact is estimated to be \$19 billion in 2006.

The airport property itself is enormous – 18,000 acres, covering parts of 4 cities and two counties, and exceeding the size of Manhattan Island. Airport officials plan to take advantage of the airport's vast size by developing nearly 6,000 acres for commercial use over the next 20 years.

Airport property development is targeted to six key areas as shown in Exhibit 1.4. Two are for planned air cargo expansion (East Air Cargo, which has hundreds of developable acres, and West Air Cargo which anchors most current cargo facilities). DFW management is pressing hard for additional wide-body passenger and cargo flights to Asia (especially China). They have also formed partnerships with commercial real estate firms such as Trammell Crow and air cargo oriented investors such as AMB to construct “high velocity flow-thru”

cargo facilities in the west cargo area. Such large commercial real estate companies not only have expertise in state-of-the-art cargo facility development, but they also bring with them a rich network of potential cargo and other logistics tenants.

International Commerce Park (see Exhibit 1.5) is targeted to light industrial, freeway commercial, and flex office development. It currently has 264 acres leased with 115 remaining for industrial/commercial development.

A retail/hospitality/entertainment complex is planned on the northwest corner of the airport. Covering nearly 200 acres it will contain mixed use retail, restaurants, garden offices, a hotel and entertainment facilities (see Exhibit 1.6).

Bear Creek Office Park is an 1,800 acre tract with open space amenities being marketed primarily as a corporate campus site (see Exhibit 1.7). Because of natural streams and floodplain in this park, substantial open space must be maintained. The land-use plan thus calls for two 18 hole championship golf courses along with wildflower meadows and heavy tree cover. It is felt that this environment will be optimal for office development just minutes from the airport terminals, with open-space amenities desired by today's knowledge workers. A smaller amount of shielded light industrial and mixed use development may also be in this large tract's future.

Southgate Plaza is a 45-acre hybrid development at the southeastern end of the airport (see Exhibit 1.8). An innovative public-private partnership was formalized in April 2009 between the airport authority and the private-sector real estate developer which will serve as the master developer of Southgate Plaza, a 1.5 million square feet mixed use airport property project. Utilizing a ground lease, the developer is providing all of the internal infrastructure (roads and utilities). In turn, all ground rents go back to the develop until the infrastructure costs are paid back. This saves the airport upfront infrastructure costs. Moreover, operating as a private-sector firm, the developer can move much faster since it does not have to meet traditional government bureaucratic regulations in awarding construction contracts.

Designed to be DFW's southern gateway, Southgate Plaza is proposed to accommodate two hotels, office complexes, and restaurant and retail space. Connected to terminals via shuttle bus service the project will create 2,700 permanent jobs, US\$95 million in wages and salaries and an initial \$3.2 million in rent annually for the airport. As noted, this rent will be rebated to the developer until infrastructure development costs are paid back.

In addition to those planned at Southgate Plaza, hotels have become pivotal to DFW's airport city environment. These include the large existing

Hyatt Regency DFW and Grand Hyatt attached directly to its international passenger terminal.

DFW's Grand Hyatt featuring meeting rooms and concierge business support services represents how airport hotels are increasingly acting as virtual headquarters for new economy firms and are shaping a new corporate meeting style. The following paragraph extracted from the August 20-27, 2007 issue of Business Week magazine on the future of work, illustrates:

The fact that virtual connections still need to be balanced with face-to-face contact places the airport squarely in the path of modern urbanism. Consider the experience of Sage Software Inc., a \$1 billion company which sells software to help businesses run better. It has 30 locations throughout the U.S., the result of a nine-year acquisition spree, but no headquarters. So its eight-member executive team, scattered from Tampa, Fla., to Irvine, Calif., fly once a month to Dallas. There they check into the Grand Hyatt DFW in terminal D for two days of meetings. Everyone can get there for a 1 p.m. start, work until 6 p.m., get dinner together, and then work all day the next day until 5 p.m., when they run for the next flight home.

Commercial activity and resulting non-aeronautical revenues have become critical for DFW to meet its infrastructure and facility expansion and modernization needs. It has also helped the airport be more competitive and connected by keeping airline costs down. In 2010, 65 percent of DFW's revenue came from commercial activities.

While DFW is evolving as a new urban core of Metroplex, its economic reach and impact extends many miles out along nearby interstate highways and expressways. Two excellent examples of this are Infomart and Dallas Market Center, both of which are located on the I-35 corridor to DFW. Infomart is a huge, ultra-contemporary merchandise mart for information and communication technology (ICT) companies. Tens of thousands of visitors travel through DFW annually to attend Infomart trade shows.

Dallas Market Center – a cluster of four large buildings that contain nearly five million square feet of display space for fashion clothing and home merchandise – is the world's largest wholesale merchandise mart. Hundreds of thousands of buyers and vendors fly into Dallas annually to conduct business at Infomart and Market Center. In 2010, Dallas Market Center alone attracted buyers and vendors from all 50 U.S. states and 84 countries, who purchased 300,000 airline seats and filled 720,000 nearby hotel rooms while conducting an estimated \$8 billion in wholesale transactions.

The airport has been a major factor in attracting nearly 20 Fortune 500 corporate headquarters to the broader airport region including five major Fortune 500 headquarters to Las Colinas just east of DFW. This 12,000 acre airport-linked community has 22.3 million sq. ft. of class A office space, 8.5 million sq. ft. of light industry, 1.3 million sq. ft. of retail, over 14,000 single- and

multi-family residences, 2,845 luxury and business-class hotel rooms, 75+ restaurants, and 4 championship golf courses. Dedicated light rail to DFW and to downtown Dallas is being developed.

Future regional passenger rail to DFW will be an important and integrating feature of the broader airport region with longer-term sustainability implications to reduce airport area congestion. Exhibit 1.9 illustrates planned routes of future light rail, commuter rail and high-speed rail lines that will feed into DFW's terminal stations.

As is common in Texas, nothing is planned and developed in a small way. What impresses me, though, is the recognition by airport management and airport-area planners of the growing importance of aesthetics and environmental amenities as they develop properties.

1.6.2 Memphis

In less than 30 years, FedEx has transformed Memphis from a sleepy mid-size southern city into a global trading center. Its Memphis hub is the largest, most connected air logistics complex in the world. In 2010, the airport handled 4.1 million metric tons of cargo, 96% due to FedEx which processes over 3.3 million packages per day on average.

Burlington North Sante Fe Railroad (BNSF) has opened a new \$200 million Memphis intermodal facility in early 2010. The expansion increases the size of the facility to 185 acres and provides the potential for 1 million lifts a year. As of January 2011, Delta/Northwest Airlines offered 279 daily scheduled departures to 89 U.S. cities and to Amsterdam.

As a result of the FedEx presence, the economic impact of Memphis International Airport is immense. According to a 2009 study by the University of Memphis, the airport had a \$29 billion impact on the metropolitan economy in 2008, \$27.1 billion resulting from air cargo activities. A total of 220,154 jobs in the metro area are tied to the airport (32,000 employed by FedEx alone) which constitutes over 1 in 4 jobs in the Region. Almost half of the businesses in the Memphis area feel that their economic future is linked to the airport.

Because of the high employment multiplier effects of air express and air cargo activities (e.g., trucking, logistics, and distribution centers, time-sensitive assembly, repair and testing, etc.). Memphis International Airport has an economic impact greatly disproportionate to its passenger numbers and population base (see Exhibit 1.10 for comparable 2004 figures). For example, while Phoenix Sky Harbor Airport has nearly four times the annual passengers and its metropolitan population base is three times larger than Memphis,

Memphis International has an economic impact that is 50 percent larger than Phoenix Sky Harbor airport.

A substantial aerotropolis is evolving at and around Memphis International Airport. In addition to logistics and distribution facilities, hotels, office parks, retail and entertainment complexes are locating along airport corridors. The FedEx hub has attracted major arterial clusters and strings of logistics and distribution facilities (see Exhibits 1.11 and 1.12). These include:

- World's largest laptop computer repair depot – Flextronics repairs 3,000 laptops each day with same-day turnaround
- World's largest cornea bank – The National Eye Bank Center
- World's largest DVD distribution center – Thomson Technicolor ships 1.2 million DVDs per day (½ of DVDs purchased in the U.S.)
- Largest overnight drug testing center in the U.S. – Advanced Toxicology runs up to 10,000 lab tests per night for next day delivery

Major national distribution facilities for Hewlett-Packard, Sharp, Cingular, Jabil Global, Pfizer, Baxter, GlaxoSmithKline, Medtronic, and many others have located in Memphis largely because of the FedEx hub. Some of these, such as Sears logistics services, Hewlett-Packard, Nike, Williams-Sonoma and Thomson Technicolor, operate distribution facilities that exceed two million square feet.

To foster between growth around the airport and throughout the broader region, which composes the Memphis Aerotropolis, two organizations have been formed. One is a Memphis Airport Area Development Corporation, which is

focusing on aesthetic improvements and investment in the immediate airport area. Operating with private-sector funding from a number of Memphis' leading corporations (e.g., FedEx, Medtronic, Elvis Presley Enterprises), the corporation has a full-time executive director and substantial operating budget. Its primary objective is upgrading the appearance of immediate airport area and drawing more attractive businesses to corridors leading into and out of the airport to create more positive impressions by business people and tourists coming to Memphis.

The second is a Memphis Aerotropolis Steering Committee composed of public and private sector leaders in the region. Four task groups have been created: (1) airport corridor planning and development, including high priority commercial clusters, (2) gateways and beautification to create short-term visual improvements in the immediate gateway area in collaboration with the Airport Area Development Corporation, (3) access and transportation to support passenger and freight movements and reduce congestion, and (4) marketing and branding including website development, promotional advertising in the media, and developing the brand of Memphis as “America's Aerotropolis”

In 2008, the Memphis Region Chamber of Commerce hired a full-time vice president for Aerotropolis and Logistics Development. This executive plays a

key role in coordinating and supporting aerotropolis initiatives by various public and private-sector groups across the Memphis region.

1.6.3 Detroit

Detroit officials are acutely aware that they are spiraling down economically and that bold steps must be taken to overcome the likely continuing decline in its automotive manufacturing sector and other traditional industries. In a regional assessment of its assets to compete in the new economy, one clearly stood out—the region's aviation connectivity through Detroit Metro Airport (DTW).

DTW is the sixth busiest airport in the U.S. in terms of takeoffs and landings serving 160 non-stop destinations in the U.S., Europe, Asia, and Latin America. Seven miles from DTW is Willow Run Airport (Detroit's original municipal airport) that has become a significant air cargo airport that is home to numerous charter cargo airlines, including the nation's leading on-demand heavy-lift cargo carrier.

Just to the south of DTW's runways and along and near the NAFTA I-94 corridor connecting DTW to Willow Run, the assessment showed that there were 25,000 acres of undeveloped land (see Exhibit 1.13). A public-private leadership

group was formed (now called the Detroit Region Aerotropolis Steering Committee, similar to Memphis' Aerotropolis Leadership Committee) to encourage zoning and development plans to leverage the two airports to attract new industry to the broader airport area and serve as a nucleus of renewed regional economic development and business competitiveness.

In 2006, nine governments near Detroit Metropolitan Wayne County Airport and Willow Run Airport signed a memorandum of understanding to co-operate in region-wide planning. The following year, a 35-member public-private leadership task force was established to oversee the formation of an aerotropolis strategy.

A Detroit Region Aerotropolis strategic plan, completed in 2008, identifies 13 primary development sites for airport-linked commercial development covering approximately 5,000 acres of land with potential expansion to 25,000 acres. The plan estimates that upwards of 60,000 jobs can be created.

An Aerotropolis Development Corporation (ADC) has been formed which will provide for a unified, cross-jurisdictional mechanism for moving the Detroit Region Aerotropolis forward. The ADC collaborates with local governments (two counties and seven municipalities) on four primary activities (1) marketing and business attraction, (2) master planning and design standards, (3) regulatory

assistance and incentives, and (4) inter-governmental communication and coalition building, including outreach to businesses, citizens, and landowners.

It will promote long-term partnerships among communities, build relationships with existing businesses in the region, co-operate with other economic development entities in the region, and work with the State of Michigan to provide financial incentives to attract air commerce businesses to the Detroit Region Aerotropolis. All of this will boost airport passenger and cargo volumes.

The ADC is being funded through membership fees by local government signatories (who compose the Corporate Board) and private-sector contributions. Reporting to the ADC Corporate Board is a 10-12 member executive committee of public and private sector participants, providing continuous oversight of the Development Corporations activities.

Over the past five years I have given a number of presentations to this group on the aerotropolis concept. From these presentations, the steering committee put together Exhibit 1.14 which illustrates how my generic model might be adopted to specific commercial and residential land uses, including the creation of a ring road with two aerotropolis corridors (I-94 and Ecourse Road).

One of the issues that concerned the Aerotropolis leadership group was how to overcome the image of Detroit as an unattractive, old industry “Rust

Belt” region. Most commercial development around DTW neither effectively leveraged the connectivity the airport offered, nor was it physically attractive — much of it being clusters of less expensive hotels and strips of conventional small stores and service establishments (convenience, gas stations, auto body shops), with some older factories and warehouses along the connecting highways.

When 1,300 acres just south of DTW were acquired by the airport authority and Wayne County for noise mitigation for the fifth runway, plans were drawn up to use this as a new image-building gateway to DTW to signal Detroit's emergence into the new 21st century economy. Over 1,000 acres were designated as Pinnacle Aeropark, with a planned physical layout, green space, and commercial facilities providing a much more appealing and contemporary “front door” to the Detroit region by air travelers (see Exhibit 1.21)

The project is designed with the physical features, site amenities, and support services to attract and support clusters of research and high tech firms, Class A office buildings, value-adding logistics and transformation centers as well as exhibition, education, and meeting facilities in an aesthetically pleasing and functionally integrated fashion. Amenities and support services proposed include, among others, luxury hotels, conference facilities, fitness centers, a championship golf course, jogging and biking trails, upscale shopping, restaurants, and a high-speed telecommunications infrastructure.

Wayne County, the initiator of the project, is envisioning the Pinnacle as a “business location with wings” fully leveraging the project's adjacency to Detroit Metro Airport to provide tenants and users with excellent national and global air access. Their assumption is that time-pressed executives and professionals whose responsibilities require frequent travel to branch facility, partner, or client sites will have access in minutes to DTW's passenger terminals for day and possibly even half-day business trips. Firms who frequently bring in their clients by air for meetings, presentations or direct service can host them with one day round trips, avoiding the costs of overnight stays. Those clients or colleagues needing to remain for longer periods will have available, convenient on-site amenities such as first-class hotel accommodations, golf, fitness centers, and quality restaurants and shopping. These amenities would also be available to international or other long-distance travelers connecting through DTW and as an attractive “airport city” destination for local residents.

To attract high-tech goods-processing firms, supply-chain management and value-adding logistics service providers will be targeted. As the FedEx hub at Memphis has demonstrated, in many new-economy industries, hours and even minutes are of critical importance to meeting market objectives. Examples here include medical and pharmaceutical laboratory testing facilities, organ banks, and lost credit card reproduction, all of which depend on rapid national and global shipping turn-around.

To appeal to today's knowledge-workers and new economy industries, the Pinnacle plans to blend efficient business form and function with on-site amenities. Carefully planned and aesthetically integrated clusters of flex-tech, research and development, clean light manufacturing, and value-adding logistics/transformation (as opposed to big-box warehouse and distribution) facilities will radiate from the core. These facilities, which will be developed following covenants, restrictions, and quality construction design standards, will have contemporary, architecturally appealing facades with buildings interspersed with biking and pedestrian trails. The Pinnacle's planned distinctive roundabout serving as the town center, landscaped green space, and campus-like clusters of commercial facilities will be highly visible to millions of U.S. and international passengers flying into and out of Metro each year, acting as a reinforcing 21st century visual complement to the new \$1.2 billion McNamara terminal that most will pass through (see Exhibit 1.22).

Numerous studies have documented that knowledge-workers and their high tech firms frequently seek architecturally distinctive, planned campus-like settings that are relatively self-contained and provide green space and opportunities for active recreation. Incorporating such land use, the Pinnacle hopes to set the standard for Detroit Region Aerotropolis development and go a long way toward transforming the commercial use of the airport area. Its planned site design, architectural features, and anticipated commercial tenants

would no doubt markedly improve the appearance of the airport area while helping change southeastern Michigan's image from a region of traditional manufacturing to a location for high tech firms.

In terms of commercial use, initial Pinnacle planning shows approximately 25 million square feet (576 acres) devoted to “flex tech” buildings that will enable customized allocation and periodic reallocation of administration, research, laboratory testing, engineering, production, and materials processing either under one roof or in one concentrated area. Approximately 4.7 million square feet (109 acres) are allocated for value adding logistics/transformation facilities that conduct supply chain management, kitting, sequencing, reconfiguration as well as information technology functions for tracing and tracking goods flows around the world. There are also 3.6 million square feet (83 acres) allocated for commercial development, and 2.9 million square feet for Class A offices. The remaining acres are designated for landscaped open space, recreation, and rights-of-way (see Exhibit 1.23).

At full development, phased over an estimated 15-year time-frame, the Pinnacle has been targeted to generate approximately 25,000 full-time jobs, including 13,000 in office, research, and technology, 7,500 in logistics, and 4,300 in retail/commercial. It is anticipated that this project will evolve into the central business district (or airport city) of the broader Detroit Region Aerotropolis.

Attracted by easy air transport and availability of land, a number of businesses have decided to set up shop near the airport and in the process, create jobs. General Electric recently announced plans to build a wind power R & D facility near the airport. This could bring 1200 jobs to the area. General Motors and A123 Systems, a battery maker, have also announced plans for plants and together, they could employ 4,000 or 5,000 people.

1.6.4 Kansas City

Kansas City International Airport (KCI) encompasses 10,200 acres in a low density suburban setting, 20 miles northwest of downtown Kansas City. KCI offers flights to 68 non-stop destinations in the U.S., Canada, and Mexico.

In 2010, the airport had just over 11 million passengers and handled about 114,000 metric tons of cargo; small by major city airport standards. It offers just 48 non-stop flight destinations in the U.S., Canada, and Mexico. A 2006 study showed that KCI's economic impact on the area totaled \$5.5 billion and generated almost 61,000 jobs.

For the three decades since KCI opened it has been counted upon to attract business and drive economic development in the northern part of the metropolitan area. Yet, in the eyes of many, results have been disappointing.

Airport-linked commercial development has been slow to evolve. Most of the 10,000 acres that fall within KCI's boundaries remains vacant despite the fact that nearly the entire airport has been designated as a Foreign Trade Zone. Moreover, even with its excellent highway connectivity, only a handful of distinct KCI-linked business clusters can be identified in its outlying reaches.

Initial planning for a KCI aerotropolis three years ago included combining existing commercial development just east of the airport with proposed new development that will constitute the KCI Business District, or core Airport City (see Exhibit 1.24).

With the KCI Business District (Airport City) established, clusters of hotel, retail, office, industrial logistics, and residential units are anticipated to develop outward from the airport along nearby interstates and state highways.

According to Kansas City area officials, there are approximately 10,400 acres of industrial/office park development (off-airport) in the airport area recommended land use plan. Development proposals are in place on 3,200 acres and these plans provide: 14.5 million square feet of office, 17.8 million square feet of logistics/industrial and 2.6 million square feet of retail.

Hotel clusters and mixed-use residential are also planned. Combined commercial and industrial development is expected to employ 90,000 workers.

Exhibit 1.25 illustrates the type of Aerotropolis development which would be expected to occur near KCI over the next five to ten years.

A major inside-the-fence business park, known as KCI Intermodal BusinessCentre, has also been planned and is going to be developed by Trammell Crow on 800 acres in the southeastern sector of the airport (see Exhibit 1.26). It is designed to simultaneously leverage the aviation and air cargo infrastructure of KCI along with its nearby highway systems to provide time-sensitive manufacturers, distributors, and logistics service providers with efficient sourcing, production, and distribution. Initial industry targets are high tech (especially semiconductors), aerospace components, cargo distribution and third-party logistics providers.

The site is divided into four development areas. The first two (the airfreight and hanger areas) were directly tied to the primary airport functions. As such, they are purposely isolated from other uses to provide a greater measure of security. The other two areas provide for a more standard office distribution and industrial development. The site area, building area and building type are illustrated and detailed in Exhibit 1.27 and the table below.

Development type	Site area	Building area	Building type
Airfreight	300 acres	2,240,000 sq. ft.	2 story
Maintenance/Hangar	65 acres	462,000 sq. ft.	1 story
Office/Distribution/Industrial	207 acres	1,763,300 sq. ft.	1 story
Office	69 acres	1,254,500 sq. ft.	2 & 3 story

1.7 Asia's Airport Cities and Aerotropolises

Asia is leading the way in airport city and aerotropolis development. One key reason is that their airports are newer with many constructed on greenfield sites. This enables officials to design and develop them and their surrounding areas consistent with the new roles of airports in the local and global economy. Many Asian airports also can be planned by powerful government bodies that simultaneously control the development process of the airport and its environs with few social or environmental constraints. Below, I elaborate three leading examples: Hong Kong, South Korea's Incheon, and Singapore.

1.7.1 Hong Kong International Airport

Hong Kong International Airport (HKIA) is an exemplary airport city and aerotropolis in evolution. Its 1,258 hectare (2,700 acre) site was created in the mid-1990s by leveling two small islands and reclaiming land from the sea.

The airport opened in July 1998 with a total project cost of US\$20 billion, including a 26 miles multi-lane expressway and modern airport express train to both Kowloon and Hong Kong Island.

Three commercial districts adjacent to or near HKIA's terminal and runways are well along in development (see Exhibit 1.28). The 70 acre South Commercial District is composed of logistics facilities, including (1) Tradeport Hong Kong Ltd., constructed and operated by an international consortium of Asia and European Partners, (2) HACTL's Super Terminal 1 (the world's largest stand-alone air-cargo and air-express facility with a gross area of 2.7 million sq. ft), (3) the 2 million sq. ft. Asia Air Freight Terminal, and (4) a 1.4 million sq. ft. mixed-use freight-forwarding warehousing and office complex. DHL has opened its Asia air express hub in this zone, as well, with Cathay City (a major aviation-linked office complex) developing nearby, (see Exhibit 1.29 showing Cathay City under construction next to the HACTL super cargo terminal and Tung Chung New Town in the background).

The 52 acre East Commercial District is being developed as an office park. It will have gross floor area of 3 million sq. ft. targeted to regional corporate offices and air travel-intensive professionals. The 125 acre North Commercial District is the Airport City's signature development zone, known as SkyCity. The 10 million sq. ft. commercial development is adjacent to the passenger

terminal and served by the airport express train. SkyCity's master planner, Skidmore, Owings & Merrill, designed it as a commercial destination for working, shopping, meeting and trading (see Exhibit 1.30).

SkyCity's first phase opened in late 2006 and contains SkyPlaza, a multipurpose commercial complex connected to the passenger terminal and the airport express train station. The lower floors of SkyPlaza provide a 300,000 sq. ft. retail center, including an 4D Extreme Screen theater (see Exhibit 1.31). Above this podium is class A office space with a total gross floor area of another 300,000 square feet.

SkyCity's first phase development also includes a 750,000 sq. ft. international exhibition center (Asia World Expo) with full-time trade representative offices, SkyPier (a China cross-boundary ferry terminal), a 650-room hotel, and the SkyCity Nine Eagles (9-hole) golf course (see Exhibit 1.32). The future phases will consist of a business park, hotels, and leisure and entertainment facilities developed in a pedestrian friendly and public-transit integrated way (see Exhibits 1.33 and 1.34). The 1,171-room Regal Airport Hotel, which connects Terminals 1 and 2 opened in 2007. HKIA's passenger terminals house 30 high-end clothing designer shops along with over 100 other retail, food and beverage, and service outlets.

SkyCity will be the multimodal Central Business District of a far reaching Hong Kong Aerotropolis. In addition to its Hong Kong Island and Kowloon connections, it will be linked by the express train and highway to the nearby Disney Theme Park that also opened on the airport's island in 2006, about 10 minutes from the SkyCity (see Exhibit 1.35). The airport express train connects as well within 5 minutes to Tung Chung, a massive new town housing 45,000 airport workers and their families, complete with schools, churches, shopping and medical facilities (shown in Exhibit 1.29).

1.7.2 Incheon: Korea's Air City

Perhaps the most ambitious effort to develop on airport an airport city and greater Aerotropolis is taking place at and around South Korea's new Incheon International Airport. At its core is Air City, a set of airport commercial complexes being developed with all the features of a modern metropolitan center: retail areas, office buildings, logistics and high-tech manufacturing facilities, ICT functions and leisure activities, a conference and exhibition center, as well as a mixed-use new town. Elaborate expressways, bridges and tunnels connect the airport to Seoul (42 miles to the North) and to nearby islands, the latter forming an expansive commercial and residential complex. A commuter

rail line between downtown Seoul and Incheon International Airport was completed in 2010.

The airport property (15,000 acres) is considerably larger than most in Asia. Opened in March 2001, Incheon was immediately among Asia's major airports in passengers and cargo. Its current master plan (with a 15-year horizon) has commercial and residential development evolving through three phases, creating an ever broadening and deepening urban expanse (see Exhibit 1.37). The first phase (already complete) is an Airport Support Community consisting of airport-related industries (primarily logistics), commercial services, and housing for airport area employees and their families, which total 100,000. The second phase (also completed) involves expanding (both spatially and functionally) the Airport Support Community while transforming it into an International Business City. A 360 acre international business center composed of four office complexes, a shopping mall, convention and exhibition facility and two five-star hotels opened between 2007 and 2009.

An additional 220 acre commercial project under development is the Airport Free Zone. This international logistics and manufacturing zone became fully operational in 2011. Both the International Business Center and Airport Free Zone are planned to double in space in the coming five years.

The third and most ambitious stage (The International Free Trade City) is a full-blown aerotropolis tied together by the extended Incheon free enterprise zone (IFEZ). The IFEZ will encompass three islands, connected by expressway bridges (man-made Songdo and Cheongra, along with Yeongjong where the airport is located). A pivotal component in the Republic of Korea's plan to transform the country into the commercial and trading center of Northeast Asia, IFEZ is being promoted as “Pentaport” — a combined airport, business port, seaport, teleport, and leisure port.

The greater Incheon Aerotropolis has dual urban growth poles. The first, Yeongjong Island, is its Air City, with development on the airport focusing on aviation-oriented office functions, hotel, trade and exhibition facilities, logistics, and tourism and leisure activities (see Exhibit 1.38). Two of the largest are a 384-acre water park opened in 2010 and a 250-acre mixed-use commercial complex immediately south of Incheon's passenger terminal.

Songdo Island will host the aerotropolis' second urban growth pole, New Songdo City, being created from scratch entirely on reclaimed land by Gale International of New York City and POSCO E & C (a division of South Korea's largest steel producer) in partnership with the Korean Government with financing through Morgan Stanley, the World Bank, ABN Amro and Kookmin Bank.

This 1,500-acre, US\$33 billion project is the largest private development project currently underway in the world. At full build-out in 2015, New Songdo City will have over 15 million square feet of office and commercial space, more than 9,000 residences (mostly condominium and town houses), a convention center, a cultural center, a central park greenway, an 18-hole golf course designed by Jack Nicklaus, a state-of-the-art medical facility, and an international school for children of expatriate workers being planned by Harvard (see Exhibit 1.40).

Phase I of this mega-project which commenced in 2005 and was completed in 2010 includes a 1 million sq. ft. retail complex, a 1,000 room hotel, a 65-story trade center, and 2,360 homes. As an incentive to its developers, the Korean government has agreed to construct a six-mile, six-lane bridge from New Songdo City directly to Incheon International Airport and provide all utilities.

From the start of Air City on airport property to the development of New Songdo City six miles away, the Korean government is actively soliciting private-sector participation and foreign investment. Tax holidays and other generous financial incentives along with the provision of extensive infrastructure throughout the greater Incheon airport region are likely to catalyze considerably more private-sector development throughout this emerging Korean Aerotropolis.

1.7.3 Singapore Changi International Airport

Since commencing operation in 1981, Singapore Changi, 16 miles from downtown Singapore, has been considered among the most efficient and aesthetically pleasing airports in the world. The opening of its swank Terminal 2 in 1991 positioned Changi as an Asian leader in infusing passenger facilities with modern retail and service functions. The Civil Aviation Authority of Singapore (CAAS) has invested continuously to upgrade its two terminals and establish them as commercial and leisure nodes of a relatively compact Changi Airport City. A third even more magnificent terminal, costing \$1.8 billion opened in 2008, with an extensive array of commercial, cultural, and leisure services.

Branding Singapore and providing a memorable experience to airport users are key objectives to the ongoing modernization of the passenger terminals. More than 200 retail outlets, many with Singapore or S.E. Asia themes, line Changi's concourses in a free-flow manner. Artwork and waterfalls exhibit a sense of local history and natural beauty. Coffee shops and food outlets also provide a local flavor, modeled after the facades of 1960s Chinatown, while restaurants have open kitchens where passengers can observe cooks preparing Singaporean dishes along with a variety of other international cuisines.

At the same time, Changi's passenger terminals are state-of-the-art technologically and in service amenities. They were among the world's first to

offer Wi-Fi access to passengers with laptops and high-quality surround sound lounge seats with plasma and liquid crystal video equipment. Small group movie theaters, sports and news viewing lounges, in-transit passenger sleeping, massage and shower facilities, along with health and fitness clubs round-out terminal commercial amenities. Passengers with a 5-hour layover can even take a 2 ½-hour off-airport tour, including the downtown financial district and a bum boat ride on the Singapore River. More than 60 percent of the airport's revenues come from non-aeronautical activities.

The limited amount of land surrounding Changi's 3,200 acre airport property has constrained landside commercial development. Connectivity to downtown Singapore has therefore been enhanced by a newly opened subway line that transfers travelers to the airport in about 20 minutes and a beautified tropical expressway with excellent taxi service between the airport and the downtown. The airport, airport expressway, and downtown are pristine, giving visiting business people and tourists a highly favorable impression of the Singapore city-state, a factor often noted in attracting international corporations. To spice up its sometimes staid image, large casinos with associated hotels and entertainment clusters are being constructed on reclaimed land near the expressway and close to downtown.

As one of Asia's leading tradeports, logistics is big business in Singapore, accounting for 8 percent of the nation's GDP. In 2001, CAAS along with Singapore's Economic Development Board and the local government authority created a 60 acre Free Trade Zone at the airport. Known as Airport Logistics Park of Singapore (ALPS), the zone has been developed to house value-adding third-party logistics providers, firms involved in assembling high-tech products, and e-commerce fulfillment. With direct airfield access, a considerable number of the world's top logistics firms already have located in the zone, most in multi-story facilities, given the airport's limited developable land.

The airport is minutes away from large wafer fabrication and disk-drive manufacturing facilities that rely on Changi's sophisticated and rapid international air cargo handling. Reclaimed open land lies to the east of the airport and to the west is an industrial park with an aeronautical focus. The Singapore Aviation Academy immediately adjacent to airport property provides state-of-the-art training facilities for those in the aviation industry.

Aggressive wide-lane highway development ensures that all of Singapore's industrial, office, hotel and exhibition space is in quick and easy access to the airport. The most distant industrial estate, for example, is still within 40 minutes of Changi. Because of the great importance of international air

passengers and air cargo for Singapore's economy, Changi has become the pivotal transportation node in what is essentially an island-wide aerotropolis.

1.7.4 Taiwan Taoyuan International Airport

Taiwan opened a trendsetting gateway airport in 1979, shortly thereafter named Chiang Kai-shek International Airport (CKS) in honor of its former military and political leader. Airport and government officials from throughout Asia visited CKS during the 1980s to see and learn from this modern aerodrome which quickly became one of the busiest in Asia.

The airport was renamed Taiwan Taoyuan International Airport (TTIA) in 2006, reflecting its location in Taoyuan County, 40 kilometers southwest of downtown Taipei. By this time, challenges and some disappointments with TTIA had already emerged.

Despite two excellent hub airlines (China Airlines and Eva Airways), periodic infrastructure upgrades, and a second more contemporary passenger terminal added, the airport did not keep pace during the past 15 years with many of its Asian competitors. TTIA was thus leapfrogged in passenger volume and quality rankings by numerous newer, larger, more architecturally glamorous

and commercially endowed airports in the region. Capacity constraints were also impacting terminal and airside operations.

Taking stock of TTIA's current shortcomings and future needs, The Ministry of Transportation and Communications (MOTC) has commenced a bold initiative to revitalize TTIA to regain its regional prominence, while making the airport a greater catalyst for Taiwan's business competitiveness and economic development. Designated the Taoyuan Aerotropolis project, the plan calls for significantly expanding and modernizing the airport's aeronautical and commercial infrastructure along with creating over 4,000 hectares of aviation-integrated business zones around it.

The aerotropolis plan was approved in 2009 by Taiwan's Executive Yuan (Cabinet) and has become the flagship project of the government. Nearly US\$10 billion will be allocated to improving TTIA's infrastructure and facilities as well as its external transportation links. Much more will be spent by government and the private sector for infrastructure, commercial, and industrial development in TTIA's outlying aerotropolis zones.

Fried Egg Analogy

Taiwan's MOTC uses the image of a fried egg when explaining how aerotropolis land use will evolve, and be administered. The expanded airport is likened to the egg yolk. This inner core, to be managed by a newly established airport company, will consist of aeronautical infrastructure and commercial facilities directly related to the airport such as terminal-based retail, offices, hotels, air cargo and logistics services.

The outer ring (or egg white), which is being planned by Taoyuan County, will house commerce and industry whose activities depend heavily on the airport. These would include facilities such as trade and exhibition complexes, time-critical light manufacturing, and medical tourism.

Airport Expansion

TTIA currently occupies 1,249 hectares, including a connected 45 hectare free trade zone (FTZ) operated via a concession with the Farglory Group. Plans are to expand the airport to the north by 575 hectares and to the east by 170 hectares, the latter adding 130 hectares to the airport's free trade zone.

Expansion will bring TTIA's total size to just under 2,000 hectares. The extended northern zone will house a future third 4,000 meter runway as well as

additional air cargo operating areas and overnight aircraft parking slots necessary to meet demand of 58 million annual passengers and 4.5 million metric tons of cargo forecasted for 2030 (up from 21.6 million PAX and 1.4 million tons of cargo in 2009).

To serve anticipated growth in international passengers, much of this from increased cross-Straits travel between Taiwan and mainland China, a third terminal will be constructed. Depending on final decisions regarding the future use of original Terminal 1, Terminal 3 will be planned to process between 30 and 40 million passengers annually.

A design competition for this state-of-the-art new terminal is being contemplated for 2011, with construction targeted to commence by late 2014. This is the same year that Taiwan Taoyuan International Airport Access MRT System will connect TTIA to downtown Taipei (in approximately 30 minutes) and other key regional nodes. The MRT will serve all three terminal locations at TTIA as well as Taiwan's High-Speed Rail system about 7 kilometers away.

A major commercial complex will take shape adjacent to Terminal 3 which will house business centers, shopping, restaurants, leisure activities, and display space. A four or five-star hotel offering the full complement of concierge business and meeting services is also contemplated for the complex.

China Airlines recently opened its gleaming corporate headquarters at TTIA's entrance with a swank 360 room Novotel Hotel adjoining it. Two additional modern structures (a center for crew activities and a flight simulation training center) complete this new US\$141 million complex.

Given Taiwan's leading position in microelectronics and information and communications technology (ICT) exports, air cargo and logistics are major components of TTIA, and will be even more so in the future. In addition to planned cargo facilities expansions by China Airlines and Eva Airways, Farglory Holdings has already invested over US\$150 million in completing Phase I of its free trade zone logistics complex. The complex, operating under a 50 year BOT (build, operate, transfer) concession, includes the world's largest single-story automated air cargo terminal, a value-added logistics park (two buildings) and international distribution express warehouse and support facilities. Phase II, scheduled for completion by the end of this decade will include additional value-adding logistics facilities, a forwarder's building and a major business center.

TTIA plans to expropriate land for an expanded FTZ area adjacent to the Farglory FTZ. The area will house firms in time-critical distribution, merchandise testing and certification, vendor managed inventories, business process outsourcing (such as printing and distributing credit card replacements

and payment request forms), e-commerce fulfillment, and value-adding logistics services like kitting or labeling for reexport.

New Management Structure

To date, TTIA has been managed by a bureaucratic agency run largely by civil servants who lack autonomy, speed and agility in making strategic decisions. This bureaucratic structure will be replaced in late 2010 by a more business-like organization called the Taoyuan International Airport Corporation (TIAC), Ltd.

Though remaining a subsidiary of the Taiwan government, the new airport corporation will be freed from much of the government red tape hindering efficient response to airport opportunities and challenges. It will therefore be able to negotiate and execute contracts with concessionaires, consulting firms, and construction companies in a quicker, more agile manner. It will also be able to hire and promote talented individuals based on performance. In short, the new airport company is set up to do business the way business does business.

It is anticipated that TIAC will eventually be listed on the Taiwan stock exchange enabling private-sector investment and returns which should further encourage improved airport performance. Privatization (partial or full) could

also provide additional airport revenues for future facility modernization and infrastructure expansion.

The new airport company is expected to coordinate closely with those involved in broader aerotropolis development. This will promote stronger synergies between inside-the-fence and outside-the-fence developments.

The Aerotropolis

The Taoyuan Aerotropolis consists of TTIA as its multimodal core and approximately 4,150 surrounding hectares divided into seven functional zones (see Exhibit 1.41). In laying out the seven outside the fence areas, Taoyuan County planners focused on highest and best land use leveraging proximity to the airport as well as transportation connectivity to the airport and the broader region.

To the immediate south of the airport are two aviation-related industrial zones. A 670 hectare aviation industry area will be geared to aerospace equipment design and manufacturing, aviation equipment repair, and air logistics services, plus a possible aviation training center. The 1,345 hectare airport-related industry zone (which also has a portion northwest of TTIA) is

designated for aviation R&D, in-flight service industries, air sports and leisure industry, and car rental and parking, among other services related to the airport.

The 490 hectare Trade and Exhibition Area already with some development hosts an international convention center with future hotels, shopping, entertainment, and office buildings planned. This zone is further leveraged by a High Speed Rail station and MRT station, the latter which will connect to the airport.

A Refined (specialized) Agriculture Development Area of 460 hectares on the airport's southwest periphery is planned as an agriculture produce distribution center. Auction centers as well as an agri-business technology R&D centers are similarly proposed for this area.

North of TTIA, a 360 hectare Coastal Recreation Zone is planned for marinas, water sports facilities, fish markets and indoor and outdoor water parks. Incentives will be provided to encourage investment in these as well as associated hotels with conference facilities, vacation homes, restaurants and shopping streets.

To the east, a 155 hectare Free Trade Related Zone will be developed to leverage the Farglory FTZ and the extended airport FTZ. Included in this zone will be automated warehouse and distribution centers, trade centers, and time-critical light manufacturing.

To provide good residences and minimize commute times, a number of quality living areas totaling nearly 700 hectares are planned for various sections of the Aerotropolis. These will be designed as sustainable living communities based on balancing life, neighborhood, work and ecology. Aerotropolis quality living areas will also have mixed-use services such as shopping malls, restaurants, libraries and schools.

At present, the outside the fence aerotropolis zones are primarily conceptual and will be developed as economic demand and market opportunities emerge. For example, in the Airport-Related Industrial Zone planned to the northwest of the airport, it is possible that some portions outside the airport's noise contours could support a significant "Health Port" made up of clinics to serve medical tourism along with health and wellness centers.

Integrated Transportation

Success of an aerotropolis rests as much on surface transportation connectivity as it does on air connectivity. The MOTC, together with Taoyuan County transportation planners, have therefore been diligent in specifying highway and light rail improvements to TTIA and throughout the region. These include highway upgrades connecting the airport to Taipei and other major regional

commercial nodes, as well as a series of airport area circular roads efficiently connecting all aerotropolis functional zones.

Such fast and efficient airport access to the broader northern Taiwan region will bring important commercial centers from metro Taipei to the north to the Hsinchu Industrial Park (Taiwan's Silicon Valley) to the south within the aerotropolis orbit, making a much more geographically expansive airport-integrated economic region. The goal of the government is for this expanded aerotropolis to be Taiwan's primary infrastructure asset to compete in the globally-connected, speed-driven economy of the 21st century.

1.8 European Airport City and Aerotropolis Experiences

Europe has been a pioneer in the airport city model, with Amsterdam Schiphol first introducing this approach to airport and airport area development in the early 1990s. Others have followed and are beginning to expand their airport cities into full-fledged aerotropolises. Here I describe Amsterdam Schiphol and Frankfurt as exemplary models for Tocumen to consider. Frankfurt is particularly appropriate because land and environmental constraints forced it to develop two commercial complexes on space roughly equivalent to what Tocumen has available for its airport city.

1.8.1 Amsterdam Schiphol

Amsterdam Schiphol is the leading European airport city and is clearly driving a greater Aerotropolis. Its grounds employ 62,000 people daily – far more than the 50,000 resident criteria to attain metropolitan central city status in the U.S. Two major expressways link the airport to downtown Amsterdam and the broader urban area. A modern train station, directly under the air terminal, efficiently connects travelers to the city center and the rest of the Netherlands.

Schiphol's passenger terminal, incorporating modern retail plaza design elements, contains expansive, well-appointed shopping and entertainment arcades accessible both to travelers and the general public (see Exhibit 1.42). By combining terminal design with mall design, Schiphol has substantially increased revenues through concession rents and passenger purchases. In fact, the airport often attracts Amsterdam residents who come to shop and relax in its public section, especially on Sundays when most city retail stores are closed. Schiphol's terminal even has a branch of the Rijksmuseum where passengers can view famous Dutch Masters' paintings.

A 100,000 sq. ft. multimedia aviation theme park (National Aviation Theme Park Aviodrome) has been developed at the Aviodrome in Lelystad. Partnering and co-branding with KLM and Boeing, the Aviodrome will highlight

100 years of aviation progress and be a leisure experience for travelers and airport visitors.

Directly across from Schiphol's passenger terminal is the 4 million sq. ft. World Trade Center with meeting and commercial facilities and regional headquarters of such firms as Thomson-CFS and Unilever. A Sheraton and a Hilton hotel adjoin this complex (Exhibit 1.43). Surrounding Schiphol (near the airport fence) are large tracts of land being developed for office (including the European corporate headquarters for Microsoft), leisure, light industrial, and logistics purposes (see Exhibit 1.44). These include Schiphol South-East and Schiphol Logistics Park for cargo distribution and 3PLs; Anthony Fokker Business Park and Schiphol Eindhoven with 2.9 million sq. ft. and 2.2 million sq. ft. of offices, respectively; Schiphol-Rijk for time-sensitive light industrial and the Schiphol Golf and Business Center for sports, golf and leisure activities that are to complement a corporate office campus on the site.

Providing further logistical advantage, the A4 and A9 high-speed motorways are both within a mile and a half of the airport center. Radiating from Schiphol along these motorways are strings and clusters of business parks, logistics parks, high-tech industrial parks, distribution centers, information and telecommunication complexes, and wholesale merchandise marts such as the famous Aalsmeer Flower Auction Market – all of which are airport-intensive

users. Exhibit 1.45 illustrates the synergies between Schiphol's Airport City and its broader regional Aerotropolis.

An excellent example of airport-Aerotropolis development synergy is Amsterdam Zuidas within a southern reaches of the city of Amsterdam, about six minutes by airport expressway or airport express train to Schiphol's passenger terminal. Zuidas is a 21st century airport "edge city" containing over 11 million sq. ft. of class A office space and retail, along with a large mixed-use commuter rail terminal with a World Trade Center above it. Among its occupants are the world headquarters of ABN AMRO and ING banks, plus numerous regional corporate headquarters of other multinational firms who rely on Schiphol airports excellent European and international connectivity for business purposes (see Exhibit 1.46).

In good measure because of the airport and its multimodal commercial mix, over 1,000 international companies have chosen the Amsterdam region as a place to invest and create jobs, many of which located in downtown Amsterdam, not just Zuidas.

Schiphol's experience illustrates that as the aerotropolis forms and evolves, can be a reinforcer of downtown investment and business vitality, rather than a competitor. We have seen this in Asia (Hong Kong, Seoul, Singapore, etc.), the U.S. (Atlanta, Chicago, Miami, etc.) and throughout Europe.

As one concrete U.S. example, Boeing located its world corporate headquarters in downtown Chicago, rather than the O'Hare airport area, even though most of its commercial activities it deals with, including the headquarters of United Airlines, are in the immediate airport area.

In fact, in some nations, the airport area (if properly developed and maintained) has become so attractive to office and time-sensitive industries that it often commands the highest commercial rents in the metropolitan region. This can be seen in Exhibits 1.47 and 1.48 which present the office rents (Eu/m²/yr) and industrial rents for 2010 in the immediate Schiphol area compared to those of Amsterdam city center and other outlying locations. Research on industrial rents around the globe show that the highest are found adjacent to London's Heathrow airport. And one of the classiest and most business friendly hotels in the world is the Sofitel Grand Luxe next to Heathrow's new T-5 which commands up to €3,000 per night for its suites. Less than a 90 meter walk from T-5, this airport hotel offers 45 meeting rooms and a 1,700 delegate conference center, making it the third largest conference venue in the UK.

1.8.2 Frankfurt International Airport

Fraport, as it is known, is the most international hub in the world with 119 different scheduled airlines flying to 304 destinations in 106 countries. Every

single day the airport handles over 145,000 passengers (54% of whom are transfers), 10,000 meters and greeters, 6,000 metric tonnes of cargo, 1,300 aircraft and 380 terminal-linked passenger trains (both short and long-distance).

Its international hub status brings in tens of millions foreign passengers annually who eat, shop, and otherwise participate in Fraport's upscale street-scapes of commercial establishments. These include 17 duty-free shops, 88 specialty retail stores, 58 food and beverage establishments, and 53 service establishments including a medical clinic serving 36,000 patients annually and a casino. Together, these terminal retail and services facilities brought Fraport over US\$200 million in revenue in 2008.

Because Fraport is surrounded by protected green areas on the one side and noise-sensitive communities on the other, it has been constrained in its outward growth. Fraport management has therefore had to be innovative in its approach to airport city development. It has therefore followed a strategy of commercial development based on the principles of best use and highest value, maintaining top international standards. Airport management has also coordinated closely with officials of surrounding municipalities to prevent misunderstandings.

Connected by pedestrian walkways to Terminals 1 and 2, respectively, are Frankfurt Airport Center 1 and 2. These 1 million+ sq. ft. complexes contain offices, banks, a 1,008-room Sheraton convention hotel with a 1,400-person

congress center and an executive tower with all business services. The two airport centers' office complexes are targeted to companies engaged in aviation and tourist-related businesses as well as for business meetings and trade shows.

Rail is less than a five minute walk from the public section of the airport's terminals and to the local and regional commuter rail station under Terminal 2 as well as to the long-distance ICE train station with 174 daily connections throughout Germany and Western Europe.

The Airrail Center Frankfurt, currently under construction, above the airport's long-distance train station is a nine story complex more than 300 meters long (see Exhibit 1.49). With covered pedestrian access to Terminal 1, it comprises 1.6 million sq. ft. of class A office space, high-end retail, restaurants of all types, a wellness center and a Hilton Hotel with conference facilities. Airrail Center is scheduled to open in 2010, will be the European headquarters of KPMG, which had already leased 40,000 square meters.

Near Airrail Center is a development just getting underway called Gateway Gardens (see Exhibit 1.50). This 3.8 million sq. ft. project is being positioned as a management hub and civic plaza for international business. Designed with cutting-edge architectural style Gateway Gardens will offer trend-setting corporate office buildings, hotels, restaurants and entertainment facilities with "new urbanism" civic plazas and a central park (see Exhibits 1.51 and 1.52). In addition to business offices and their supporting urban services, an

International Trade Center with meeting and conference facilities is planned. Development, which is being financed through a public-private partnership including Fraport, is expected to be market-driven and incremental, commencing this year through projected build out in 2016.

The third major development, near the other end of the airport, is a 272 acre mixed-use project called the Mönchhof site. This site will be adapted to a range of commercial facilities from logistics companies to large-scale retailers to airport-related enterprises and is being led by the real estate division of Fraport. Like Gateway Gardens, quality construction and aesthetics will be emphasized at the Mönchhof site.

1.9 The Middle East—Dubai: United Arab Emirates

The leaders of Dubai have been visionary in their use of air commerce to foster investment and development in this emirate. Recognizing that the emirate's position halfway between Asia and Europe could make it an important transit point for passenger and cargo traffic, a decision was made in the mid-1980s to fully liberalize its air cargo and passenger access for development purposes.

This put air cargo at Dubai International Airport on a rapid trajectory. By 1998, the airport was handling 300,000 tons annually in its Cargo Village, with another 120,000 tons flowing through temporary areas. Dubai's air cargo has

continued its rapid trajectory in recent years to 1.8 million tonnes in 2008, up from 940,000 tons in 2003. With cargo growth at the airport continuing at a breakneck pace (1.82 million metric tons in 2008), new facilities have followed suit. The first phase of a Mega Cargo Terminal with annual capacity in 2018 expected to be 3 million tonnes has been completed along with a state-of-the-art fresh flower facility.

Dubai's airport is within a free trade zone, which makes it even more attractive to companies looking to invest in the emirate. The Dubai Airport Free Zone (DAFZ) has 1.2 million square meters of space for offices, warehouses and distribution centers and manufacturing plants. Its benefits, including 100 percent foreign ownership of companies in the Zone, tax-free status for up to 30 years and no personal income tax, are designed to attract those companies producing high value-to-weight goods and shipping them by air. There are over 1500 companies in the DAFZ, including Bang & Olufsen, Boeing, Chanel, Diageo, Johnson & Johnson, LVMH, Mitsubishi, Caterpillar, Porsche, Rolls Royce and Wyeth Pharmaceuticals. As of October 2008, approximately 80 percent of companies in the DAFZ were in the information technology industry.

So successful has development been at and around Dubai International Airport, that the emirate's leaders are currently constructing a second massive airport complex 10 years earlier than planned. The new Al Maktoum International Airport (JXB), expected to open in June 2010, will be an example of

the Airport City/ Aerotropolis model. It will include planned clusters of industries in logistics, high technology, financial services and tourism whose needs are served by aviation. The entire Aerotropolis complex, when fully built out, will cover 140 square kilometers (54 square miles), including an airport operating area composed of five parallel runways and three passengers terminals with extensive shopping and entertainment arcades. The first commercial zone is Dubai Logistics City, located adjacent to the airport operating area and next to the Jebel Ali Free Zone.

Along with Dubai Logistics City, other aerotropolis components planned include (1) Commercial City which will Dubai World Central's business and financial hub with 85 towers ranging from six to seventy-five stories in height and expected to employ around 130,000 people, along with up to twenty-five hotels, ranging from three-star to five-star deluxe, (3) Residential City to house up to 250,000 people in a mix of two-story villas and luxury apartments in blocks reaching up to twenty-four stories in height. Residential City will also include three hotels, an international school, medical facilities, and a large shopping mall.

Exhibit 1.53 is a rendering of Al Maktoum International Airport and its adjacent airport cities. Originally scheduled build-out is 2017; exceptionally fast by world standards, construction has been all but brought to a halt in 2009 as a result of the global recession and Dubai's commercial real estate crisis. Dubai's leaders claim strong commitment to completing this project as originally planned

and see this as a one to two year delay until Dubai's commercial real estate market recovers. Others are not so optimistic and see delays stretching Dubai World Central's development over a much longer period than originally envisioned and substantially scaled down from that original vision.

In the meantime, other Middle Eastern countries have commenced airport city and aerotropolis development backed by immense energy resources. These include Abu Dhabi, Qatar, and Saudi Arabia. To date, little more than conceptual plans are available, but the ones I have seen are highly ambitious.

1.10 Smaller Air Logistics Hub / Aerotropolises

1.10.1 Ontario, California

Commercial growth surrounding Southern California's Ontario Airport — an emerging air logistics hub that cornerstones a major urban complex 40 miles east of Los Angeles — offers an excellent contemporary illustration of multi-modal logistics and aerotropolis development synergies. The airport (recently renamed LA/Ontario International Airport) is at the nexus of major east-west and north-south interstate highways I-10 and I-15, with the Burlington Northern-Santa Fe intermodal rail yards about 5 miles away. The ports of Los Angeles and Long Beach are connected by interstate highways and rail lines.

Between 2000 and 2008, over 60 million square feet of warehouse, distribution, and light industrial space were added adjacent to the airport and along Interstates 10 and 15 radiating out from it, led by e-commerce fulfillment and distribution facilities ranging up to 1 million square feet in floor space. With logistics and distribution facilities being complemented with clusters of hotels, entertainment, office, and retail complexes commercial clusters around the airport and outward along I-10 and I-15, Ontario is emerging into a full-fledged aerotropolis.

Enhancing Ontario's air logistics and aerotropolis development is the growth of air express transportation services at and around Ontario Airport. During 2008, UPS, whose west coast regional hub is at Ontario Airport, handled over 700 million pounds of freight while FedEx carried over 100 million pounds. This express service was boosted by another 100 million combined pounds carried by BAX Global, Menlo Worldwide and DHL/ABX Express.

Ontario's development as a regional air express airport have been considered major factors in strong employment growth that San Bernardino and Riverside Counties experienced over the past 15 years. This growth has slowed as a result of overbuilding in these counties and the current real estate crisis but is expected to resume once the national and global economic rebound.

1.10.2 Alliance, Texas

Another regional air express airport/aerotropolis example is Fort Worth (Texas) Alliance Industrial Airport, where 15,000 acres span two counties and include portions of four cities. Promoted as the nation's first industrial airport by Ross Perot's company, development began in 1988 with the objective of serving business and commercial users rather than passengers. From the beginning, multi-modality was emphasized, especially quick and efficient access to regional and national markets via interstate highways and intermodal rail connections. A major development driver was put in place in 1997 when FedEx opened its southwest regional hub at Alliance. Since then, over 100 major companies (33 from the Global 500 largest) have located at and around Alliance; such as AT&T, Nokia, Goodrich Aerospace, Gulfstream, Zenith Electronics, Nestle Distribution, and Dell Inc. Alliance offers a Foreign Trade Zone, an enterprise zone with further city and state incentives, a world trade center, state-of-the-art fiber optics and telecommunications, and a special inventory tax exemption, as well as efficient U.S. customs services.

As a result of its wide variety of present and expected future tenants and users, such as time-sensitive manufacturers and distributors, third-party logistics providers, retailers, international firms and aviation-related companies, Alliance

is partitioned into geographic sectors geared to different tenant needs and requirements. These developments include:

Alliance Center, a 2,600-acre high-density business complex that encircles the airport and is geared primarily towards aviation-related enterprises that require direct taxiway access.

Alliance Commerce Center, a 300-acre business park for manufacturing and high-tech firms, which has served as a starting point for several small and mid-sized companies that have expanded into larger facilities throughout Alliance.

Alliance Air Trade Center, a 52-acre air cargo development with direct access to the Alliance Airport runway system, direct access to Interstate 35W, and nearly adjacent to the BNSF intermodal facility. It has over 250,000 square feet of warehouse space available for intermodal cargo and international air freight companies.

Alliance Gateway, a 2,400-acre distribution, manufacturing and office sector which provides parcels of land for constructing large-scale facilities such as warehouses and is designed to accommodate large distribution and industrial firms. It also has convenient access to Dallas/Fort Worth International Airport via State Highway 170.

Alliance Advanced Technology Center, a 1,400-acre complex that is becoming one of the nation's premier technology hubs for major companies from around the world.

Heritage Reserve at Alliance, which is integrated into a woodlands greenbelt and offers locations for research and development facilities in a natural setting.

Westport at Alliance, a 1,500-acre industrial and distribution sector located directly adjacent to Burlington Northern Santa Fe Railway's main north/south line and Intermodal Center. It caters to shippers needing rail access and other multi-modal transportation options.

Alliance Crossing, a 170-acre retail complex that is designed to accommodate retailers, restaurants and other service-oriented firms needed to service the areas increasing population base as well as employees and visitors of Alliance.

Alliance's commercial success has been attributed to its excellent multi-modality, a variety of economic incentives it provides to tenants, its attracting a substantial number of third-party logistics (3PL) providers who offer manufacturers, distributors and retail shippers with value-added services including packaging, labeling, inventory management, transportation and transportation tracking as well as returns management. Alliance also provides

educational and technical training facilities for companies located at its complex, including conference and teleconference facilities.

All firm recruitment and real estate development is managed by a private company, Hillwood Development. Of the \$4.8 billion invested in Alliance thus far, 97 percent has been from private sources. According to the Alliance website, this translates into over 20,000 permanent jobs at the complex and \$150 million annually in local property taxes generated.

1.10.3 Rickenbacker, Ohio

A former U.S. air force base, Rickenbacker went into service as a commercial air cargo airport in 1980. Despite being the 1980's hub for the air cargo firm, Flying Tigers (now part of FedEx), Rickenbacker did not obtain success in attracting tenants until the 1990s when a new public-private management model was put in place and a new marketing strategy developed based on the “Inland Port” concept.

Rickenbacker's value proposition thereafter rested largely with efficient and cost-effective handling and distribution of supplies and finished goods, in contrast to more costly, less efficient handling at alternative (often larger) airport complexes that lacked multi-modality and as efficient logistics operations. The

airport is strategically located to serve national markets, and it has excellent access to major interstate highways and intermodal rail facilities. Like Alliance, Rickenbacker operates in a Foreign Trade Zone. It also has special state and federal tax exemptions such as those on inventory, abatement on real estate taxes for improvements to land and buildings as well as a subsidy of \$3 million per year from local governments. In addition, the State of Ohio has committed \$65 million in revenue bonds for future facility improvements.

Rickenbacker, which operates 24/7 365 days of the year serves 24 freight companies in 2010, including FedEx, UPS, DHL, Excel, Atlas Air, Evergreen International, Kalitta, and Pilot Air Freight along with major 3PLs and freight forwarders such as Kuehane + Nagel and Bax Global.

Economic development around Rickenbacker since the early 1990s has been considerable. The airport serves as the logistics hub of a 15,000-acre development zone (nearly identical to Alliance), called the Rickenbacker Area. This area contains over 20 million square feet of state-of-the-art logistics and distribution space, employing 15,000 workers. Despite the national and global downturn in air cargo between 2001 and 2003, Rickenbacker continued to experience robust air cargo growth, though the recent (2008-09) downturn has taken a toll.

Rickenbacker provides tenants and users with a 500,000-square-foot cargo terminal (which is being continuously expanded), modern materials handling equipment and logistics services, and direct airfield access to freight forwarders, third-party logistics providers and time-sensitive manufacturers and distributors who are advantaged by airside access. As one example, Excel Logistics, one of the world's largest supply chain management companies, operates a 230,000 square foot one-stop shop facility that includes customs brokerage, airfreight forwarding, intermodal operations, value-adding logistics services, and warehousing. Rickenbacker's logistics and fulfillment firms are undergirded by state-of-the-art fiber optic loops, high-speed data circuits, and teleconference facilities.

To further spur commercial development, Rickenbacker formed a partnership with Duke Realty in 2006 to develop 1,200 acres of prime industrial land in the airport area. The partnership helped with the development of Rickenbacker Global Logistics Park which will be near the new Rickenbacker Intermodal Facility that opened in late 2007.

As mentioned above, Rickenbacker's development success can be attributed in large part to its management strategy implemented in 1991 with the establishment of the Greater Columbus Inland Port Commission to promote trade through developing and leveraging logistics services and intermodal

infrastructure. The Inland Port Commission is an exemplary public-private partnership made up of city, county, state and federal representatives from the public sector and the Greater Columbus Chamber of Commerce and individual manufacturers, shippers, logistics providers, and others from the private sector. Cost-benefit analyses have shown that for every U.S. dollar of public investment in Rickenbacker, three dollars in private investment have resulted with twenty-five dollars in regional economic impact, was estimated to be nearly \$3 billion in 2006.

1.10.4 Huntsville (AL) Multimodal Complex

Huntsville International Airport (HSV) cornerstones a successful 6,080-acre multimodal transportation complex (air, highway, and rail) known as the Port of Huntsville. In addition to the airport, the multimodal complex is made up of the International Intermodal Center and Jetplex Industrial Park.

Though serving only approximately one million air passengers annually, Huntsville International Airport has become a significant global air cargo hub. It has a 12,600 ft. runway that serves cargo aircraft bound for the U.S., Central America, Europe, and Asia along with a parallel 10,000 ft. runway used for passenger and cargo aircraft. Air cargo at HSV grew from 53,174 metric tons in

1999 to 167,888 tons in 2006, nearly 90 percent of which is international. Since 2007 air cargo growth has been slower at HSV.

Key to the growth of air cargo at HSV is a strong partnership the airport formed with international freight forwarder Panalpina. Panalpina started at HSV in 1990 with single weekly B747 air freighter to Europe operated by Luxembourg-based all cargo airline, Cargolux. This service has now expanded to eight weekly flights to Europe and two to Hong Kong, via both Cargolux and Atlas Air Freighters. The airport also serves multiple sites in Central America.

Recognizing that freight forwarders and third-party logistics providers are key to generating an airport's demand for air freighter service, the Huntsville International Airport Authority aggressively recruited these including BAX Global, Eagle Global Logistics, Expeditors International, Kuehn+Nagel, Panalpina, and UPS Supply Chain Solutions. It worked. These freight forwarders and 3PLs also boosted cargo activity at the complex's International Intermodal Center and the Jetplex Industrial Park.

Adjacent to the airport, the International Intermodal Center provides at a single location the opportunities for firms to transfer, store, and distribute products via rail or truck. In 2007 this intermodal rail center had a record 43,903 lifts, which constituted a six percent increase over 2006 and remained near this

high level in 2008. The chief driver of this growth in lifts was the expansion of automotive manufacturing in North Alabama.

The 4,000+ acre Jetplex Industrial Park provides direct runway access as well as access to the intermodal rail facility, a U.S. Customs port of entry, a foreign trade zone and industrial bond financing for new tenants. This expanding multimodal industrial park is divided into six sections to meet various needs of business from heavier industries such as diesel engine manufacturing to just-in-time distribution facilities. Boeing and Chrysler are among Jetplex's growing number of major tenants.

Combining the airport with the intermodal rail center and Jetplex Industrial Park has made Huntsville International Airport the fastest growing air cargo market outside of Asia, and third fastest in the world. Its annual economic impact is well over US\$1 billion annually. Huntsville is a model that all multimodal air logistics complexes should examine.

1.10.5 Europe: Vatry, Frankfurt Hahn, and Bremen

I have already described the evolution of an Aerotropolises at and around Amsterdam's Schiphol Airport and Frankfurt. Considerable airport-driven commercial development is also occurring around Paris' Charles de Gaulle

Airport and London's Heathrow, the latter exhibiting the most expensive industrial space in the world around it.

There are also a number of smaller European airports using air cargo and logistics to attract industry. These include Vatry Cargo Airport in the Champagne Region of France, about 110 miles east of Paris. It has been trying to position itself as a logistics hub and third airport of the greater Paris Region. Vatry commenced operations in March 2000 following a seven million Euro investment by local authorities and advertised itself as “the first multimodal 100% cargo center in Europe.” In 2006, Vatry handled 33,000 tons of air cargo with a new cargo terminal opened in 2007. It is near the center of major trucking in Europe linked to the French motorway network (A26 and A4). Prologis, a major U.S. real estate investment trust focusing on logistics and distribution centers has constructed a 620,000 sq. ft complex at Vatry. Two other business parks have been opened, each attracting a small number of tenants, primarily in distribution. Overall, development at Vatry has been slower than many anticipated with the primary reason given as its distance from Paris and paucity of freight forwarders and 3PLs in the vicinity.

Another primary cargo airport in Germany at Hahn, about 75 miles west of Frankfurt, is likewise positioning itself as an industrial airport. This former U.S. airbase with a 12,000 ft runway has consistently raised its freight tonnage

from just 5,500 tons in 1997 when it opened to 130,000 tons in 2004 and 200,000 tons in 2008. Frankfurt AG (now known as FraPort) took a major equity stake (73%) in Hahn in 2004 and the airport was renamed Frankfurt-Hahn. The fact that Hahn has no ban on night flight (an exception in Europe) made it a secondary airport for Lufthansa Cargo and other cargo carriers.

A number of 3 PLs are active at Frankfurt-Hahn. The airport features a five-lane road feeder system with integrated truck cross-docking facilities along with complete logistics services including all documentation and processing of special cargo. The airport also features 24/7 operation and is the German base of a number of air cargo charter companies, including the Western European hub of Volga-Dnepr Heavy Lift. It likewise serves as the European hub for Antonov (Russia) and as the German base for low-cost passenger carrier Ryanair.

Frankfurt-Hahn received a major boost in September 2004 when British Airways commenced weekly B747F flights to Johannesburg, Africa and Hong Kong. In November 2005, it added two more weekly flights to Hong Kong. Russia's Aeroflot has also made Hahn its European cargo hub with four DC10Fs stationed there currently offering 12 weekly flights to Moscow, Beijing, Shanghai, and Tokyo. Scheduled cargo flights are also now offered by Egypt Air, Etihad Air Armenia, Iran Air, Turkey's MNG Airlines, and Royal Jordanian.

Hahn's success in attracting air cargo companies, which is driving nearby airport-linked industrial development, is due to its openness to night flights, fast and efficient cargo handling, and lower costs compared to Frankfurt International Airport and many other large European airports. Hahn also has the advantage of being located within four to six hours trucking time of major European markets.

Once Hahn's air cargo traffic began to boost airport-related industrial development, additional air passenger demand was created. Annual passenger traffic expanded from just 29,000 in 1998 to 1.5 million in 2002, to 2.8 million passengers in 2004, to 3.7 million passengers in 2006 and an up to 4.4 million in 2009. Although much of this passenger growth resulted from Irish low-cost carrier RyanAir establishing Hahn as its German hub, a number of other new European carriers have started passenger service at Hahn, as well, over the past three years.

With both cargo and passenger demand at Hahn soaring, in 2004 the state of Hesse took a 17.5 percent stake in the airport (leaving Fraport with a 65 percent majority share) with the other 17.5 percent share held by the state of Rhineland-Palatinate. These three shareholders committed themselves to investing 42 million Euros (about 80 million dollars) from 2006 to 2011 to improve airport infrastructure and further expand cargo and passenger capacity.

At 2.4 million passengers per year, Bremen is significantly smaller than PTY yet it has been able to create a growing airport city on the basis of modest traffic and service in a moderate-sized city. The airport is well-connected, however, with five airlines providing service to the major European business centers – Amsterdam, Brussels, Frankfurt, Copenhagen, London, Munich, Paris, Stuttgart, Toulouse and Zurich – as well as many leisure destinations. Forty seven destinations are served with direct flights.

Airport City Bremen is located close-in to the central portion of the city (3 km) and can be reached in approximately 11 minutes by tram or regional bus. The public transit stop is immediately adjacent to the check-in counters. The airport can also be conveniently reached via a new expressway which helps form a loop around the central city. To attract passengers, parking is kept plentiful and inexpensive.

Exhibit 1.54 provides an overview of the airport city near the passenger terminal with a view of Bremen's center city. The cargo zone is to the west of the passenger terminal and offers direct taxiway access to some tenants. The air cargo terminal is located beside the runway and brings all the relevant partners together under a single roof. An airport hotel is directly adjacent to the passenger terminal. Several office buildings are in Airport City Central and to its immediate east. Airport City Central provides work accommodations for 5,300.

Airport City East houses mainly trade and distribution services and is being expanded to provide space for small and medium-sized firms. Airport City South is an aerospace center with production and R&D activities. EADS employs 4,500 here.

As a restructuring industrial city, Bremen is redeveloping much of its urban land. The land along the highway depicted in Exhibit 1.54 between the airport and the central city is a component of an urban renewal project which will allow Bremen's airport city to expand. Airport City West is the oldest planned industrial park in Bremen. It has been restructured for the needs of contemporary manufacturers and is targeted to logistics and assembly of time-critical products.

1.10.6 Tancredo Neves International Airport (Brazil)

Tancredo Neves International Airport (TNIA), in Belo Horizonte, Brazil opened in March 1984. Planned to accommodate rapid passenger and cargo growth and provide a major stimulus to Brazil's third largest metropolitan area, the airport's original blueprint called for the construction of two long-range runways, four 300,00sqm passenger terminals and associated cargo facilities. This would allow the gateway to handle up to 20 million passengers and 150,000 tonnes of cargo annually when fully completed.

The only trouble was the expected passenger and cargo demand was very slow to materialize – by its 20th anniversary in 2004, only 388,580 travelers had used its single five million capacity terminal and less than 26,600 tonnes of freight were being processed. But since then the pace of growth has been remarkable with TNIA handling a record 8 million passengers in 2010, with forecasts indicating this will increase to 10 million by 2014.

A major boost to the airport's fortunes came with the announcement that Belo Horizonte would be a host city for the 2014 FIFA World Cup, with hundreds of thousands of fans expected to descend on the country for the event. Meanwhile, the vision for Tancredo Neves' development took a new turn in 2001 and 2002 when Brazil's Ministry of Finance (through its Federal Reserve and Customs secretariats) announced plans to develop the country's first 'industrial airports' to underpin its economy.

The primary objective of the legislation was to create a speedy, flexible, cost-saving business environment at and around selected Brazil airports to attract new industry and expand trade. In 2004, TNIA was chosen as the first among four designated commercial airports to move forward with the new strategy.

In line with this policy, a special economic zone was established at the airport providing a number of investment privileges to encourage companies to

locate on to its premises, including suspension of taxes on imported items.

Following the signing of a technical cooperation agreement between the Minas Gerais state government and TNIA operator INFRAERO, a master plan was completed in 2009 for the gateway to encourage air traffic growth and airport city projects.

Developments are now moving ahead rapidly with the state government of Minas Gerais, in partnership with Brazil's federal airport operator, INFRAERO. A new terminal (T2) is to be opened in 2013 and further commercial development on airport property.

Tancredo Neves' airport city has begun to rise with Gol's completion of a major expansion of its aircraft maintenance depot and improvement works to the Linha Verde (Green Line Expressway) connecting the airport and city of Belo Horizonte. The location of hundreds of firms in to the surrounding metropolitan area is then expected to take place.

The airport currently offers direct flights to the US (Miami), Europe (Lisbon), Central America (Panamá City) and South America (Buenos Aires and Santiago) and is well connected to domestic destinations. Optimism is high that continuing economic growth will encourage new airlines to open routes and TNIA has set a goal of becoming one of South America's fastest growing gateways.

While there is still a long way to go before Tancredo Neves International Airport achieves its original vision in scale and local economic impact, progress today is highly encouraging. The state of Minas Gerais is taking the lead in commercially developing the airport and airport region and companies which locate within the zone can expect a number of fiscal and tariff benefits. A \$43.4 million expansion of the Gol Maintenance Center from 47,700 sqm to 91,000 sqm was completed in 2009 which has attracted a network of the company's suppliers, allowing the facility to maintain up to 80 Gol aircraft and 28 other commercial aircraft, generating some 650 direct and 500 indirect jobs.

In order to consolidate the growth of aeronautical industries within the vicinity of the airport, the state government, in partnership with the National Civil Aviation Agency (ANAC), is developing 780,000sqm Civil Aviation Pole Training Centre near the airport. The Civil Aviation Pole is being generated in partnership with colleges, airlines, maintenance and aircraft manufacturing companies. The idea is to create and develop a qualified work force in the region for the entire aeronautical sector.

Because of its location, some 38km from the city of Belo Horizonte, transport links are vital for Tancredo Neves Airport and have been a focus of improvement for some time. It was previously very difficult to access many important firms at the opposite side of the metropolitan area. A new northern

ring expressway is therefore being constructed to connect to these commercial nodes with a major exchange near the airport.

In 2005, work began to substantially improve the main airport access highway (MG-010) from the downtown of Belo Horizonte. This was completed in 2008. Dangerous intersections were replaced by a double-laned highway in both directions, which brought commuting time from the city to the airport down to 30 minutes, benefiting firms located downtown.

By speeding up the access of major commercial clusters throughout the metropolitan area to the airport and reducing traffic congestion on other important arteries, the new northern ring road will also make Tancredo Neves and its suburbs a more attractive location for time-critical industries which will generate additional air cargo for the airport.

The highway also offers broader connections between the airport and the state's diverse industries, including textile manufacturers in the Juiz de Fora and mining communities in nearby areas such as Contagem, Betim, Nova Lima, Pedro Leopoldo, Raposo, Rio Acima, Sabara; Santa Luzia and Vespasiano.

With action plans being initiated for a second terminal and future second runway, a number of firms have now begun to locate in the airports special economic zone. This is contributing further to TNIA's air cargo.

In late 2010, the state government, in partnership with the Spanish Government, through the Fondo de Estudios de Viabilidad (FEV) development agency, began feasibility studies for the extension of Belo Horizonte's metro rail system with a connection to the airport. The study will verify the best rail system to access the airport (subway, monorail, light rail, etc.) considering the costs, the benefits, speed and passenger capacity.

The state government is also studying the feasibility and the best location for a multi-modal logistics platform near the airport. Elsewhere, new commercial developments are springing up in the airport's environs, fostering the beginnings of a greater aerotropolis. Since 2003, over 100 new electronics firms have located in the Belo Horizonte metropolitan area, many near the airport. Such development is expected to boost air cargo volumes in the years ahead and attract more suppliers to Tancredo Neves' evolving airport city.

The improved airport corridor highway (Linha Verde) has likewise created convenient access to several developments such as a new headquarters for the state employing 16,000 in 2011. A world-class resort with two official golf courses, horseback riding and an F1 racetrack near the airport is also being developed. In terms of the airport's limited flight connectivity, INFRAERO stepped up to the plate again in 2005 by forcing almost all of the flights at

downtown's Pampulha Airport to move their operations to TNIA. The decision had a dramatic impact in raising passenger volumes at TNIA.

With the Minas Gerais State Secretariat for Economic Development working diligently to bring more freight forwarders and third party logistics providers to Belo Horizonte to reduce TNIA's air cargo 'leakage' and attract more international flights.

Tancredo Neves International Airport is now in rapid growth mode with cargo services developing a greater on-site presence. Bolstering these, a large microelectronics cluster has sprouted up just four miles from the airport. In addition, its rapid growth is attracting investment in the hospitality sector – a 200-room hotel, opened in 2010, and has recorded healthy occupancy levels. At least four other airport area hotel projects are in the works as the aerotropolis moves forward.

Understanding and addressing constraints of accessibility and connectivity have proved keys to this progress. Another important state government action is the macro planning of a 20km radius from the airport and the planning of a high-tech corridor at the new ring road for Belo Horizonte (about 10 km from the airport). This planning should allow a Tancredo Neves Aerotropolis to develop in a much more economically efficient, attractive, and sustainable manner in the future.

1.10.7 Airport-driven Commercial Components (both Inside and Outside the Airport Fence).

Based on the cases above and airport city and aerotropolis benchmarking conducted by the Kenan Institute, Exhibit 1.55 specifies the most common locations of airport-linked commercial elements based on whether they are people-oriented or goods-oriented.

Exhibit 1.56 places many of these commercial elements on a schematic from similar research by the Kenan Institute following the evolution of functions at and around hub airports world-wide over the past 15 years. No single airport area is evolving exactly like this but they are all slowly developing similar commercial location patterns. Those airports surrounded by decades of prior development rarely reflect this form but their more recent business locations do follow the spatial patterns in Exhibit 1.56. This is, thus, the future of airport area land use and commercial development.

1.11 Implications for Tocumen Airport and Surrounding Developments

This foundation chapter has provided the competitive logic and business rationale for a new model of airport and airport area commercial land-use. Known as the airport city and aerotropolis model, it focuses on creating

multimodal air logistics and commercial advantages at the airport and its surrounding territory that will expand passenger and cargo volumes, increase airport revenues, positively add to the passenger experience, and derive economic benefits for the greater airport region and the nation.

To highlight this new model and illustrate its key logistics and commercial features, brief case studies were provided ranging from large airports such as Dallas-Ft. Worth, Dubai, Frankfurt, Hong Kong, and Singapore to smaller ones such as Bremen, Ft. Worth Alliance, Huntsville, and Paris Vatry. Economic impacts were documented as well as challenges some of these airports have faced.

Of course, Tocumen is not a Dubai, Hong Kong, or Singapore, where 21st century-style global mega-hubs and surrounding development were planned in a centralized semi-autocratic manner without environmental issues constraining them. Nor does Tocumen have the 3,000+ inside the fence developable hectares of a Dallas-Ft Worth or Kansas City International Airport.

What Tocumen does have is a strategic location at the world's crossroads of north-south and east-west trade, newly acquired 300 hectares of land for inside the fence airport city development, substantial available land near its older cargo zone for modern logistics and time-critical good processing facilities, and a rapidly expanding hub airline (Copa) with a remarkably bright future.

Complementing these are Panamá's advanced telecommunications infrastructure, strong financial institutions, solid universities, and a vast amount of open land surrounding Tocumen that can be developed in a complementary manner to reinforce the airport.

The above factors, when taken together, provide a propitious opportunity for Tocumen to be a key driver of value-adding logistics services, luxury tourism, and high-value agriculture which are viewed as Panamá's primary economic engines in its *Vision 2020* document and the Strategic plan of the Government (2010–2014). Other commercial functions such as financial services, convention, trade, and exhibition and hospitality also fit in this category.

There are, however, a number of challenges that Tocumen, its surrounding areas (and, indeed, the Republic) face in achieving these goals. As will be discussed in the chapters which follow, the airport region's and the Republic's surface transportation infrastructure must be substantially upgraded to create logistics synergies that can exert a much stronger economic impact. In addition, financial resources must be obtained by Tocumen and its surrounding developers to put in place the modern logistics and commercial facilities envisioned. Moreover, inside the fence and outside the fence logistics and commercial development must be carefully planned and implemented so that they complement rather than compete with each other.

Flight networks must be expanded including international wide-body freighter service to reinforce Copa's narrow body passenger, cargo, and courier service. Panamá's cool-chains must be improved from ocean or field to aircraft, and development around Tocumen carefully guided so that it does not prevent future airport growth, recognizing that as the engine of airport city and aerotropolis development, the airport must be able to expand.

The next chapter will focus on infrastructure and facility expansion (both inside and outside the airport fence) as well as planning guidelines to foster a vibrant Tocumen Airport City and greater Aerotropolis. The third chapter will provide the business plan and marketing guidelines along with specifying the critical success factors for Tocumen's air logistics hub and airport city as well as for its surrounding aerotropolis to prosper. A concluding fourth chapter will present infrastructure and facility phasing timetables, investor incentives, and financing and management options. The chapter concludes with 30 specific recommendations and action steps required by stakeholders to plan and develop a world-class air logistics hub, airport city and aerotropolis at and around Tocumen International Airport.

Exhibit 1.1. iPhone Global Supply Chains

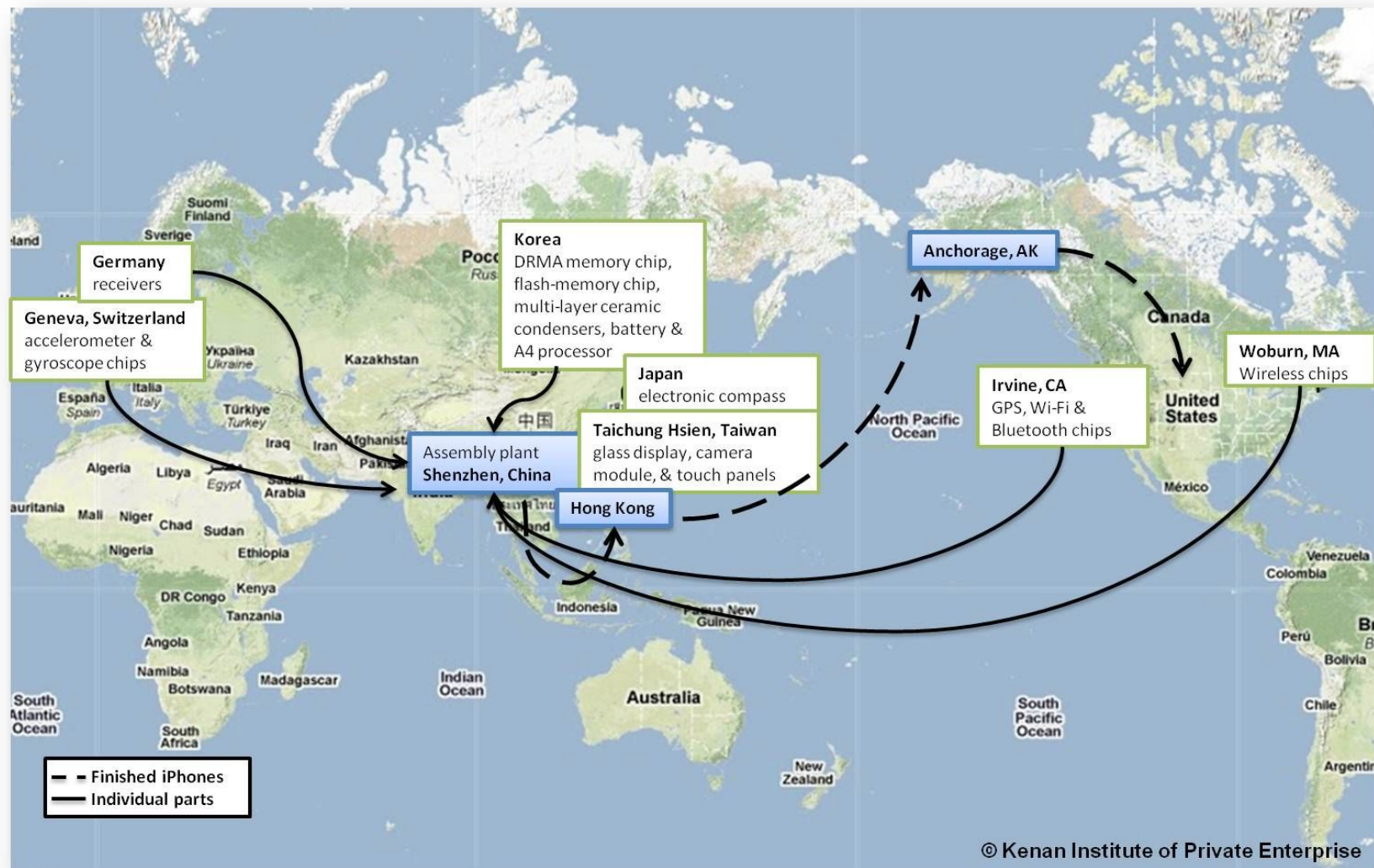


Exhibit 1.2. Global Air Transport, 1945-2010

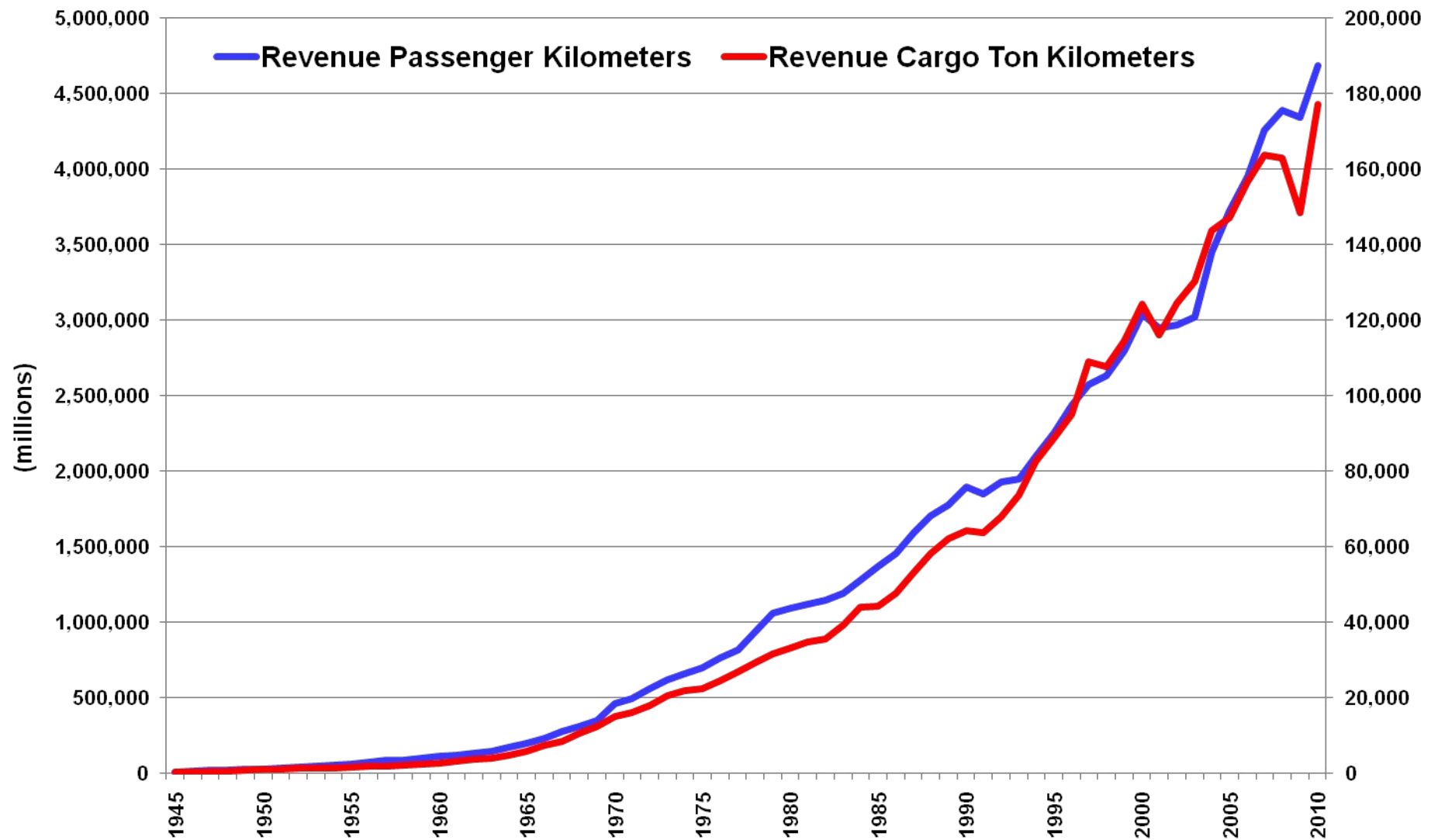
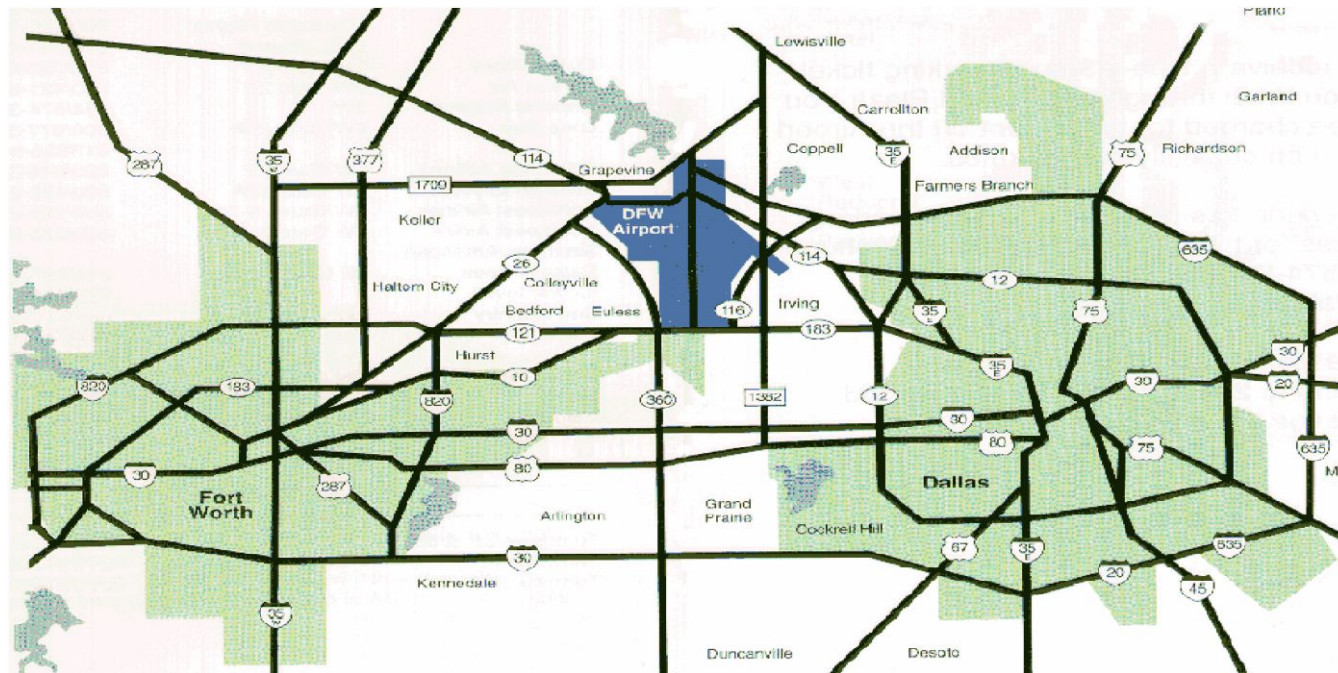


Exhibit 1.3. DFW Airport Overview—DFW Airport Is Located in between the Cities of Dallas and Fort Worth, and Is Larger than Manhattan Island



Source: DFW—An Airport City. April 25, 2007

Exhibit 1.4. DFW: 6 Key Commercial Development Areas

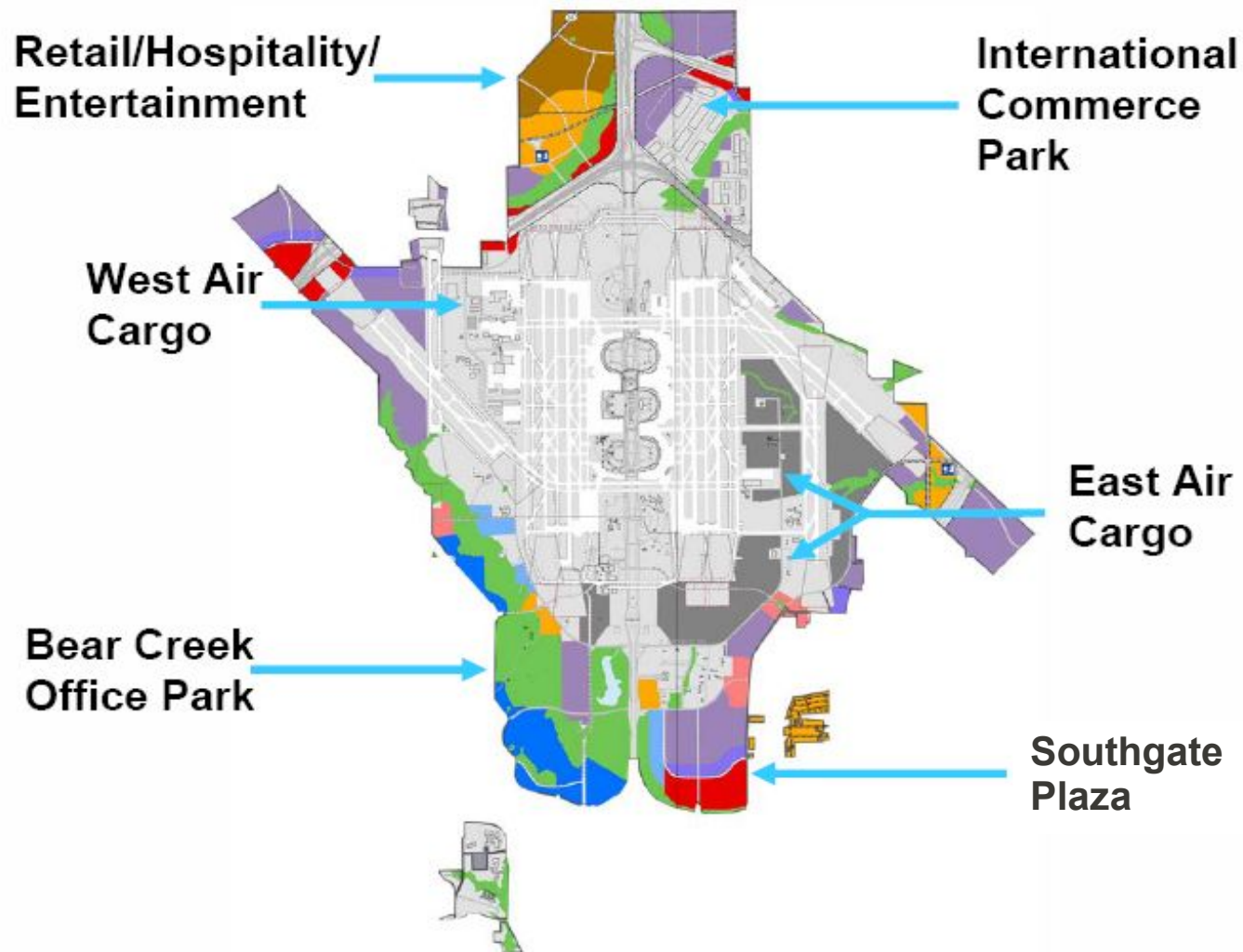


Exhibit 1.5. DFW—International Commerce Park



Industrial



Freeway Commercial



Flex Office

Exhibit 1.6. DFW—Retail/Hospitality/Entertainment



Retail/Hospitality/Entertainment



Mixed Use

Exhibit 1.7. DFW—Bear creek Office Park



Corporate Campus Mixed Use Industrial

Exhibit 1.8. DFW— Southgate Plaza: 125-acre Area, Mixed-use Development Including Grand Hyatt Hotel, Offices, Restaurants & Shops

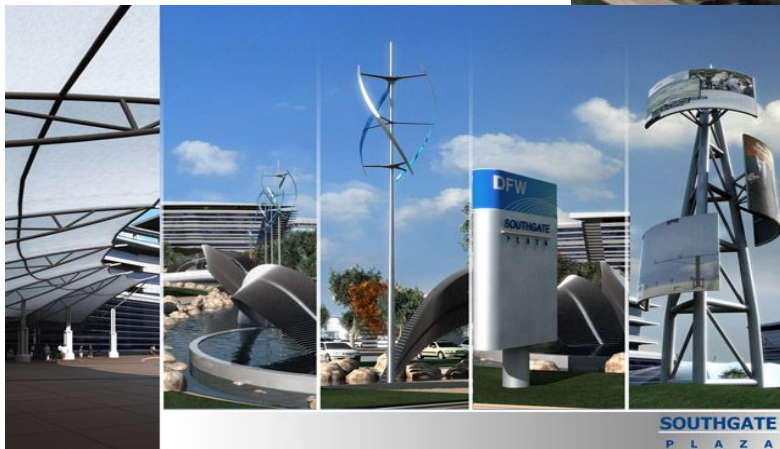


Exhibit 1.9. DFW - Future light rail, Commuter rail & High-speed Rail Lines Feed New Stations



Exhibit 1.10. Comparative Economic Impact of Airports

Airport/City	2004 Passengers	Metro Population	Economic Impact
Memphis	10,883,759	1,250,293	\$21 Billion
Denver	42,393,766	2,330,146	\$17 Billion
Phoenix	39,504,898	3,715,360	\$14 Billion
Minneapolis	36,713,173	3,116,206	\$11 Billion

Exhibit 1.11. Memphis Aerotropolis Logistics and Distribution Clusters, 2005

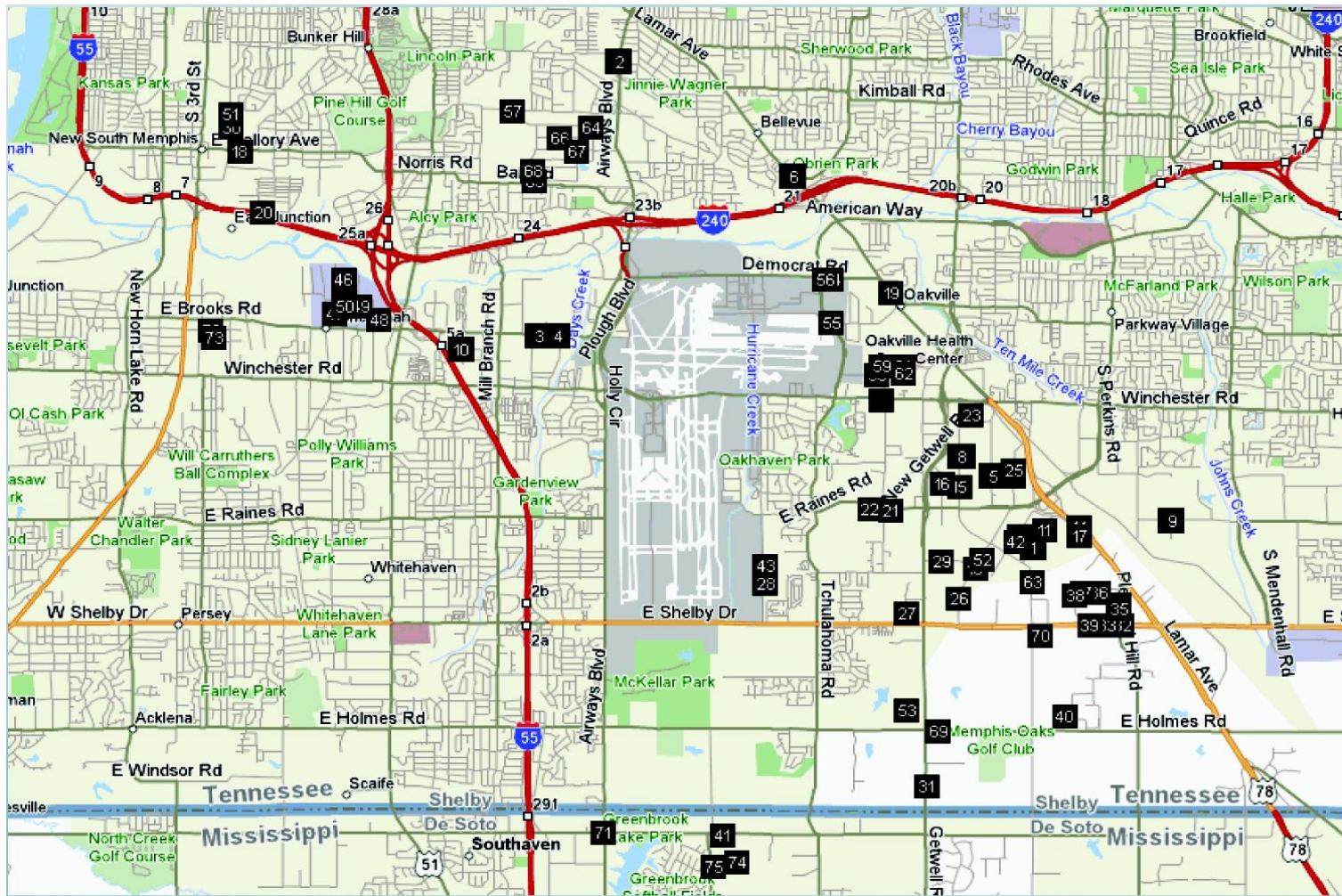


Exhibit 1.12. Memphis Distribution Facilities Near Airport, 2005

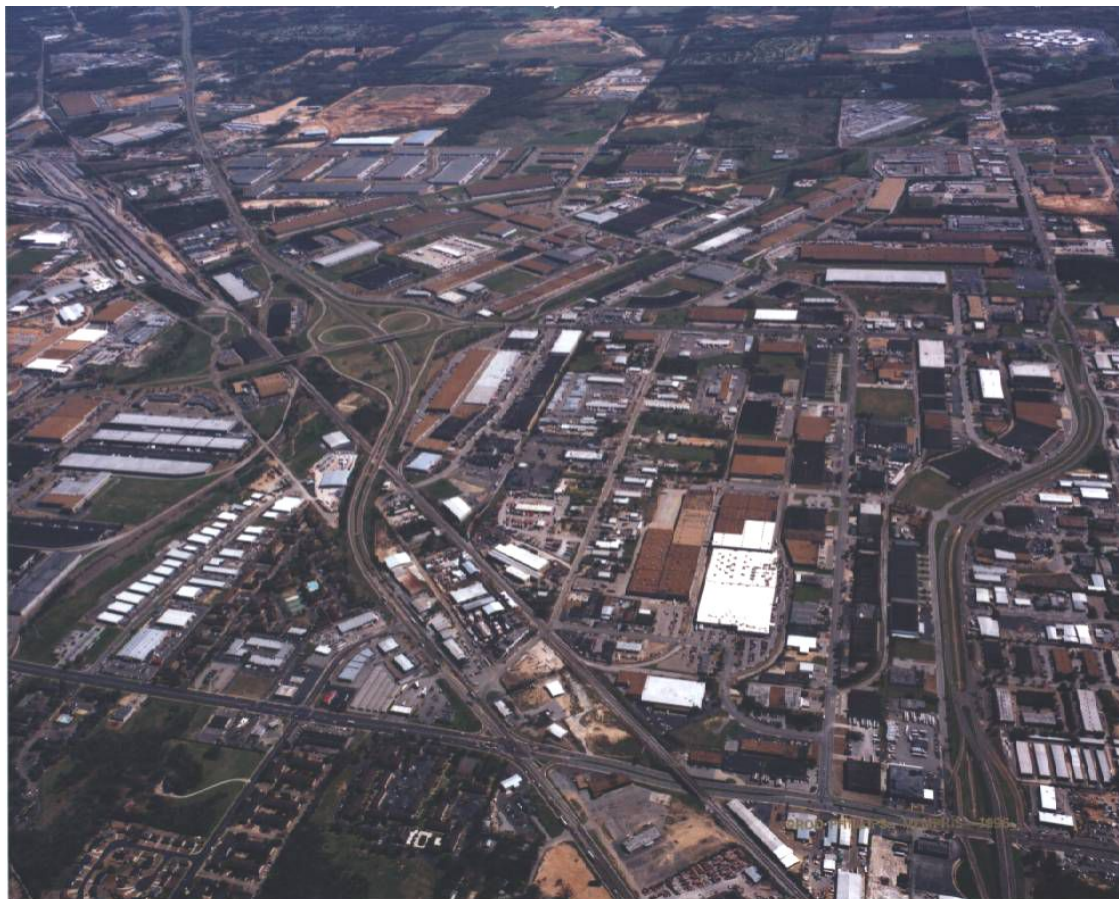


Exhibit1.13. Proposed Core of Detroit Region Aerotropolis: 25,000 Acres of Development Potential

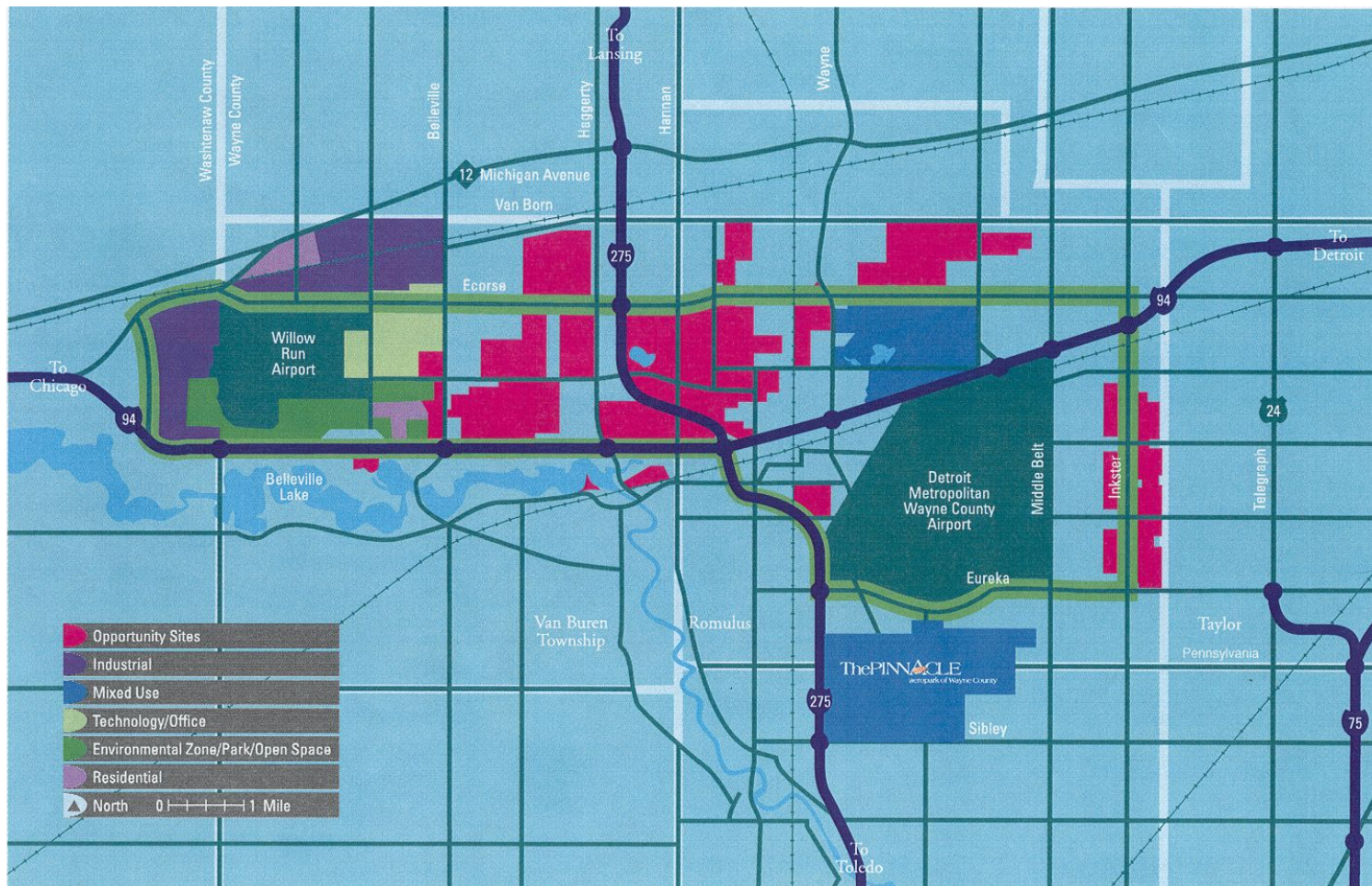


Exhibit 1.14. Detroit Region Aerotropolis Conceptual Model

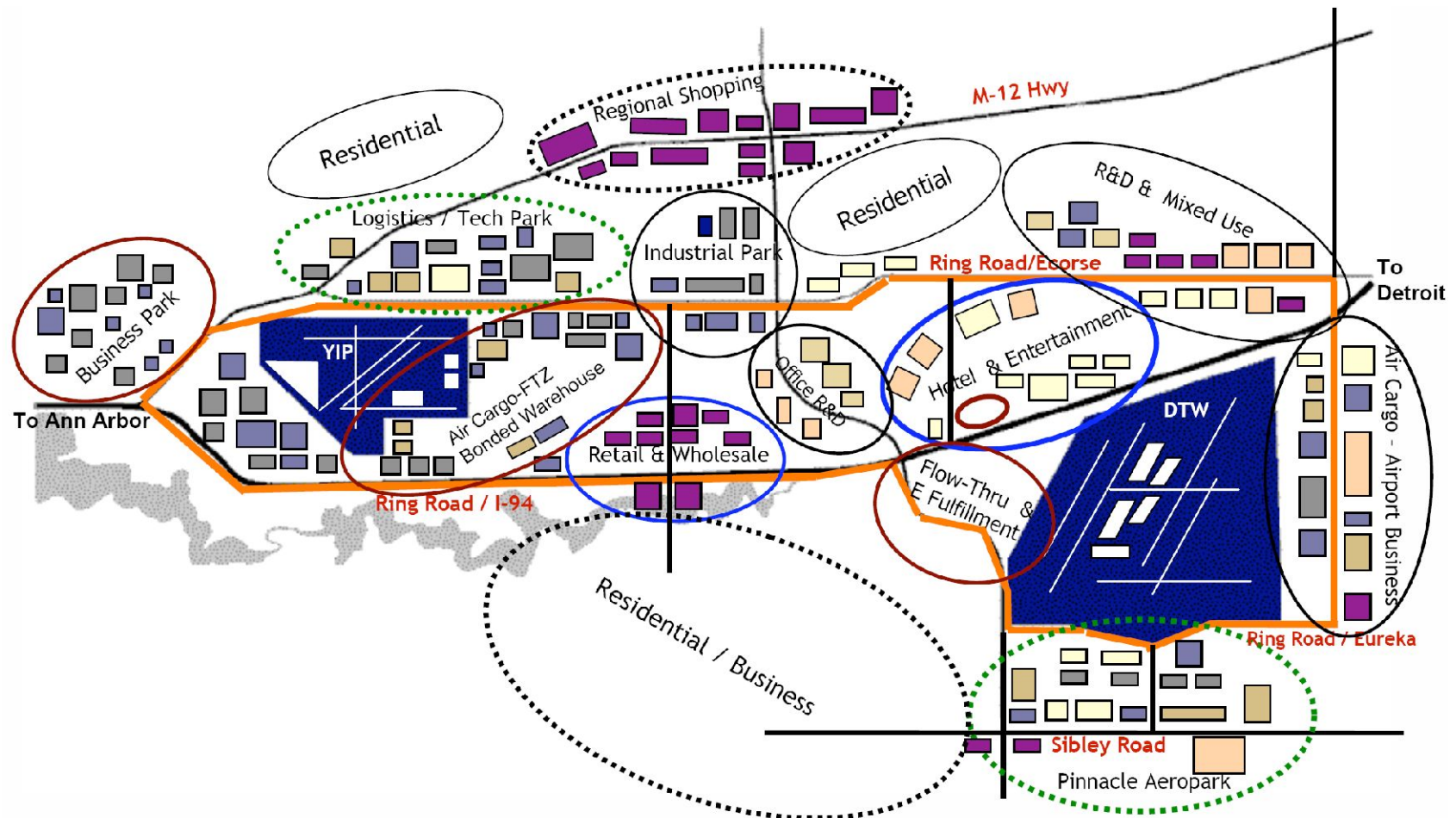


Exhibit 1.15. 2006 Aerotropolis Charrette Visions

A Conceptual Plan



Respect Existing Communities

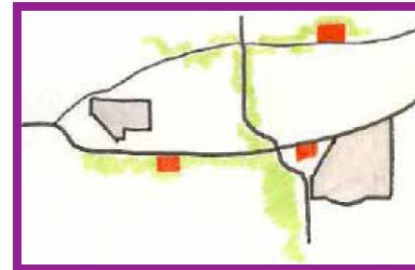


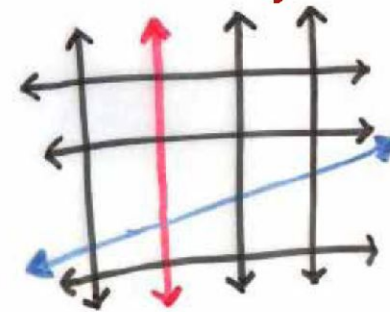
Exhibit 1.16. 2006 Aerotropolis Charrette Visions



Improve Transit Linkages

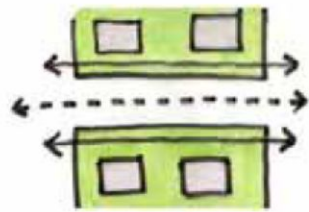


Integrate Mobility & Sustainability

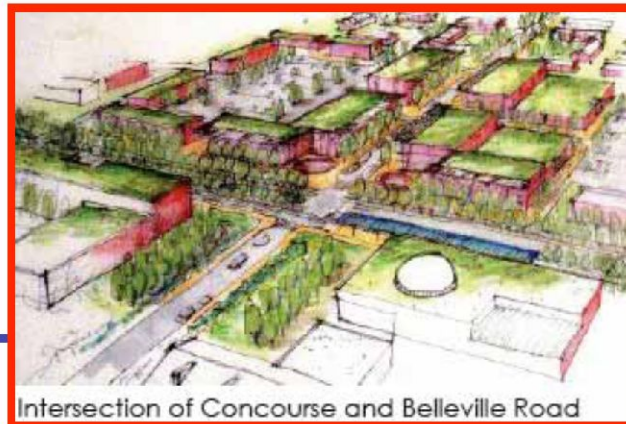


Build a Variety of Sustainable Uses and Designs - Including Green Building Design

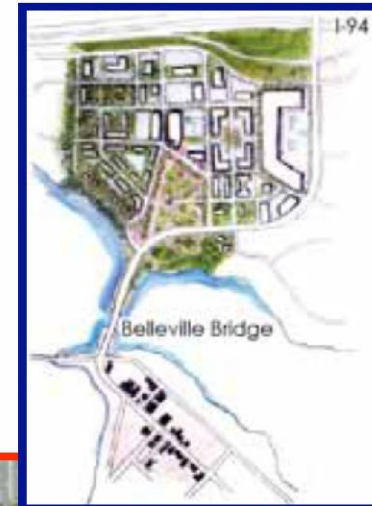
Exhibit 1.17. 2006 Aerotropolis Charrette Visions



Study Connections



Provide Good Connectivity



Design in Quality Open Space



Exhibit 1.18. 2006 Aerotropolis Charrette Visions

The Pinnacle AeroPark



The Concourse along Ecorse



A Vision of Things to Come?



Exhibit 1.19. Detroit Aerotropolis Public Transit Linkages

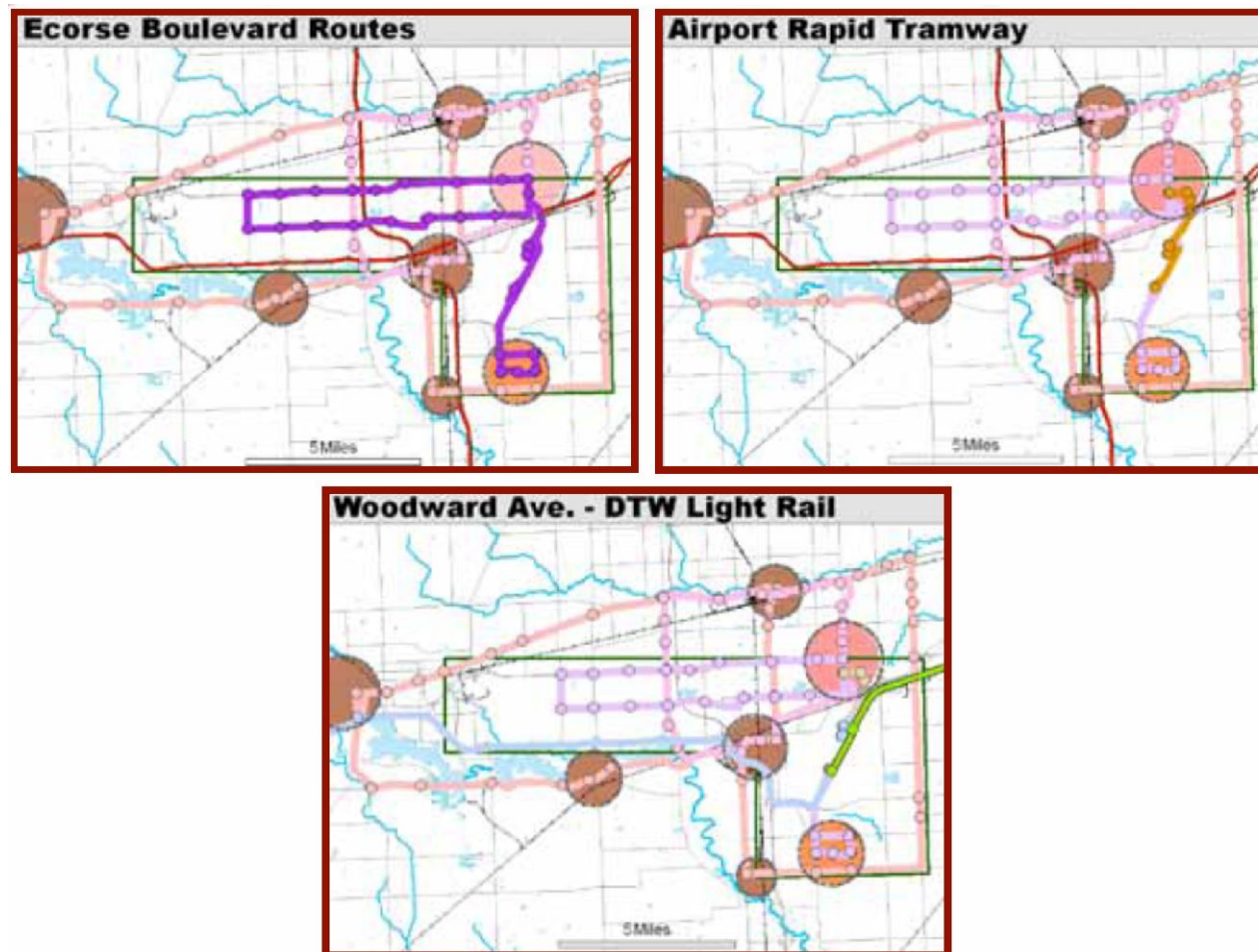


Exhibit 1.20. Public Transit Linkages

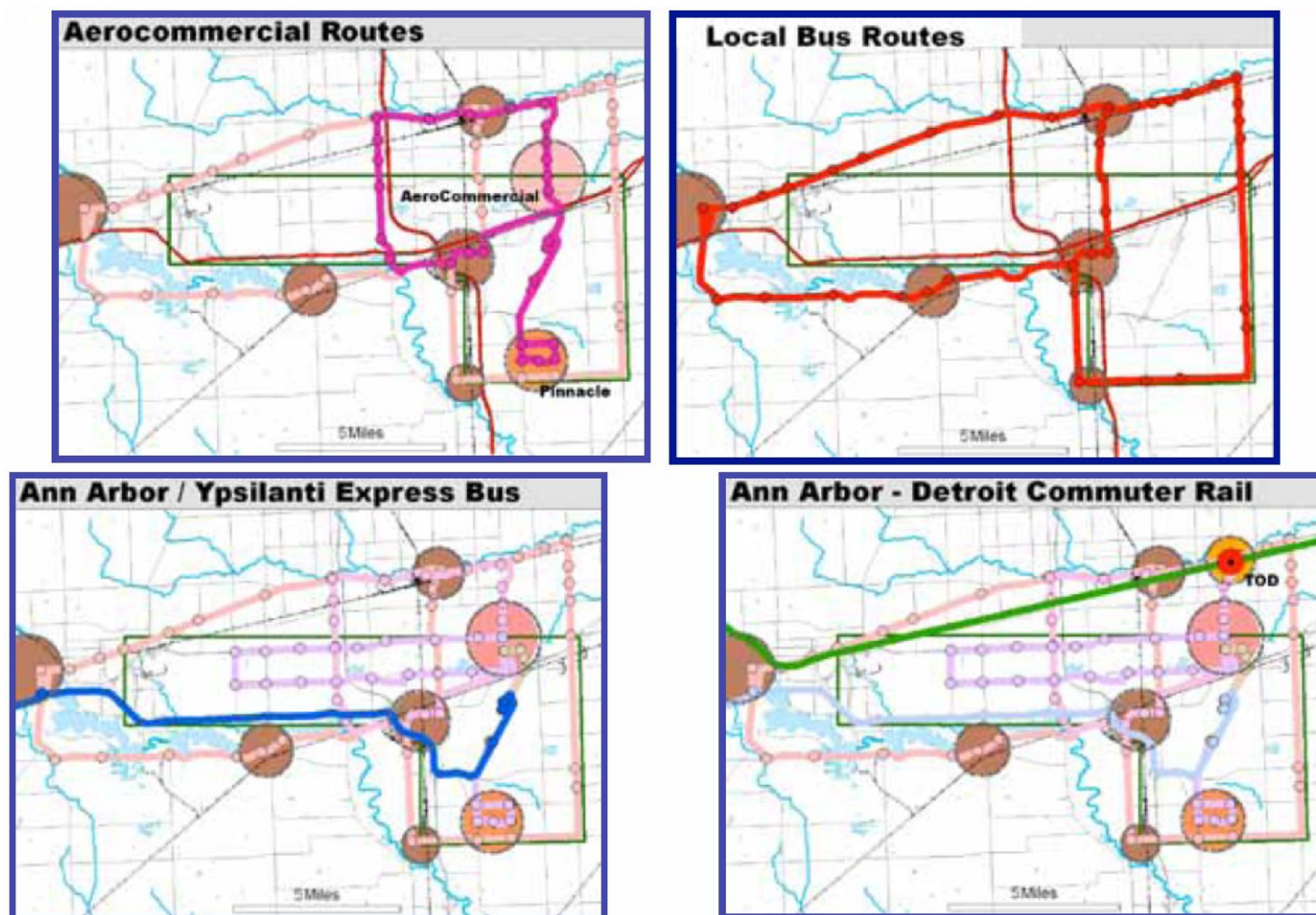


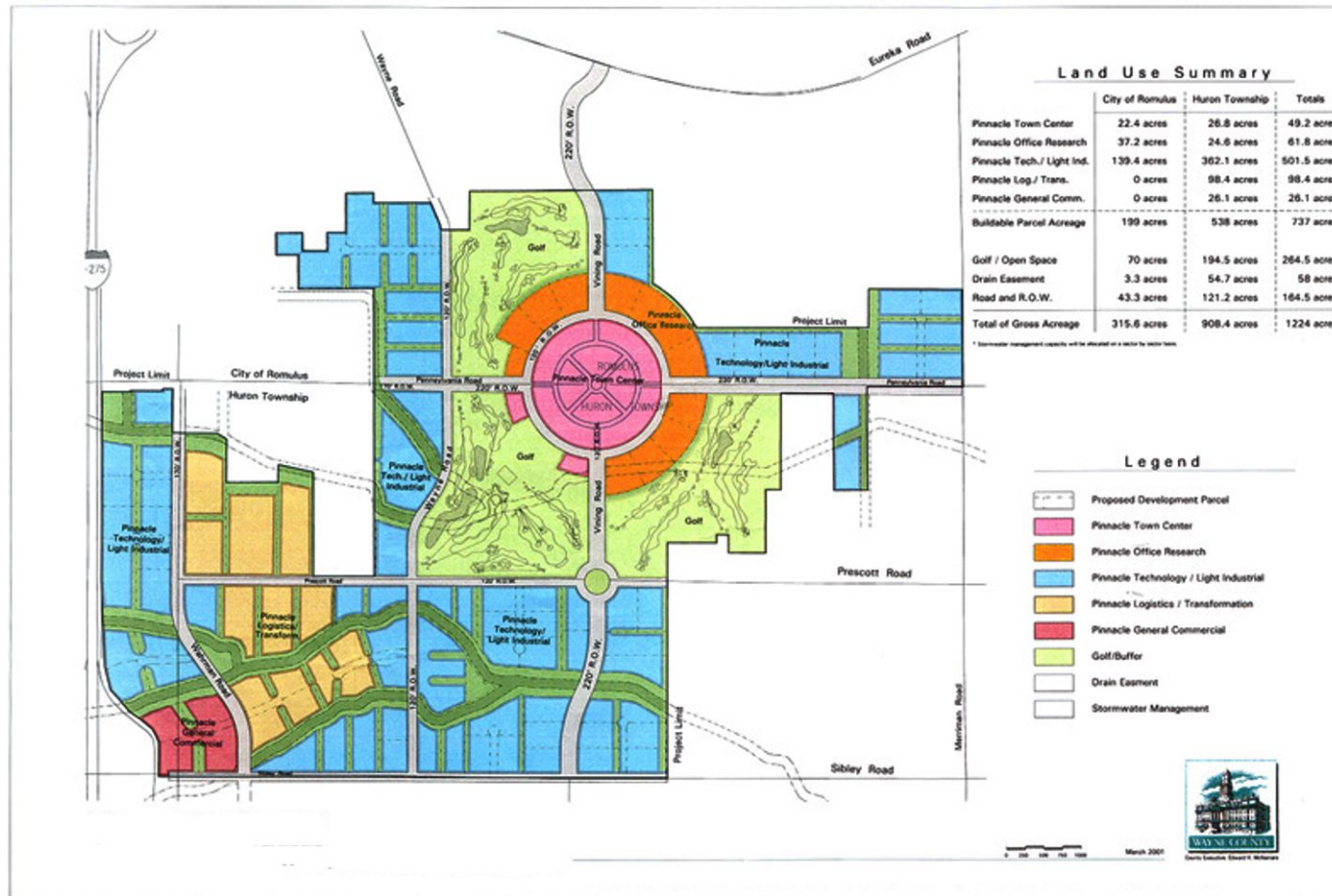
Exhibit 1.21. Pinnacle Aeropark: DTW's New Front Door



Exhibit 1.22. Aerial View of the Pinnacle Aeropark



Exhibit 1.23. Pinnacle Aeropark Commercial Clusters and Land Use



Source: Wayne County Departments of: Jobs & Economic Development / Airports / Public Services / Management & Budget; and SKW.

Exhibit 1.24. KCI Business District & Economic Development Incentives

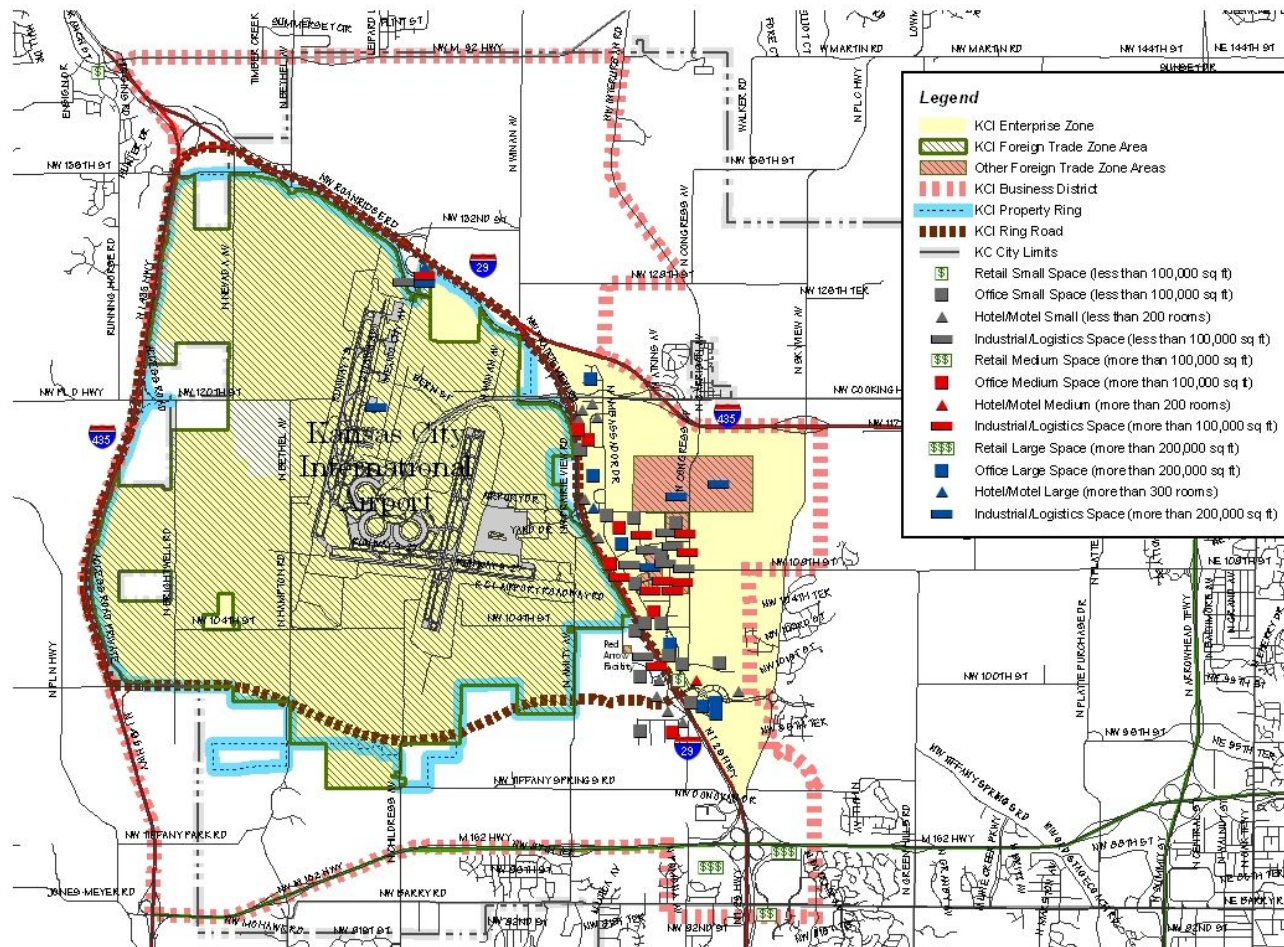


Exhibit 1.25. KCI Airport Property and Surrounding Area with Proposed Clusters

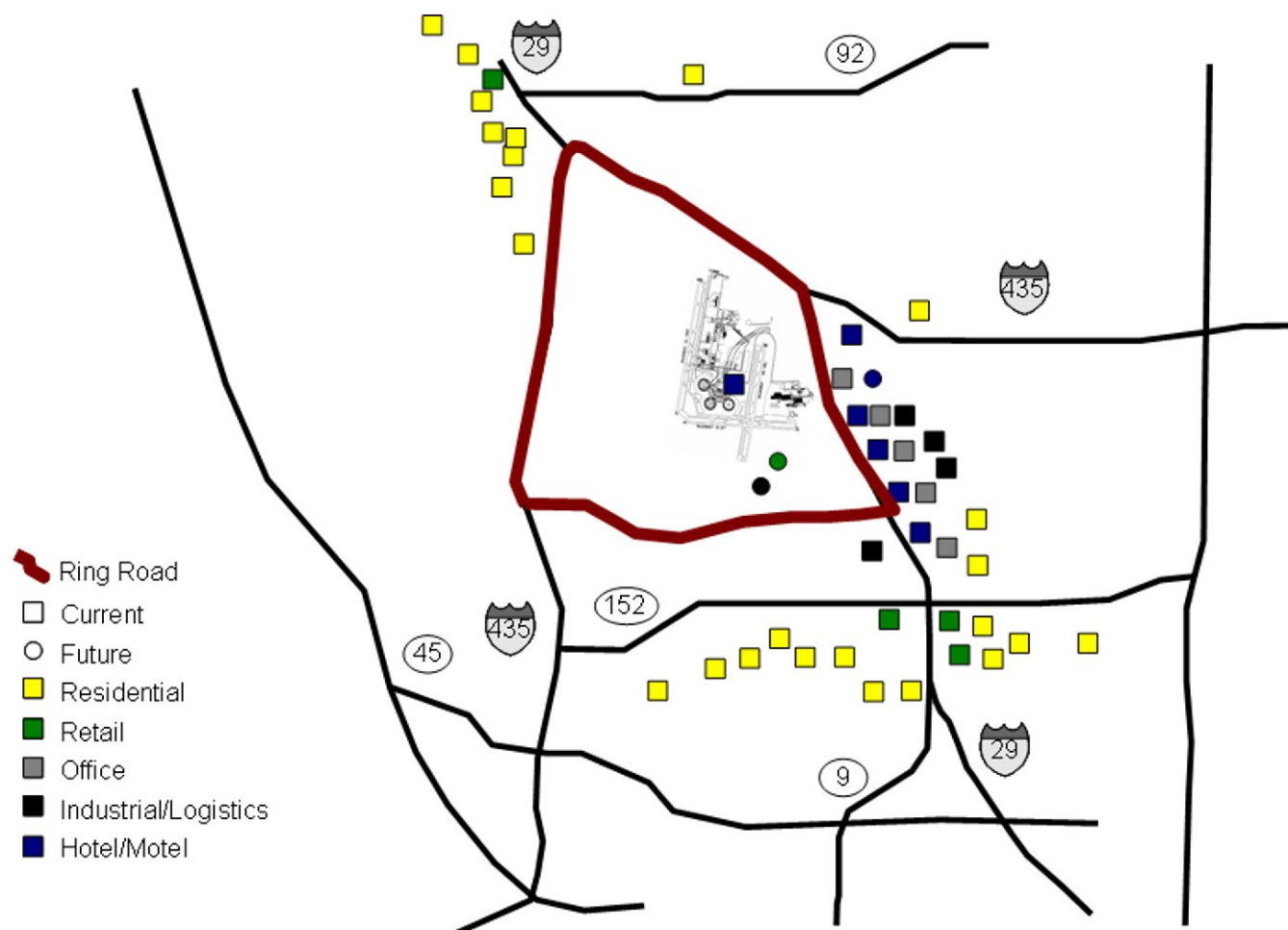


Exhibit 1.26. KCI Intermodal Business Center

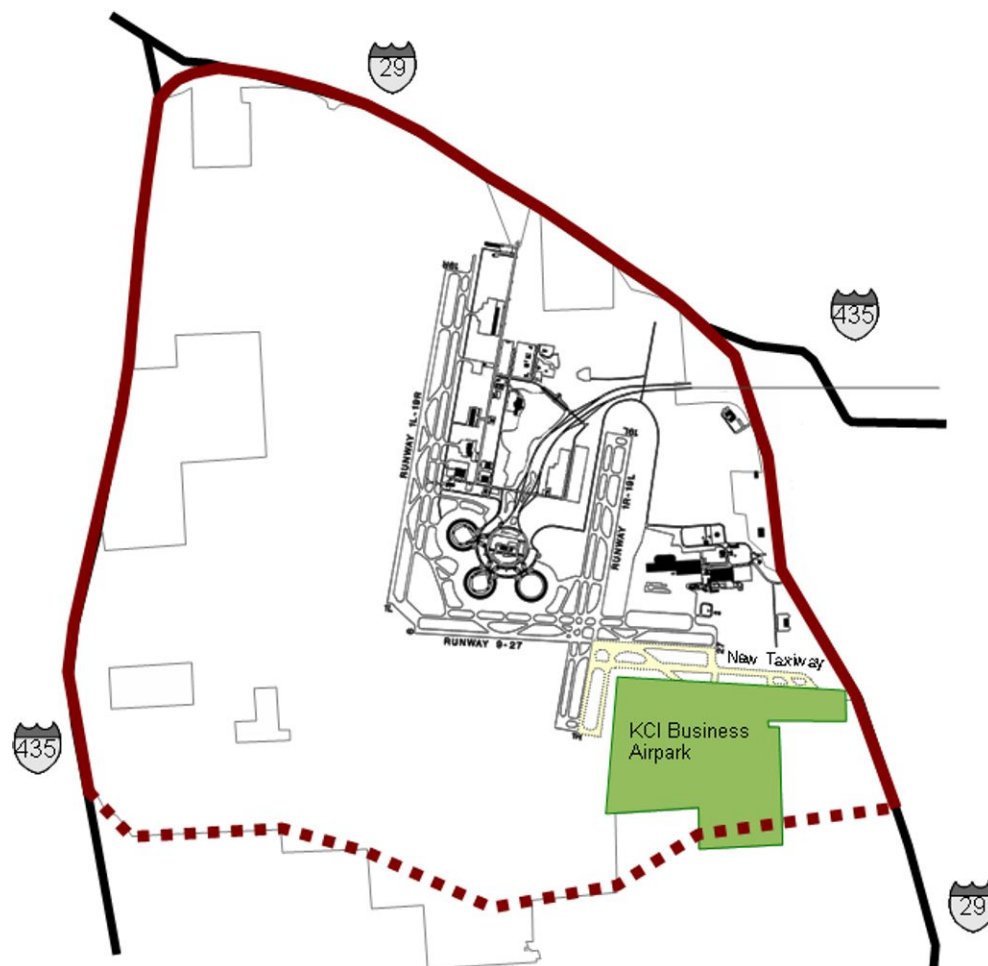


Exhibit 1.27. Location of KCI Business Airpark Conceptual Master Plan



Exhibit 1.28. Hong Kong International Airport

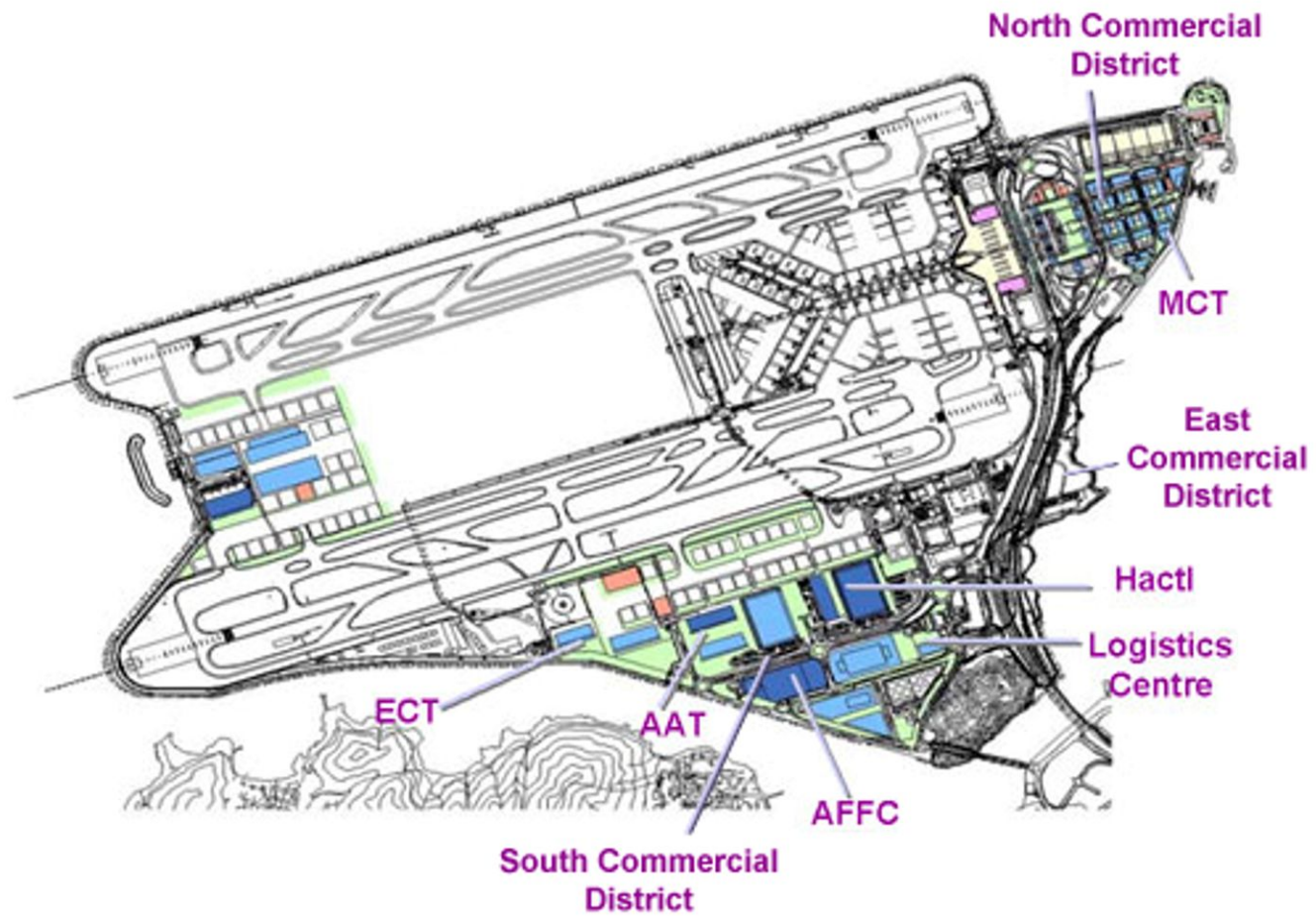


Exhibit 1.29. Office and Residential Development Near Hong Kong International Airport Major Cargo Terminal



Exhibit 1.30. HKIA SkyCity, Phase I



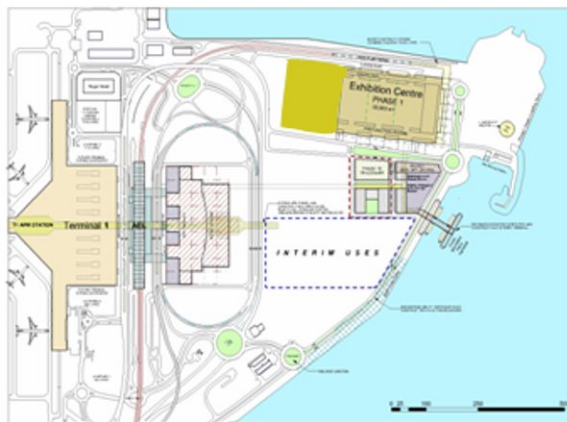
Source: SOM.

Exhibit 1.31. Terminal 2 / SkyPlaza

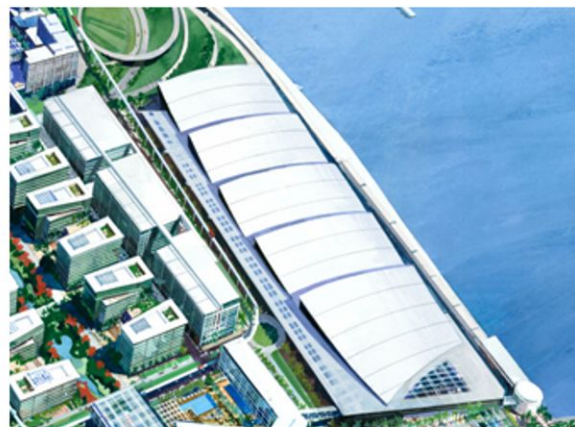


Source: SOM.

Exhibit 1.32. SkyCity — Phase 1



Phase 1



International Exhibition Center



SkyPlaza



Cross Boundary Ferry Terminal

Source: HKIA

Exhibit 1.33. SkyCity Ultimate Development Phasing Concept



Source: SOM.

Exhibit 1.34. SkyCity as a Pedestrian Precinct



Source: SOM.

Exhibit 1.35. SkyCity and Hong Kong Disneyland



Exhibit 1.36 SkyCity Economic Zone

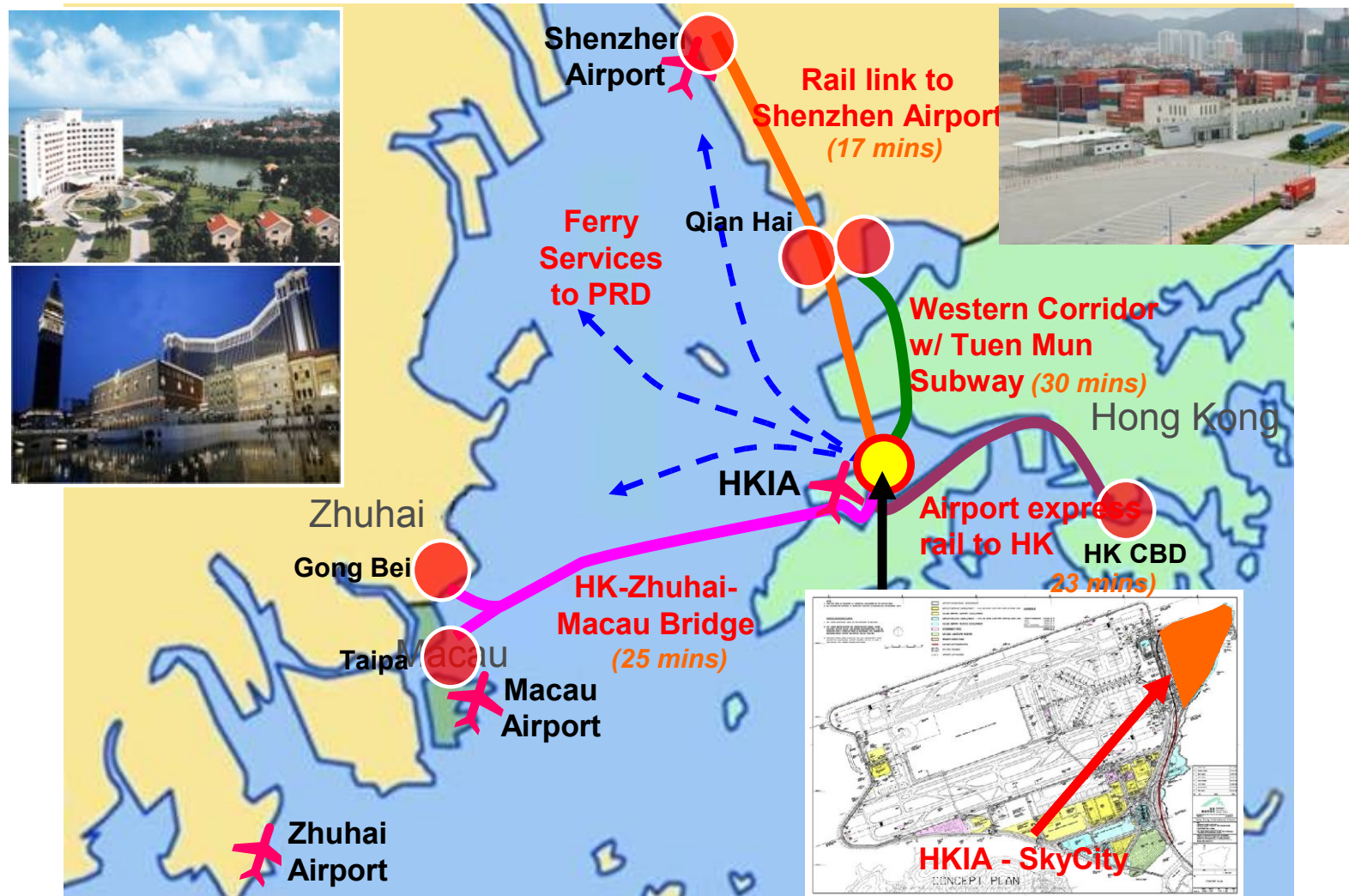


Exhibit 1.37. Incheon Airport Area Development Plan

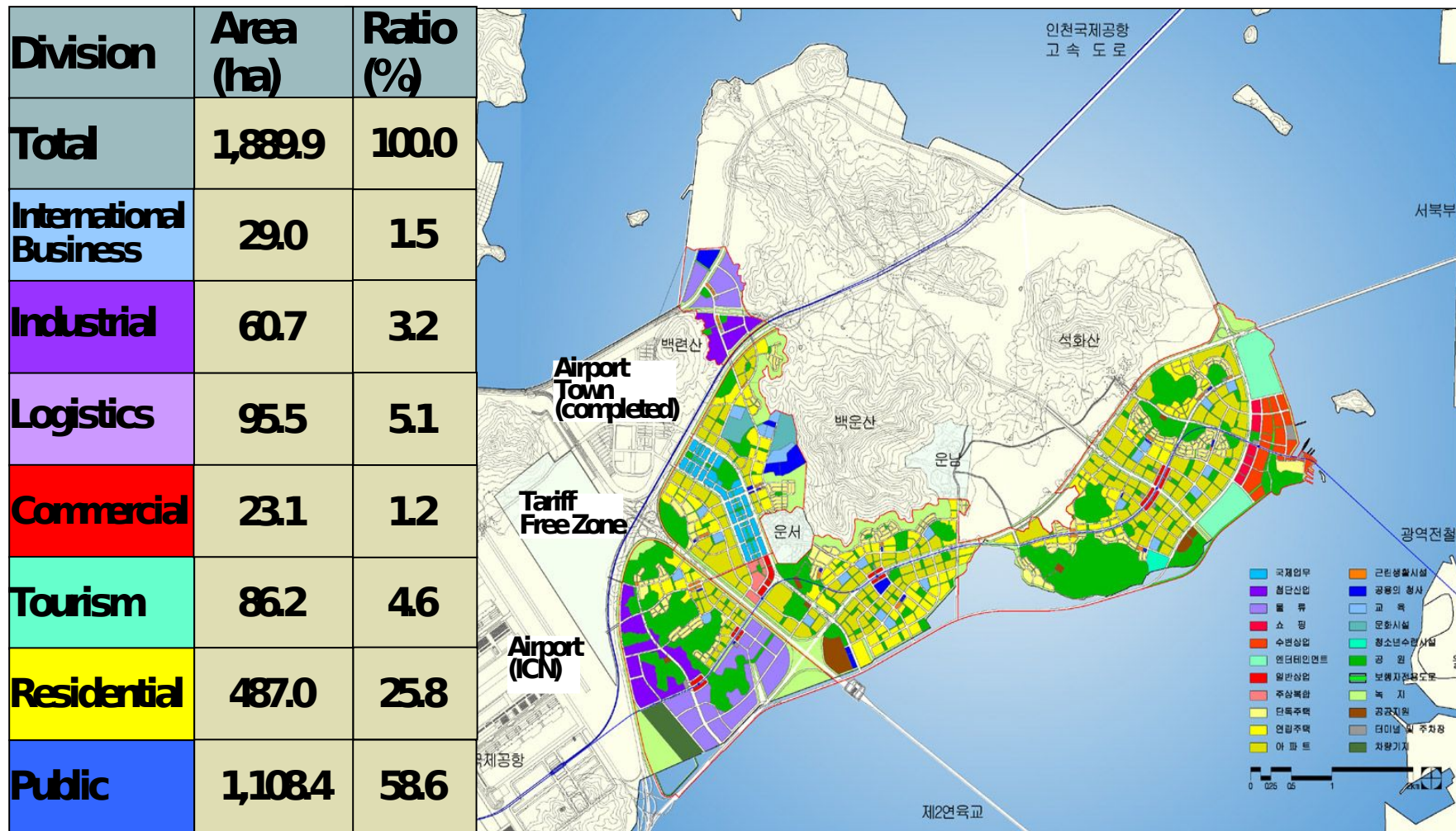


Exhibit 1.38. IIAC Air City Development Concept



Source: IIAC

Exhibit 1.39. Incheon Airport Fashion Island Project



- **Area** : IBC-I Phase 2(81.7 Acres) / The railway station area (98 Acres)
- **Total Expense** : US \$ 1 billion
- **Basic Development Plan**
 - Develop the area as **the fashion mecca in Asia** with state-of-art convention, hotels, shopping malls, luxury outlets and retails
- **Present Status**
 - MOU signed with **a world leading fashion association** (March 31, 2006)
 - Master Plan is being developed by project leaders

A World Best Air Hub

Source IAAC

Exhibit 1.40. New Songdo, Airport Edge City Near Incheon International Airport (Conceptual Plan)



Exhibit 1.41. Taoyuan Aerotropolis Functional Zones

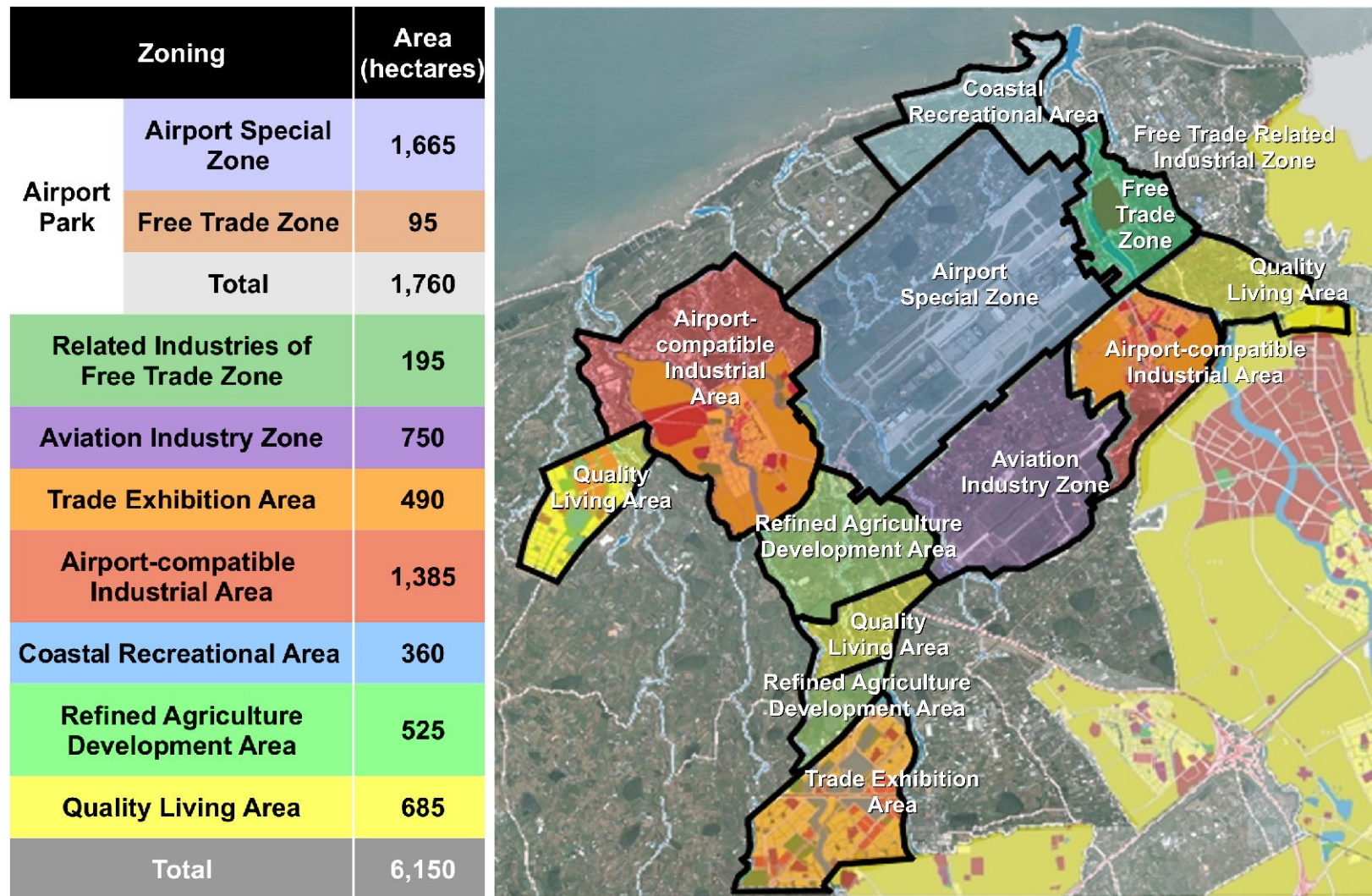


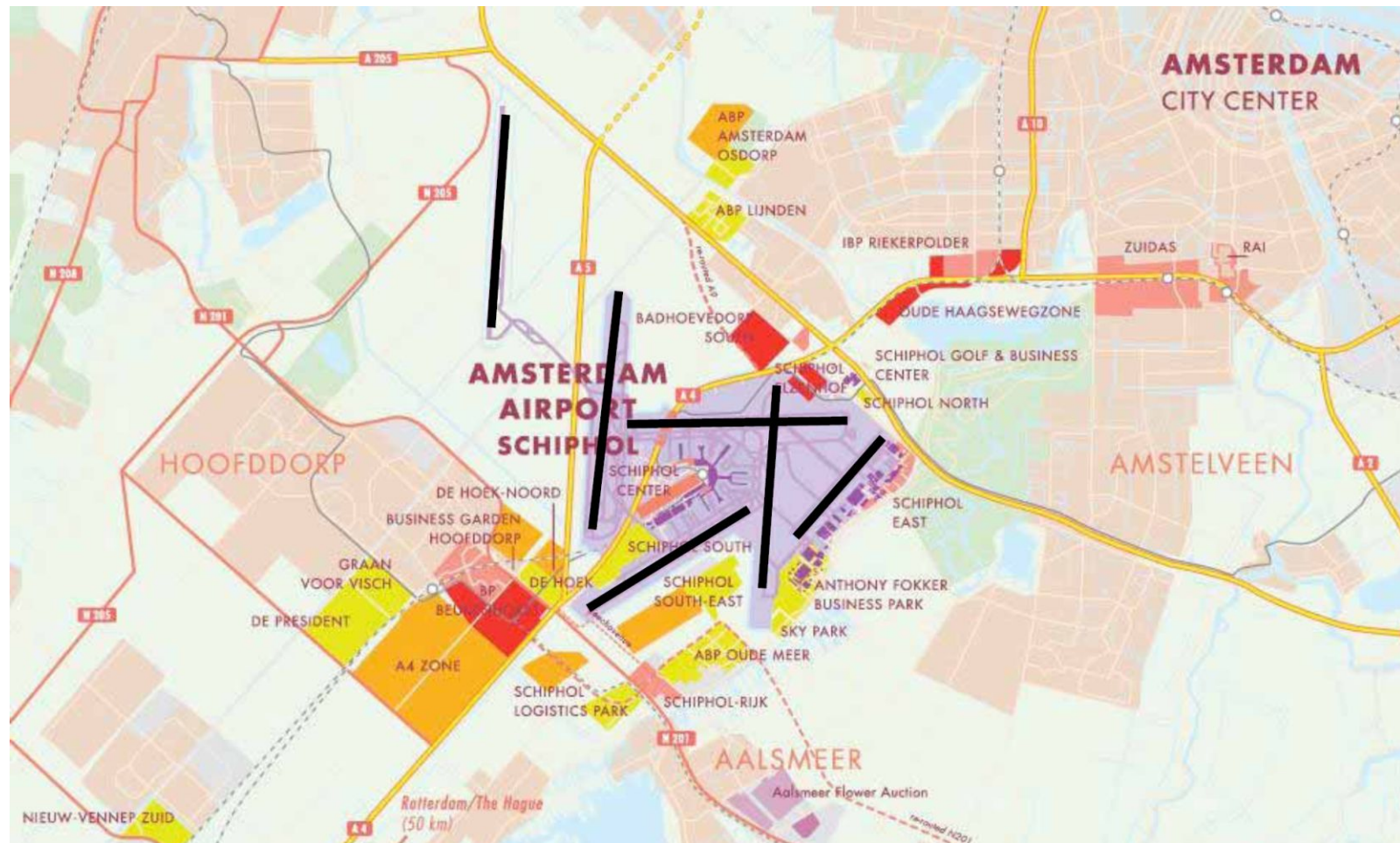
Exhibit 1.42. Amsterdam Schiphol Airport: Shopping



Exhibit 1.43. Amsterdam Schipol—World Trade Center



Exhibit 1.44. Amsterdam Schiphol Area Commercial Clusters



Source: NACO.

Exhibit 1.45. Amsterdam Schipol Airport City – Aerotropolis Synergies

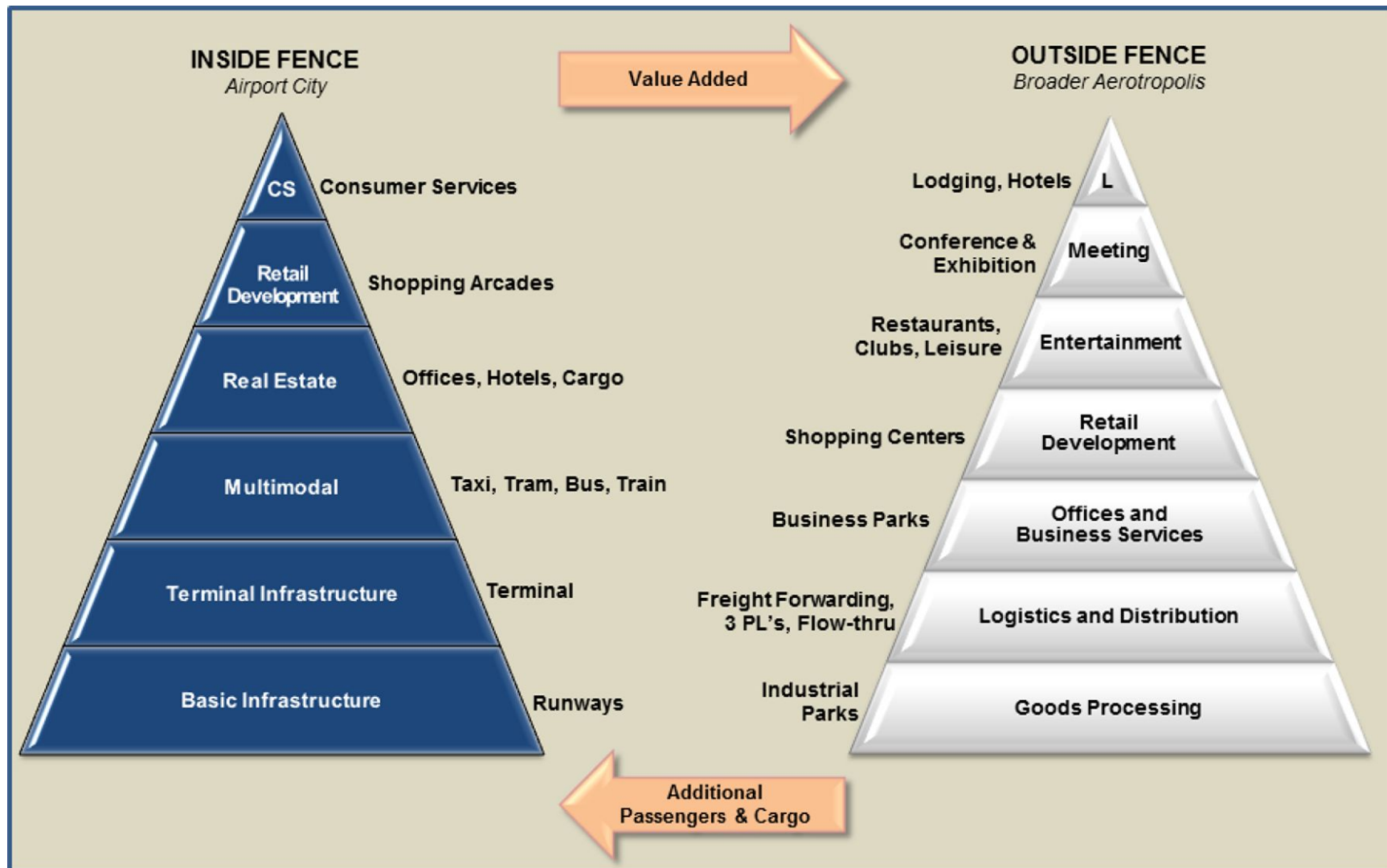
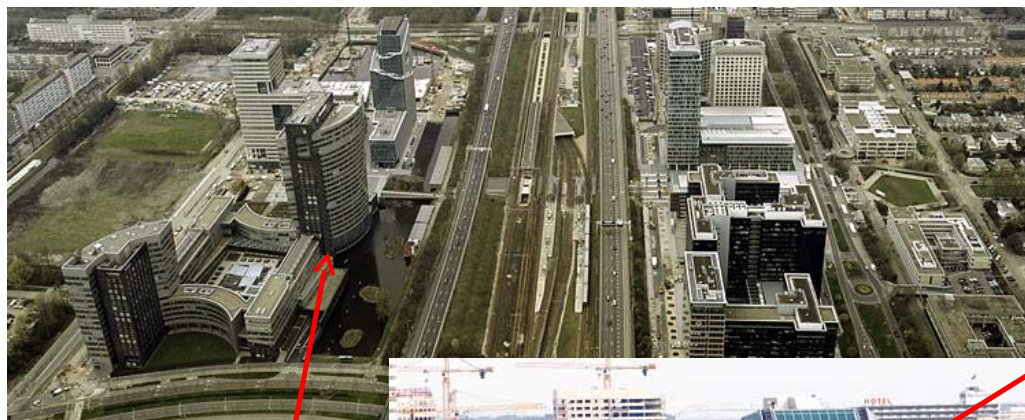


Exhibit 1.46. Amsterdam Zuidas: Airport Edge City



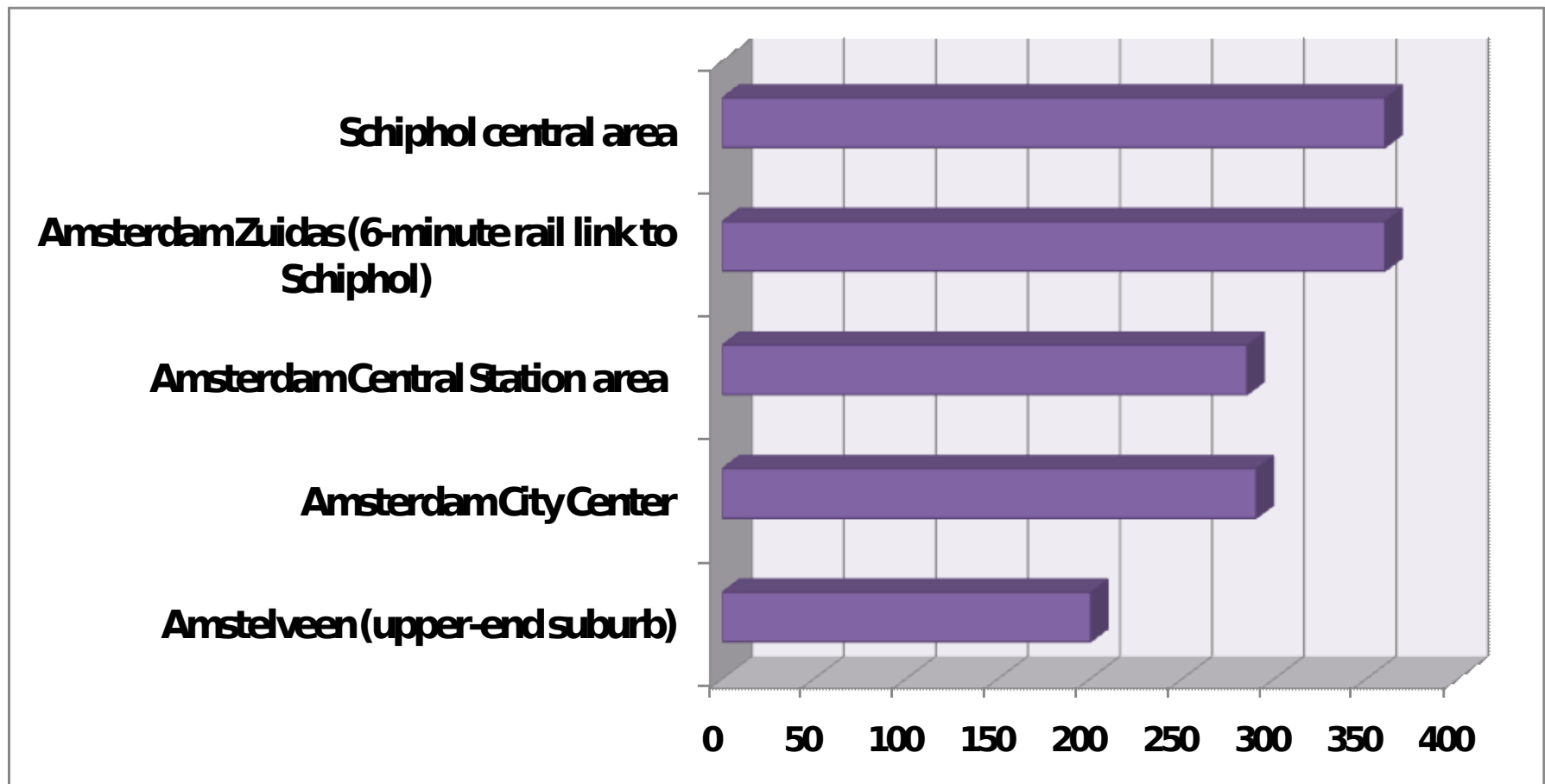
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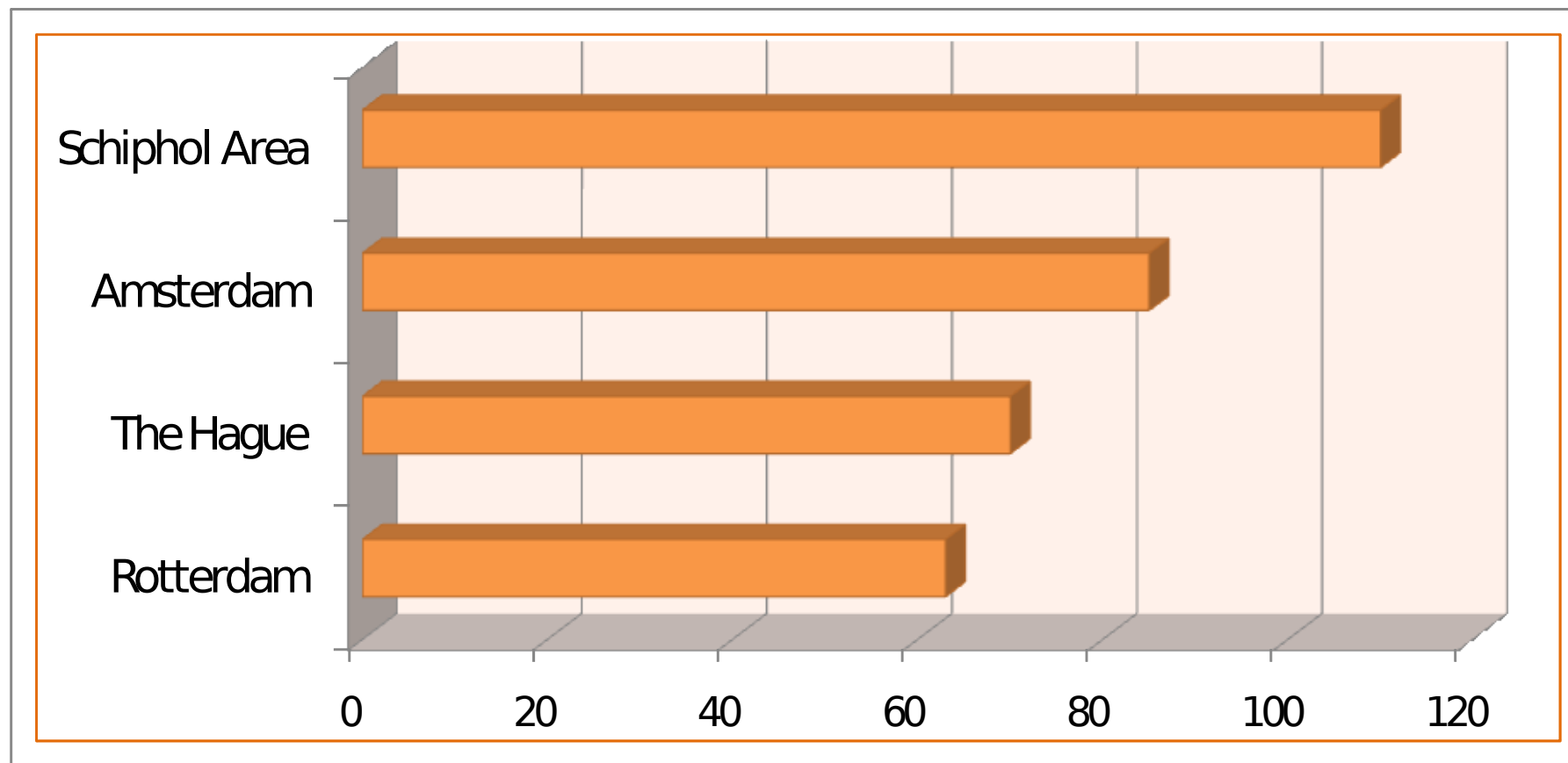


Exhibit 1.47. Amsterdam Comparative Office Rents – 2010, EU/m²/yr



Source: DTZ Zadelhoff and Kenan Institute

Exhibit 1.48. Netherlands Comparative Industrial Property Rents – 2010, EU/m²/yr



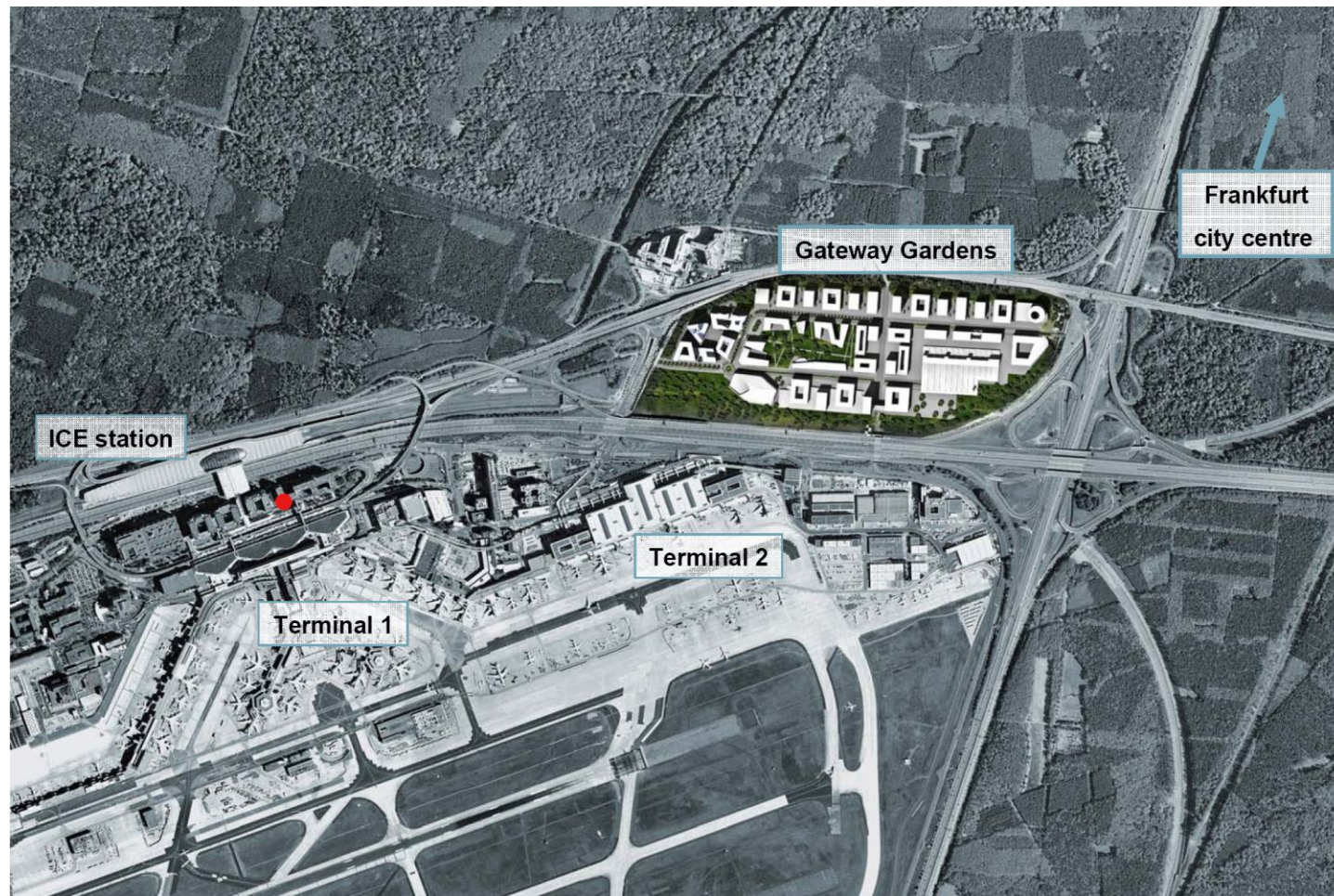
Source: DTZ Zadelhoff and Kenan Institute

Exhibit 1.49. Frankfurt Office Complex and Airrail Center



Airrail Center is now “The Squire” – photo courtesy of <http://www.thesquire.com/en/>

Exhibit 1.50. Gateway Gardens Location



Source: Fraport

Exhibit 1.51. Gateway Gardens Planned Layout



Source: Fraport

Exhibit 1.52. Gateway Gardens Urban Spaces



Source: Fraport



Exhibit 1.53. Dubai World Central International Airport and Its Adjacent Airport Cities



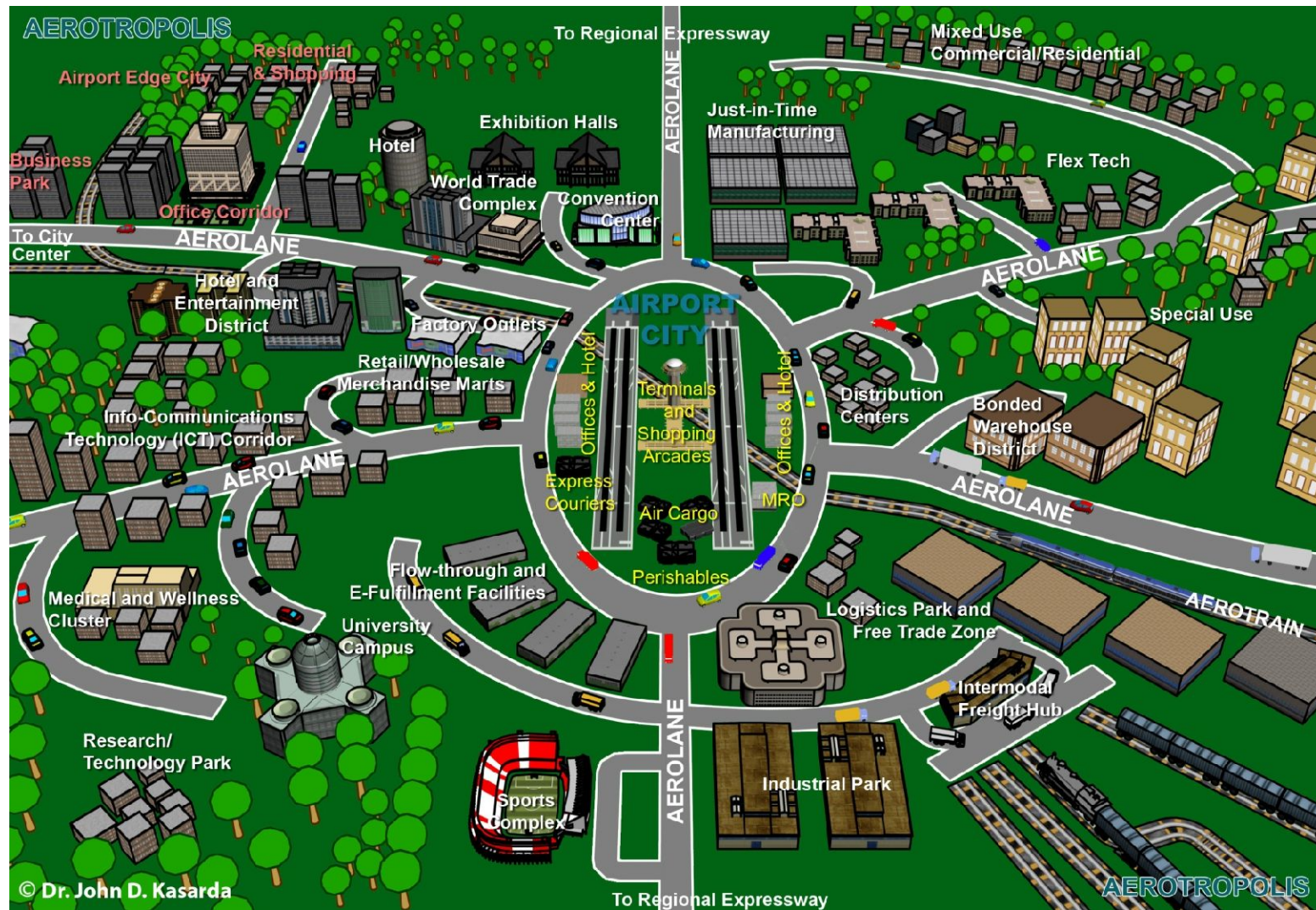
Exhibit 1.54. Bremen Airport City with View of the Center City



Exhibit 1.55. Airport City and Aerotropolis Commercial Elements Overview

	People-oriented	Goods-oriented
Terminal	<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) 	
Terminal area	<ul style="list-style-type: none"> • Hotels and entertainment • Office & retail complexes 	<ul style="list-style-type: none"> • Logistics and Air Cargo
Elsewhere on airport or outside the fence	<ul style="list-style-type: none"> • Convention & exhibition centers • Business and technology parks • Retail centers and wholesale merchandise marts • Information and communications technology complexes • Bioscience and medical facilities • Higher education campuses • Large mixed-use residential developments 	<ul style="list-style-type: none"> • Free trade zones & customs free zones • Logistics parks and distribution centers • Industrial estates and light manufacturing • Time-sensitive goods processing

Exhibit 1.56. Basic Airport City & Aerotropolis Schematic



Chapter 2

Infrastructure and Facility Plan Guidelines for a Tocumen Air Logistics Hub, Airport City and Greater Aerotropolis

2.1 Introduction

Central and South America have lagged behind many other regions of the world in air logistics, airport city, and aerotropolis development. Panamá is about to change this, leveraging its strategic location between North and South America and its rapidly expanding and modernizing hub airport to drive value-adding logistics processes and commercial development on airport property and throughout its surrounding areas.

2.2 Panamá's Tocumen Airport

Panamá, of course, is best known for its famous canal connecting the Atlantic and Pacific oceans. Some 14,000 ships carrying 12 million containers and 300 million tons of cargo traverse the Panamá Canal each year, accounting for 5 percent of world trade. When the US\$5.25 billion canal expansion is completed in 2014, cargo flows will substantially increase.

Tocumen International Airport is another important Panamá infrastructure story that is gaining global attention and prominence. This airport serves as the hub of one of the world's fastest growing and most successful airlines, Copa, whose aircraft widely connect Panamá to North, South, and Central America as well as the Caribbean (see Exhibit 2.1). With 66 Boeing 737 and Embraer aircraft, Copa's international route structure, (180 flights to 56 destinations in 27 countries) is the most extensive in the region. These routes are complemented by over 20 other airlines serving Tocumen from Europe and the Americas (see Exhibit 2.2).

Tocumen, with two active runways of 10,007 ft. and 8,799 ft., is located 15 miles (23 km) from downtown Panamá City via a speedy toll road. In 2010, the airport handled 5.1 million passengers and almost 100 metric tons of cargo, averaging double-digit growth rates of each for the past five years. Its passenger and cargo traffic are both forecasted to double in the next five years.

Since 2003, the airport has been operated by Tocumen SA, a private-like company whose shares are 100-percent owned by the Panamanian government. The company commenced significant airport expansion and modernization projects in 2006, which continue to this day.

The first phase involved expanding the main passenger terminal by 21,000 square meters (226,000 sq. ft.). Fourteen old boarding gates were replaced with

28 modern ones, including 6 remote positions. At the same time, terminal facilities were substantially upgraded and new baggage-handling and flight information systems introduced.

This initial phase also involved redesign and renovation of the original cargo terminal. New cargo buildings were built, as well.

The second phase, started in 2008, is currently being completed. It involved the construction of a new north passenger terminal (Muelle Norte) and related infrastructure which have added 12 gates, bringing Tocumen's total to 40.

This new terminal houses 15,000 square feet of commercial space supplementing a wide variety of retail outlets in the main terminal ranging from convenience item shops to fashionable boutiques. All are duty-free.

Once the new north terminal and supporting platforms are fully operational in early Fall 2011, work will commence on a new south terminal which will provide 20 further gates along with supporting aeronautical and commercial infrastructure. The US\$300 million south terminal will add a further 30,000 square feet to Tocumen's commercial space. There will also be a cargo facility constructed nearby to facilitate more efficient transfer of cargo and express packages from passenger aircraft, especially Copa's.

A team of consultants from the International Civil Aviation Organization (ICAO) is currently preparing a 30-year master plan for Tocumen. In addition to

addressing future aeronautical infrastructure and facility needs, including significant upgrades to Tocumen's cargo area, special attention is being given to planning an airport city that will be developed on 300 acres near the main runway recently purchased from the Technological University of Panamá.

The objective of the ICAO master plan (of which this report is a contributing document) is to not only make Tocumen a world-class passenger and air logistics hub, but also position its airport city as a central component of a greater Panamá Aerotropolis.

Office buildings, hotels, and meeting facilities were initially envisioned to anchor the airport city along with retail and consumer services that will complement those in Tocumen's passenger terminals (see Exhibit 2.3). Commercial facilities will be developed by the private sector under concessions with Tocumen SA and via joint ventures between developers and the airport company. Greater details on Tocumen airport city and logistics development will be provided later in this chapter.

2.3 Panatropolis

An even more ambitious airport-linked commercial development is quickly moving along adjacent to Tocumen's runway 03R/21L. Known as Panatropolis,

this 2,000+ hectare logistics, commercial, and residential complex is being sponsored and initially financed by Inmobiliaria Sol Brillante, a group of leading Panamanian businessmen and developers. Over US\$100 million has already been invested in land acquisition, site preparation, engineering, and design work.

The master plan, prepared by Miami-headquartered Bermello Ajamil & Partners, calls for 4 phases of aerotropolis development over a 40-year period. Zones include an international business center, a large logistics and light industrial zone, trade and exhibition facilities, a hotel and convention complex, shopping, leisure, and entertainment areas, mixed-use commercial areas, and residential areas containing ample green space to foster community, family, and recreational activities (see Exhibit 2.4).

Following aerotropolis principles (*www.aerotropolis.com*), Panatropolis' strategy is to fully leverage Tocumen Airport to support the efficient operation of international corporations and Panamá businesses as well as offer services and amenities for business travelers, tourists, and residents.

The first phase will be focused on developing 330 acres planned for logistics, distribution, and light manufacturing along with the international business center and selected residential areas. Structures dedicated to value-adding logistics activities (labeling, testing, sequencing, kitting, pick and pack,

etc.) will complement those dedicated to time-critical manufacturing and distribution, contributing to Tocumen's air logistics hub objectives. These must be carefully planned to be synergistic with new logistics and cargo facilities that will be recommended later in this report for the existing northern cargo area of Tocumen.

The International Business Center composed of office complexes, business-oriented hotels and meeting facilities will further Panatropolis' business hub ambitions. To the extent possible, these facilities also will be developed to reinforce rather than compete with commercial facilities being planned for Tocumen's Airport City.

Residential parcels will be developed with a variety of housing types ranging from large single-family units in gated communities to townhouses and condominiums near the business center. Mixed-use residential units will be located along boulevards with commercial space on the ground floor and housing on higher floors.

Upscale shops and restaurants, cafes, pubs and nightlife venues will line these boulevards which are designed with wide pedestrian sidewalks and for a relaxing ambiance. Educational functions are also envisioned in institutional clusters along these boulevards.

The business model for Panatropolis is to offer private developers freehold land plots of a minimum of 6 acres with all infrastructure and utilities in place. The developers will build on the plots in accordance with master plan guidelines. In some cases, the master developer might joint venture with the private developers for mutual benefit.

2.4 Other Aerotropolis Developments

Tocumen Airport City and Panatropolis represent a significant commencement of what is being envisioned as “The Aerotropolis of the Americas.” Other commercial, recreational, hotel, housing logistics, and industrial projects in the airport vicinity are either existing, under development, or being planned. Exhibit 2.6 locates these projects in relationship to the airport and Panatropolis. They include, among others, the Costa del East Industrial Park (consisting of 300 ha of warehouse, distribution, and commercial facilities, Exhibit 2.7); the 285 ha Santa Maria Golf Course which also includes 250 houses and 250 apartments, Exhibit 2.8); Panamá South Park made up of 42 ha of commercial, warehouse, and distribution facilities, Exhibit 2.9); Tocumen Business and Warehouse Park (with 325 ha for showrooms, commercial facilities, warehouses and distribution areas, Exhibit 2.10); the Global Business Complex, consisting of 8 buildings of 4 levels each and a 176 room hotel on 21 hectares,

Exhibit 2.11) and a 100 ha area tentatively designated as Teleport, a poor name choice, that is proposed to house future bio-technology park, showrooms, commercial facilities, and warehouses and distribution areas (see Exhibit 2.12).

Before future planned areas are developed it is important that both appropriate demand and supply analysis be conducted to insure that (1) the market will support all envisioned commercial developments and (2) that each planned development reinforces the others. Otherwise, the market for similar projects may be prematurely split, with undue competition limiting the potential success of each project.

It is also important that all new projects follow the development guidelines to be presented in the remaining chapters in order to optimize their economic efficiency, appearance, and environmental sustainability as well as generate solid returns for both Tocumen SA and surrounding developers. For many of the proposed projects to be successful, a number of transportation and logistics infrastructure improvements will have to be made not only at and around Tocumen Airport, but throughout the Republic of Panamá. I now turn to this challenge.

2.5 Air Logistics Hub and Aerotropolis Transportation Infrastructure Configuration and Needs

Efficiently connected highway, port, and rail infrastructure are critical for successful air logistics hub and aerotropolis development. In Tocumen's case, improved roadway access to its northern cargo area, to Panamá's ports, and to key commercial and agricultural nodes is most important. These will therefore be addressed first.

2.5.1 Highways

The Strategic Plan of the Government 2010-2014 emphasizes needed upgrades in Tocumen area roadways and those throughout the Republic if value-added logistics, high tech manufacturing and repair, high-value agricultural exports, and luxury tourism goals are to be achieved. These roadway improvements will significantly reduce the transit times of passengers and merchandise to and from Tocumen, reduce the volatility of transit times due to congestion, reduce the costs of direct suppliers of logistics services, and increase productivity and financial returns to manufacturers, agricultural producers, and luxury tourism.

Exhibit 2.13 illustrates government priorities in needed roadway improvements for the enhancement of value-added logistics services in Panamá,

a number of which directed at Tocumen and its surrounding area. These include:

1. Expansion of the Panamá-Colón Highway to reduce congestion and bottlenecks bringing Colón and its logistics assets closer in real time to logistics development at Howard's and Tocumen's cargo terminals.
2. Improved connectivity between corridors of the City of Panamá with five new interchanges built at the intersections of Via Brazil with Ricardo J. Alfaro, Transistemica, Vía España, 50th Street and via Israel. A direct connection also will be constructed between Balboa Avenue and the interchange of Via Martin Saga with the Transisthmian Highway.
3. Solution for Intra-Colón congestion since ports of the Colón Free zone will remain congested delaying movement between ports even when the Transisthmian Highway project is completed.
4. Loop road bypass from Howard to Puente Centenario could reduce transit time from Panamá Pacific to the Centenary Bridge by 40% to 50% and would provide a congestion free highway. Two new crossings would be required at intersections of the old Autopista

Panamericana with special provisions for cargo transportation such as larger turning radii and road widths.

5. Expansion of Corredor Norte to reach Tocumen Airport to improve transit time and reduce transit volatility of traffic which does not originate in the City of Panamá, such as from Colón. Currently, the only modern highway access to Tocumen requires going across the city of Panamá whose streets are frequently congested, especially at peak hours.
6. Direct access to cargo facilities at Tocumen are required since circulation around the poor perimeter roads of the airport is slow and sometimes dangerous, particularly at night when much air cargo moves. A modern four-lane connection to Tocumen's cargo area could reduce transit times up to 20 minutes each way.

Apropos the above, a new highway loop should also be considered in order to access the new south terminal and provide improved access to surrounding aerotropolis developments. Tocumen SA along with government agencies may wish to provide road access using the right of way along the west side of Runway 03R/21L and possibly eventually offer a shuttle between aerotropolis developments and the future south terminal area. (See Exhibit 2.14).

Future airport accessibility would also be improved if the road that connects via Tocumen to both Parque Sur and Panatropolis were to be improved.

Before moving onto rail infrastructure, let me note a promising roadway improvement program to boost higher-value perishables exports by providing new road infrastructure and cool-chain facilities at strategic locations around the Republic. These roadway improvements and cool-chain facilities would reduce access time to Panamá's ports and airports while maintaining the freshness of perishables. More than 125 new or rehabilitated roads have been identified that would accelerate transit of agricultural products to the ports and Tocumen.

Exhibit 2.15 shows the numbers of these new highways and upgraded roads along with their estimated costs. Exhibit 2.16 illustrates the locations of the cool-chain facilities that have been proposed to maintain freshness and cut losses.

It should be noted that the authors of the strategic plan who recommended these roadway improvements and strategically located cool-chain facilities correctly point out that such infrastructure and facilities will not be leveraged unless soft infrastructure improvements are simultaneously put in place by government. This soft infrastructure would set and enforce international sanitary standards and develop an appropriate institutional mechanism to establish prices in cooperation with local retailers and exporters to

reduce the costs charged to producers and promote universal application across Panamá.

2.5.2 Rail

The Panamá Canal Railway (see Exhibit 2.17) directly connects the Atlantic and Pacific Oceans. Used for both cargo and passenger services, the railway complements Panamá's existing transportation infrastructure provided by the Canal, the Colón Free Trade Zone, ports, highways, and airports.

Daily passenger trains connecting Panamá City and Colón offer service to executives traveling between the two cities as well tourists. Travelers take in spectacular scenery of lush forests, lakes, and views of the Colón's lakes which the railway follows.

Freight traffic moves along this 47-mile single line track from the Balboa to Colón ports with 10 trains in each direction every 24 hours. The track has two-way lines at strategic locations so that traffic can operate continuously each way between the ports.

The railway operates double-stack bulkhead-type rail cars in two sets of six with each set moving appropriately 75 60' x 40' and 15' x 20' containers. The

current 500,000 TEU container capacity per year is expected to be increased by the railway to a capacity of almost 2 million TEU's in the future.

The ultimate objective of the railway, which is structured to reinforce rather than substitute for the Canal, is to transform Panamá into a dual-ocean transshipment and distribution hub with fast and flexible ports. Panamá is the only location in the world where containers can be shipped in-bond from the Atlantic to the Pacific in under four hours. This effective land-bridge permits quick transfer of large volumes of containers that can line up with ships at either end of the Canal, duty-free.

Analysis conducted for the strategic plan of the Government, 2010-2014 suggests that if supplemented by more automated processing of containers and a facilitating regulatory environment (e.g., Customs and Quarantines) that major returns would be created including (1) improved vessel carrier asset utilization, (2) enhanced opportunities to redeploy “saved” vessels and (3) increased opportunities to consolidate services and capitalize on scale economies to match specific transshipment volumes at both ocean sides and achieve higher vessel land factors.

This railway land-bridge could thus go a long way to improving intermodality in Panamá thereby significantly contributing to President Martinelli's goal of making Panamá the “Hub of the Americas.” If appropriate

spurs are designed and developed to the Tocumen Airport area, such intermodality with air could take the Republic even further along toward “Hub of the Americas” status.

Tocumen Rail Links

At present there are no rail links to Tocumen airport or its surrounding areas for either passenger or freight movement. There has, however, been some talk of future planning for a light-rail line to be constructed from Panamá City to Tocumen when the airport toll-way is further expanded. Ideally this would be planned to intersect with Panamá's proposed new metro subway system, the first phase of which will cost \$1.8 billion.

There has been periodic discussion of making Panamá a sea-air intermodal hub. As noted, Tocumen's links to Panamá's ports are by highway. Exhibit 2.18 illustrates that during un-congested times it takes appropriately 30 minutes to move by truck from Tocumen to Balboa and about 90 minutes from Tocumen to Colón.

I pointed out in Chapter 1 that a number of airports and aerotropolises benefit by having rail access. This is not only for efficient passenger movement

to and from the airport and surrounding areas to the city center and elsewhere, but also for cargo movements via nearby intermodal rail yards.

The Tocumen area could benefit by rail access, as well. Although detailed engineering, geological, and environmental studies would have to be conducted, I provide a conceptual illustration in Exhibit 2.19 of what such direct rail connectivity to Tocumen might look like.

Routes A, B, and C are regular rail spurs from the Balboa area to the Tocumen area with Route A also providing passenger service from the Corozal Station. These rail routes circumvent the most densely developed areas of Panamá city.

Route D illustrates a possible passenger light rail line that would also connect Corozal Station with Tocumen but pass through the center of Panamá City allowing stations in high density areas to pick up and drop off passengers. As noted, Exhibit 2.19 represents first order conceptual illustrations of Tocumen rail connectivity that require substantial engineering and cost-benefit analysis to assess feasibility. If proven feasible, though, such connectivity could provide a major boost to both Tocumen airport and its surrounding aerotropolis.

2.5.3 Ports

Considerable emphasis of the importance of port connectivity has already been made. Suffice it to say here that Panamá has been, is, and always will be known for its Canal and associated ports, if for no other reason than their scale and significance to the global economy.

Four port container terminals presently operate in Panamá administered by three of the ten most important container terminal operators in the world. Together, they move over 4.25 million TEU's annually including 1.4 million TEU's at Manzanillo International Terminal, 2.4 million TEU's at Panamá Ports Company (PPC), and 448 thousand at Colón Container Terminal. A fifth terminal, currently being competed in front of PPC, will be operated by the Ports Authority of Singapore.

No doubt that once the Canal is expanded the importance of these terminals and the Canal will be greatly increased. Since intermodal connections will become all the more critical further attention will be given to these later in this chapter and in Chapter 3.

2.6 Phased Tocumen Commercial and Logistics Development

I now turn to providing details on future commercial and industrial facility placement at PTY which correspond to phased infrastructure development. Four phases of expanding infrastructure and facilities will be presented: Phase 1 (present); Phase 2, short-term (2011–2020); Phase 3, mid-term (2021–2030); and Phase 4, long-term (after 2030). Dates accompanying the short-term, mid-term, and long-term phases are approximate estimates for illustration. Actual years for these phases will be determined by market conditions, aviation growth at PTY, financial resources, and other factors.

Phase 1, which represents primary infrastructure and facilities at present, is illustrated in Exhibit 2.20. This assumes Muelle Norte and associated infrastructure are operational this fall. It also shows the existing cargo buildings on the upper left side of the northern runway and the 300 hectares of land designated for the Tocumen Airport City.

Phase 2 (short-term, 2011–2020) should experience initially slow but then accelerating development of logistics, GA (FBO), and training facilities. As illustrated in Exhibit 2.21, logistics facilities and cool-chain will begin siting along the taxiway of the northern runway. Additional GA facilities including a new FBO, corporate hangars, and an air taxi facility will be joined by a logistics and education and training center and possibly a distance education worker training

center (both to be described in Chapter 3), as well as an EDI/telecom facility (discussed later in this chapter) near the education and training centers. It is anticipated that a high-velocity flow-thru facility (air to truck) and a live animal holding facility will be added late in the decade (close to 2020) as will a couple of third-party logistics (3PL) facilities. This short-term period will also see Copa's new cargo warehouse and courier center fully operational adjacent to Mulle Norte.

It is impossible to predict exactly which type of logistics facility will be sited in the older northern cargo sector in the short-term phase or their precise locations. Much of this will be determined by the analysis of the northern cargo area being conducted currently by ICAO as part of the updated master plan. Apropos the latter, it is not unreasonable to think that some value-adding logistics facilities might eventuate near the year 2020 in the northern cargo area, but these are most likely to come on-line there in the mid-term phase 2021–2030.

It is in Phase 2 that commercial development will commence in Tocumen's Airport City. Here it is recommended that at least a three-star (and possibly four-star) hotel be constructed within walking distance of the central passenger terminal and parking. The hotel should be complimented by an attached or adjacent casino and a set of luxury direct factory outlets. The casino, and especially the luxury direct factory outlets, would not only likely generate considerable short-term phase revenues for Tocumen SA but also attract players,

tourists, shoppers, and others from the Latin American region, boosting passenger volumes. In the latter part of the decade (close to 2020) it is suggested that quality office buildings be constructed for Tocumen and airline managers, as well as for possibly others in the Airport City.

Phase 3 (mid-term, 2021–2030) is the stage when I anticipate airport logistics and commercial development to progress rapidly. As illustrated in Exhibit 2.22, flex-tech, value-added logistics and e-commerce facilities will locate in the northern cargo zone. These will be joined by a set of 3PL's working with these facilities. Truck and freight-forwarder facilities will start to grow on the inner ring road at the far north end of the airport.

It is in this phase that a new northern cargo facility will be required to handle a substantial increase in the volume of Tocumen's air cargo as wide-body freighter service adds to growing passenger-aircraft cargo. This shared cargo facility serving airlines other than Copa and possibly LAN Chile will be described later in this chapter and in Chapter 3. New air express facilities will join the new northern cargo facility

During Phase 3 Tocumen's Airport City will also experience considerable development. Growth in passenger volumes by 2030, along with additional commercial facilities at or near the airport city will likely justify a second hotel on airport property by 2030. Based on successful airport city developments elsewhere, it is proposed that consideration be given to recruiting a World Trade

Center (done via franchise), medical and wellness facilities, and university programs such as weekend executive MBA programs that are becoming increasingly popular among executive who fly to airline hub areas for them; especially if offered by a top business school.

Phase 3 should see expansion of the luxury direct factory outlets and the casino. Mixed-use commercial developments should be sited in the airport city where accessibility to the new highway access loop is created. Special use (yet to be identified) commercial facilities and a consolidated car rental facility will locate near the completed new southern passenger terminal.

In the long-term (after 2030) Phase 4, presented in Exhibit 2.23, reveals substantial additional logistics and aviation-related industrial facilities in the northern zone. It is also expected (recommended) that an intermodal rail facility be constructed in the far north where the proposed rail spur described previously will terminate. A zoom-in of northern area development in the long-term (after 2030) identifies more clearly the type of development envisioned at build-out (Exhibit 2.24).

Exhibit 2.25 provides a zoom-in of proposed commercial development in Tocumen Airport City at build-out. Here, I recommend that an exhibition center, a convention center, a Panamá tourism center, a wholesale merchandise mart, and new office buildings and mixed-use commercial facilities be added. After

2030, Copa will also likely have a new southern cargo facility operational which may attract some cargo-related businesses.

Referring back to industrial, commercial and logistics facility development in the long-term, Exhibit 2.23 also provides a first-order illustration of an automated cargo transfer system that would connect cargo facilities in the north with terminals in the south and possibly outside the fence logistics and production facilities offering PTY tenants and users fast and agile sourcing, assembly, and distribution. This will include a cargo transfer system (CTS) linking all parts of what will be the core of a full-fledged Tocumen Air Logistics Hub.

The guidelines for this cargo transfer system (CTS) and other PTY logistics support components will be provided in the next section. Suffice it for me to reiterate that the placement of all logistics, commercial, and industrial facilities illustrated in Exhibit 2.23 are predicated upon more detailed site and market analysis by others responsible for future development of non-aeronautical facilities at Tocumen.

2.7 Air Logistic Hub and Aerotropolis Infrastructure Design and Configuration

From the start, I have emphasized that one of the most important competitive attributes for a Panamá Aerotropolis will be fast-cycle logistics built around efficient multimodal transportation systems, anchored by air cargo. In the following sections I therefor elaborate the infrastructure and facility planning guidelines that should be generally followed in implementation of a Panamá Aerotropolis fast-cycle logistics system with emphasis on the future development of Tocumen's new northern cargo and logistics area. These guidelines should be followed regardless of the timing and exact location of PTY's new logistics infrastructure and facilities.

2.7.1 New Northern Cargo Area Facilities and Design

An important future feature of a Tocumen Air Logistics Hub (TALH) will be the aforementioned Northern Cargo Area (NCA) which will constitute a future zone of new facilities at the northern end of the airport (see Exhibit 2.24). The NCA will include a New Northern Cargo Facility (NNCF), which can be a shared facility attractive to all cargo carriers complimented by air express facilities and perishables center (PC) to support in-transit and Panamá's agricultural shipments, e-commerce fulfillment, and the Customs Clearance Center (CCC) at

the new Northern Cargo Facility. Other primary components of the Northern Cargo Area will be the Logistics Operation Area, with value-adding logistics and distribution tenant facilities alongside taxiways, nearby truck docks, special materials handling and freight forwarder and 3PL facilities, and eventually (after 2030) a Cargo Transport System (CTS) connecting all TALH tenants with cargo processing facilities. Since the northern cargo area (NCA) will be one of the most important future components of the TALH and overall PTY development, its infrastructure and facility planning guidelines are elaborated below.

2.7.2 Guidelines for Northern Cargo Area Design

Three key principles of agility should be followed in the design for the future Northern Cargo Area: 1) Flexibility; 2) Targeted Mechanization; and 3) Expandability/Phased Growth. Building agility into the processing capability and location of facilities is essential because of: 1) unpredictable longer-term cargo handling demands on the TALH; and 2) a dynamically changing and improving technological and logistics environment.

2.7.3 Flexibility

A critical design requirement of the future Northern Cargo Area (NCA) is that its developments should be demand-driven and responsive to changing needs and requirements of PTY tenants and users. A flexible, incremental development approach is highly recommended, given the difficulties of forecasting the exact types and levels of cargo and industrial activity at and around the TALH. Thus, for example, automation of material handling systems or full-scale development of intermodal connectors and interfaces may not be prudent early in the implementation of the TALH. In the design of most processing systems, cost, flexibility of operation, and operational efficiencies demand appropriate cost/sophistication compromises at different stages of infrastructure and technology development.

Three realities caution against initial automation of NCA materials handling and processing systems: 1) the expanded Tocumen Air Logistics Hub (TALH) will likely have to accommodate all manner of aircraft and cargo equipment (i.e., standardization of aircraft gauge and related cargo handling equipment for serving domestic and international air cargo markets are currently not possible); 2) non-automated materials handling and accumulation (short-term storage) systems are often more cost-effective and flexible in terms of meeting peak requirements and other unanticipated immediate problems by

simply providing more forklifts and manpower to meet unexpected or peak requirements; and 3) longer-term air cargo demand and other transportation mode cargo demands are difficult to forecast in turbulent national and global environments.

Only as actual demands are experienced over time for such a multimodal logistics complex would it be possible to incrementally predict materials handling equipment, logistics infrastructure, and facility needs, and to gain verification of the estimated industry mix of cargo demands placed on the TALH (e.g., aerospace parts and components, manufactured products, fresh cut flowers, seafood and other perishables, retail distribution products, etc). For these reasons, it is recommended that the northern cargo area commence operations with relatively inexpensive, low-tech systems. These can be upgraded over time as the demand and future tenant requirements become better known and the benefits to be acquired through automation become better understood, measured and demonstrated.

One means of attaining processing flexibility, and commonly employed in modern just-in-time (JIT) operations, is to create subsystems that have multiple processing equipment rather than one large processing system. Designing one large system often appears to offer economies of scale (i.e., less cost per unit produced as process equipment size increases). Such all the eggs in one basket type of operation, however, could easily lead to inflexibility and an inability of

the Authority to shut down part of the total process capability for maintenance, equipment testing, equipment enhancing and even off-line employee training.

To save initial expenses and promote flexibility, mobile equipment is generally preferred to fixed position equipment (e.g., a mobile nose loader/unloader as compared to a fixed-bridge nose loader/unloader). Ideally, all equipment should be readily reconfigurable and rearrangeable as operations layout requirements change over time. I have found that fixed position equipment (e.g., automated conveyors attached to the floor or hung from the structural system) hinders the “fluid” design concept recommended for the TALH.

2.7.4 Targeted Mechanization

Experiences of air cargo operations at other mid-size airports do permit initial determination of the degree of mechanization in TALH operations for efficient cargo handling. Mechanization of standard processing operations such as container consolidation, container breakdown, and conveyors to accommodate x-ray equipment should be included in all new Northern Cargo Area (NCA) operations. Yet, such targeted mechanization should be provided only when and where it is clearly demand driven and economically justified.

As stressed above, because of the difficulty of predicting material handling demands and a desire to provide flexibility of arrangement which is consistent with 21st century business practices, the cargo facility design should assume that initial material handling operations would be performed with relatively low-tech material handling equipment (e.g., forklifts, motorized tugs, pallet jacks, etc). This technology is not only far less costly but also “tried and true” time-tested and reliable. At likely relatively low initial levels of manufacturing and supply-chain management demand at the TALH, fully automated materials handling systems, though flashy, simply may not make economic sense.

When demands over time become better known and experienced, one-at-a-time evaluation of potential productivity benefits of automated equipment and facilities can be assessed and enhancements implemented to take advantage of operational improvements. For example, as available New Northern Cargo Facility (NNCF) space fills up in Phase 3 (mid-term, 2021–2030) with increased activity, pallet racks should be provided to gain better use of the facility cube. Later, when sufficient put-away and picking requirements develop, fork-lift use would be discontinued for automated put-away and picking of cargo from racks and replaced by computerized rail-guided picking and put-away equipment.

2.7.5 Expandability/Phased Growth

I have been emphasizing that future demands placed on Tocumen Air Logistics Hub (TALH) facilities and their resulting space needs are difficult to predict with any confidence. This is why it was proposed that facility development at the TALH encompass flexible, evolutionary and phased growth. Future facility requirements are being estimated as part of the ICAO updated master plan air cargo forecasts for PTY, but the TALH must also be allowed to become what it needs to be as actual cargo market demands and other requirements reveal themselves over time. Thus, the design guidelines proposed herein are not so much a fixed plan as they are a flexible framework to accommodate a wide variety of tenant facilities, regional users, and physical layouts.

The above framework allows for TALH development to be modified as cargo and market demands, resources, new technologies, and infrastructure advances occur. For example, the new northern cargo area including its logistics and industrial facilities should employ a modular layout for maximum flexibility and phased development. Ground transportation designs should incorporate redundant routings and flexible road systems to minimize the impact of congestion or accidents, both within the northern cargo area and in connecting highway systems. Rights-of-way should be sized to allow future expansion without negatively affecting ongoing highway operations.

PTY's aviation infrastructure must periodically be updated with state-of-the-art (possibly next-gen) navigational aids to allow for growing air capacity demands and eliminate periodic weather delays. It is also important that appropriate outside the fence zoning controls minimize potentially conflicting land uses and noise problems that could preclude the extensive 7-day, 24-hour airport operation as aviation operations grow.

Tocumen SA and local economic development organizations likewise must be prepared to respond rapidly and creatively to evolving tenant and user needs and an ever-changing business environment; hence, PTY's management itself must be agile as it creates or coordinates “one-stop shop” support for tenants and regional users from each logistical, industrial, or commercial sector. Down the road, Tocumen Airport Management and Panamá's organizations may not only wish to market the TALH, but also operate as strategic partners with tenants and outside the fence developers in dealing with other government agencies and in seeking access to a full range of technical, financial, and political resources to facilitate PTY's logistics, industrial and commercial development.

Consistent with PTY's emerging “green” principles and ISO 14000 standards (international standards that enable companies to systematize and improve their environmental management efforts), maintaining environmental quality and safety are a fundamental objective of TALH planning and development. The TALH system must provide facilities and procedures for the

handling, storage, transportation, and disposal of environmentally sensitive materials as a continuous process. Likewise, modern TALH utility systems must offer high-quality and reliable power, water, natural gas, wastewater treatment, and solid-waste disposal to meet growing tenant needs in the developing areas of PTY's northern cargo zone and Airport City. PTY's planning to date implies that all these conditions will be met.

Each potential commercial tenant at PTY should be evaluated for its compatibility with environmental regulations and standards. A PTY management/tenant partnership should address the requirements for operating within acceptable environmental parameters jointly. Innovative site planning and design should ensure visually attractive development with ample landscaping and aesthetic touches.

Aesthetics will be as important to PTY's cargo and logistics areas as its Airport City and passenger areas. Ideally, logistics, cargo and light industrial clusters at and around PTY should appear more like a university campus than a traditional industrial/logistics park.

Although cost savings remain important in today's industrial location decisions, PTY management (and outlying developers) should operate under the assumption that tenants will pay more for its integrated, high-quality, reliable services and sound environmental planning. Because a delicate trade-off exists between costs and on-site services, however, PTY's cost effectiveness will be

optimized by the phasing of development to minimize initial investment and location costs for tenants. Development of the overall site infrastructure and facilities at PTY and its surrounding aerotropolis should be incremental, demand-driven, modularized, and reconfigurable.

Further flexibility in the new northern cargo area as well as Tocumen's Airport City would be achieved by oversizing and reserving spacious rights-of-way for future infrastructure and facility expansion. The internal transportation corridors linking the transportation modes and production, logistics, and commercial facilities also should be oversized to meet increasing traffic levels over time and to accommodate future developments in vehicles and transport systems. The same corridors should have all the underground utility channels needed for powering and servicing airport goods processing firms and shared support facilities. This includes designing corridors with rapid and flexible plug-in telecommunications capability for tenants, as needed.

I've recommended that PTY's New Northern Cargo Area be designed with flexible or expandable facilities with modular and reconfigurable attributes. Such design would allow facilities to grow over time to accommodate ultimate space needs. One way to reserve space initially is to provide excess separation between contiguous facilities, allowing them to grow closer together as increasing space requirements are met over time. Another way is to site select easy-to-relocate facilities between other facilities with the intention of moving

them at a later date to permit the surrounding facilities to grow together in the space vacated by the relocated facility. The goal here is to optimize long-term land use at Tocumen so that all commercial parcels are oriented to highest and best use over time.

2.7.6 Intermodal Interfaces

A major process element of the Tocumen Air Logistics Hub (TALH) is the interconnection and integration of multiple modes of transport (air, truck, and rail). Ideally, each mode must be able to seamlessly and efficiently connect to any other mode without significant loss of time or high cost. The primary long-term operational TALH connector (the “glue” that connects the various transportation modes) is a cargo transfer system (CTS). The transfer system will emanate from the New Northern Cargo Facility (NNCF). The cargo transfer system may be composed of a combination of trucking modes operating on internal roads, or in later phases of development (likely after 2030) by dedicated automated cargo movement systems (for example, rail or tram) depending on the relative configuration of the elements of the TALH and the level of activity.

2.7.7 Guidelines for On-Site Transportation Connectivity

The new northern cargo facility (NNCF) would need to interface with the following modes of transportation: 1) air, via PTY taxiways and ramps; 2) truck, with adequate cross-docking at the NNCF and other Northern Cargo Area facilities as required to meet cargo trucking demand forecasts; and 3) tram, by providing CTS access throughout the airport and later perhaps providing an interface between the CTS and a potential rail spur in proximity to PTY to the planned intermodal facility on its northern ring road (see Exhibits 2.23 and 2.24). The CTS would also be the primary connector between the NNCF and off-ramp TALH production and distribution facilities. These intermodal interfaces are illustrated in Exhibit 2.26.

Because the predominant mode of transportation of products moving to and from PTY locally and throughout Panamá would be via highways, truck terminal facilities and facility cross-docks at and near the TALH along with airport future ring road links would be helpful design elements for successful operation of the TALH.

2.7.8 Guidelines for TALH Connectivity

A Tocumen Air Logistics Hub multimodal logistics system must be able to accommodate a broad variety of transportation origins and destinations to and from it in the mid- and long-term phases. Flow paths of domestic and international air, water, truck and rail modes are represented in Exhibit 2.27 as they might occur between the TALH and domestic or international origins and destinations at ultimate development. Flow paths of intra-TALH cargo are shown within the boundaries of the TALH in the exhibit. Truck, potential rail and air cargo terminal links are included as nodes of the cargo transfer system. Truck cross-docks and the CTS may locate near manufacturing or distribution tenants as the extended TALH develops in later phases.

Regional truck transportation should be available between all major aerotropolis industrial nodes and the TALH. Truck shipments consigned to TALH tenants will most likely be delivered directly to those tenants. Deliveries to consignees located further from the TALH will be delivered to the NNCF, or to appropriate truck terminals for processing and subsequent delivery to the consignee.

Good truck transportation to Panamá ports will be required if the TALH is to achieve full quadramodality. Though there tends to be limited air-vessel product movement, bringing all capabilities together at the TALH and nearly

areas will create the critical mass of logistics activities that will make it a powerful magnet for industry. I will return to this point in the next chapter.

2.7.9 Electronic Data Interchange and IT System Guidelines

To support 21st century business practices of electronic commerce, just-in-time delivery, and supply chain management, electronic data interchange (EDI) must be provided as a tool for TALH facility operators, tenants, logistics service providers, and Panamá Customs. The TALH EDI system will be a network of computers and databases that provide an interface between all parties involved in arranging a shipment. This EDI system must be capable of interfacing with multimodal carrier systems to provide on-line tracking and tracing capability for both the shipper and consignee. A key function of this system should be to interface with Panamá Customs. The TALH EDI network should also have access to global telecommunications networks via satellite transmission. Similarly, the EDI system should be tied to a bar-coding or preferably more advanced RFID (radio frequency identification) systems for shipment identification within the system and in-transit. The general objectives of the TALH EDI system, consistent with the communication vision of 21st century business practices are to:

- Build a cost-effective, resilient, and manageable EDI network throughout the Panamá Aerotropolis region and beyond that is web-based and open architecture.
- Allow all of Panamá's businesses to connect to the TALH via a network backbone at lowest charges possible.
- Ensure connectivity by providing enough fiber optics bandwidth and connection channels.
- Ensure capacity so that the Panamá business community and TALH tenants can connect and not be denied access due to insufficient electronic ports.
- Provide support for all protocols required by the users of the system.
- Allow tenants, users, and logistics service providers with a range of hosts (e.g., workstations with high-speed network access, mobile computing and data exchange via secure WiFi, WiWan and fiber networking) to connect to the TALH's network.
- Allow PTY tenants and the greater aerotropolis user community to access applications (e.g., database inquiries/updates) on a range of different information management systems operated by third-party entities.

Conceptually, the TALH Communications System can be viewed in

Exhibit 2.28 This exhibit presents a vision of a possible future global communications system for the Tocumen Air Logistics Hub.

2.7.10 Tocumen Air Logistics Hub Planning Integration Strategy

As described in the previous sections, the Tocumen Air Logistics Hub (TALH) represents a new kind of logistical center in which information technology,

transportation, perishables, and supply chain activities are operationally integrated to create a seamless business environment. Traditional airport master planning activities do not capture the intersections and linkages that are necessary to create this new environment.

The proposed integrated planning process at and around PTY must differ from traditional planning processes in three respects:

1. Shift from Element Focus to Process Focus. Traditional master planning typically targets individual elements of multimodal infrastructure in separate plans; for example, independently produced master plans for rail, ports, highways, and the airport. Each of these master plans is based on traditional roles and functions of these infrastructures. In a process-oriented plan, the exercise begins with an understanding of the integrated business processes and seamless multimodal transportation needs of the tenants and customers. In this new approach, the design concept for a regional intermodal rail facility or truck cross-docking facility at the airport should be guided by the desire to create value for the user of the facility rather than to maximize the utilization of designed capacity. This will involve a close coordination and integration of all elements of infrastructure planning for the TALH and greater aerotropolis.

2. Identify New Elements of the TALH. To achieve success, the Tocumen Air Logistics Hub will require new elements of infrastructure. In the 21st century, businesses compete based on how efficiently and creatively they manage information to create competitive advantage. Even Fred Smith, Chairman of FedEx, has described his company as an IT firm that happens to fly airplanes. The provision of information technology therefore is not an afterthought, addressed once the size and function of a building or infrastructure have been designed, but rather an organizing principle around which the identity and function of a building or infrastructure have been designed. In this process planning environment, information technology capabilities must complement and reinforce the development of multimodal transportation and logistical capabilities at the PTY and throughout its surrounding Aerotropolis.
3. Establish New Linkages Between Infrastructure Elements. The creation of a 21st century business environment at the TALH and Panamá Aerotropolis requires new linkages among key infrastructure elements. Uninterrupted flow of people, products, and materials through the TALH and the aerotropolis require the integration of various modes of transportation. It is therefore necessary to plan the

material handling and management systems that will integrate the movement of goods and materials from across these modes regionally and to and from the PTY.

2.7.11 Designing for Future Tenant Business Needs

The ultimate success of the future Tocumen Air Logistics Hub will depend on how well it meets the needs of future tenants. The real customer for the planning process is not Tocumen airport management or any government agency, but firms that Tocumen SA and Panamá's economic development organizations wish to recruit. Therefore, concepts and capabilities targeted to 21st century business practices described below should guide and inform the planning process and the required functionality of PTY and its broader Aerotropolis. These businesses require the following:

- Paperless Environment. Companies are rapidly moving to a paperless environment in which orders for materials as well as finished goods are transmitted electronically from customers worldwide to their suppliers. Global manufacturers and perishables providers are insisting that their suppliers communicate electronically, and the availability of access to global communications and information networks will qualify future TALH tenants, large and small, for new commercial demands.

- **End-to-End Supply Chain Visibility.** The ever growing imperative for speed and lower costs has caused companies to more closely manage their manufacturing supply chains and perishables cool chains. The basis of competition has changed from head-to-head competition between companies to a competition that pits supply chain against supply chain. A weak link anywhere along the supply or cool chain can have a devastating impact on a company's ability to perform. Increasingly, companies are requiring end-to-end asset visibility along the entire chain requiring state-of-the-art tracing and tracking information technology.
- **Just-in-Time Delivery.** As companies manufacture in increasingly smaller lots and provide more customization of their products, the need for just-in-time delivery has grown. Not only must small batches of materials be shipped as economically as large batches, but they often must be delivered within 36 to 48 hours anywhere across the globe. Traditionally, manufacturers seek suppliers that are located near the manufacturing site. The availability of an integrated information and transportation infrastructure provides the capability for suppliers, manufacturers, and customers to work across great distances as if they were located nearby.

- Real-Time Asset Control. To assure flexible and fast response to changing customer needs, companies must not only be able to trace and track their assets quickly, but also to change their destination, routing or carrier mode as customer requirements change. Only the complete integration of information, transportation, manufacturing, and cool chain management can provide this capability. A growing portion of multinational companies are able to do this now which will likely become a standard of doing business in the future.

In sum, successful development of the Tocumen Air Logistics Hub intermodal and information technology systems will require a broad understanding of the basic business processes of tenants, users, and logistics service providers, their current information system capabilities, and future technology/business needs. These include better understanding of the emerging needs of information-rich industries such as 1) microelectronics, medical instruments, and telecommunications, 2) logistics, trading and transshipment, 3) aerospace, pharmaceuticals, perishables, and 4) even hospitality industries, including hotels, tourism, and recreation that will form the service backbone of much of Tocumen's Airport City and broader airport-area commercial development.

Attracting more high-tech manufacturers, assemblers, and distribution industries will also require a thorough understanding of modern supply chain management principles and the order-to-delivery process. To offer a truly marketable competitive advantage, Tocumen management should bring together experts in logistics and supply chain management, multimodal infrastructure development, and information technology to collaborate to create the design specifications that properly integrate all system elements. Few locations in the world are doing this, so PTY can have a first-mover advantage in attracting high value-adding industries if it takes the lead in seizing this opportunity. This logistics expertise is but one component of the broader business resource planning required for Tocumen Air Logistics Hub and greater Panamá Aerotropolis success to which we now turn our attention.

Exhibit 2.1. Tocumen Airport with Copa's Hub



Exhibit 2.2. Hub of the Americas — Copa's Route Network



Exhibit 2.3. Tocumen Airport City



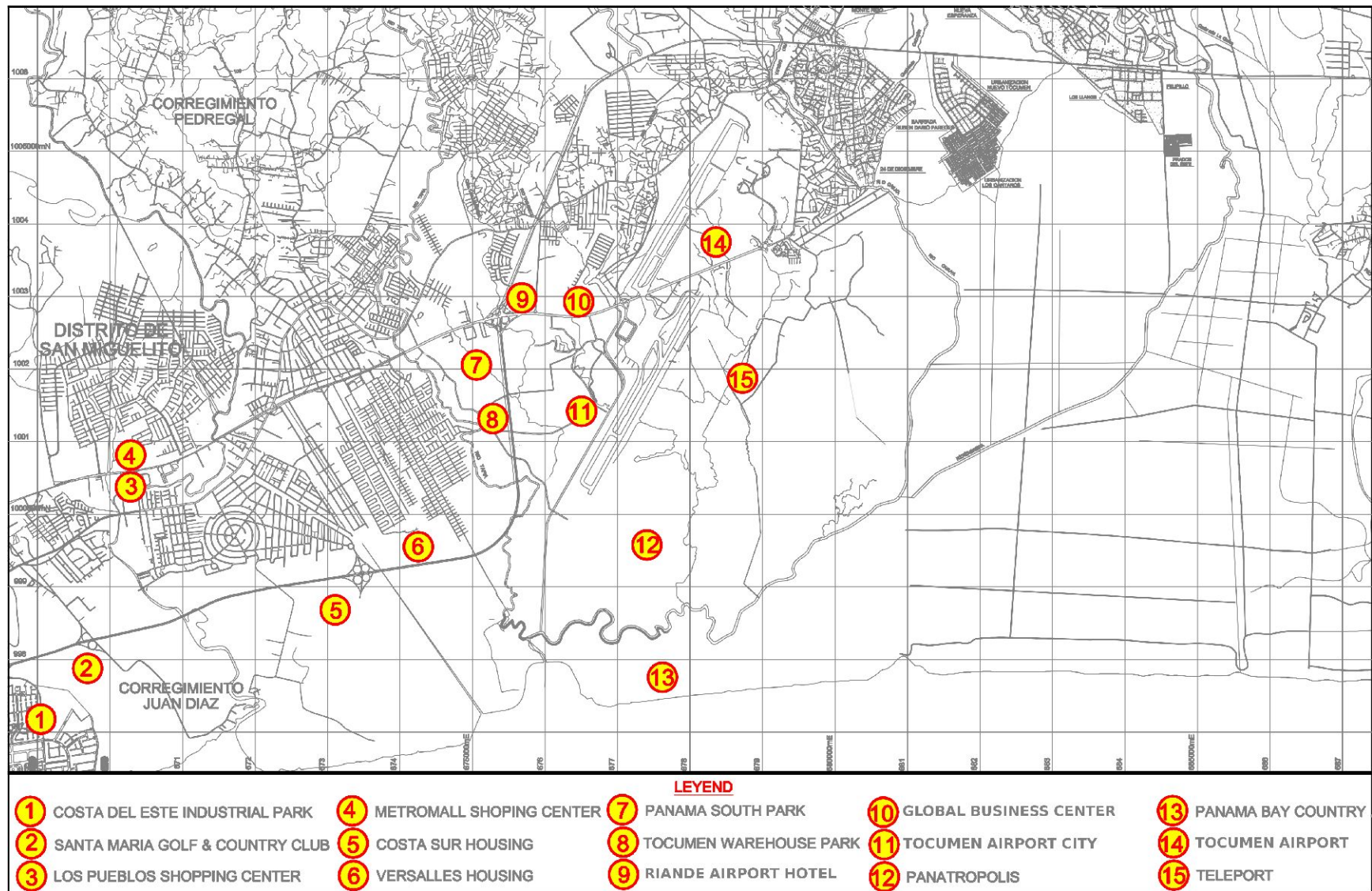
Exhibit 2.4. Panatropolis Development Zones



Exhibit 2.5. Vision of Future Panatropolis Skyline



Exhibit 2.6. Existing, Planned, and Proposed Aerotropolis Developments



INFRAESTRUCTURE

- WAREHOUSES
- COMMERCIAL AREAS
- DISTRIBUTION AREAS

AREA

ALMOST 300 HECTARES/
741.31 ACRES



INFRAESTRUCTURE

- GOLF COURSE
- 250 HOUSES
- 250 APARTMENTS



INVESTMENT

OVER US\$ 100 MM

AREA

285 HECTARES/
704.25 ACRES

INFRAESTRUCTURE

- WAREHOUSES
- COMMERCIAL AREAS
- DISTRIBUTION AREAS

AREA

42 HECTARES/
103.78 ACRES



INFRAESTRUCTURE

- WAREHOUSES
- COMMERCIAL AREAS
- DISTRIBUTION AREAS
- SHOWROOMS

INVESTMENT

U\$ 800 MM



AREA

325 HECTARES/
803.09 ACRES

INFRASTRUCTURE

- 8 BUILDINGS, 4 LEVELS EACH
- 1 HOTEL OF 176 ROOMS

INVESTMENT

U\$ 95 MM



AREA

21 HECTARES/
51.89 ACRES

INFRAESTRUCTURE

- WAREHOUSES
- COMMERCIAL AREAS
- DISTRIBUTION AREAS
- SHOWROOMS
- BIO-TECHNOLOGY PARK

AREA

100 HECTARES/
247.10 ACRES



Exhibit 2.13. Required Roadway Improvements for Establishment of Added-Value Logistics Services in Panamá

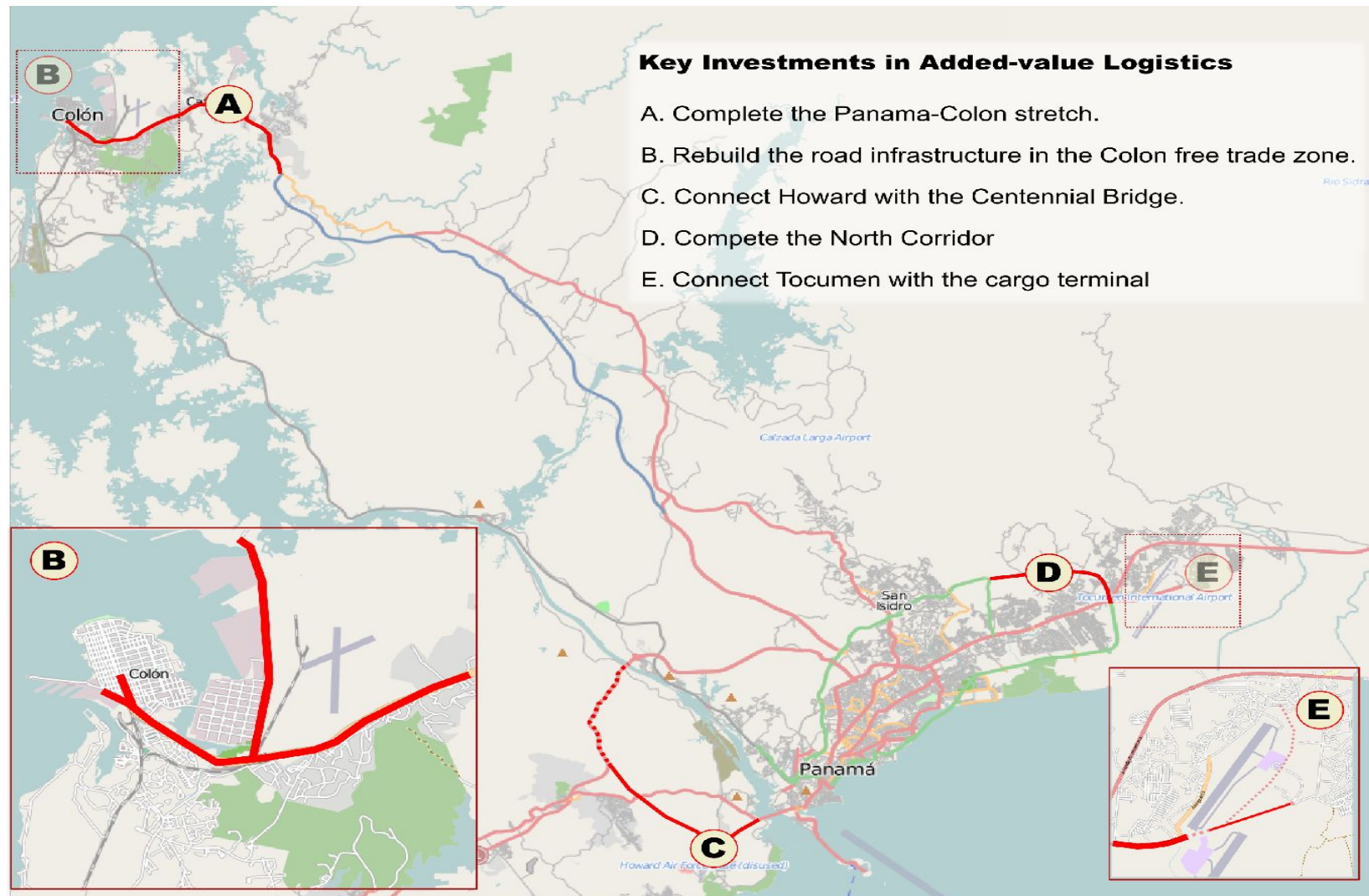


Exhibit 2.14. New Highway Loop with Access to Future Airport South Terminal and Aerotropolis

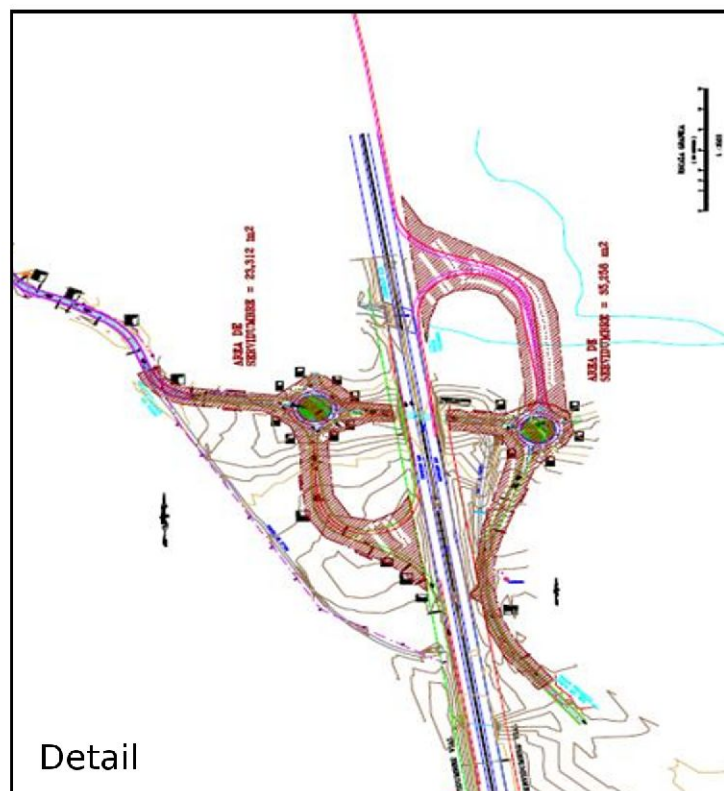
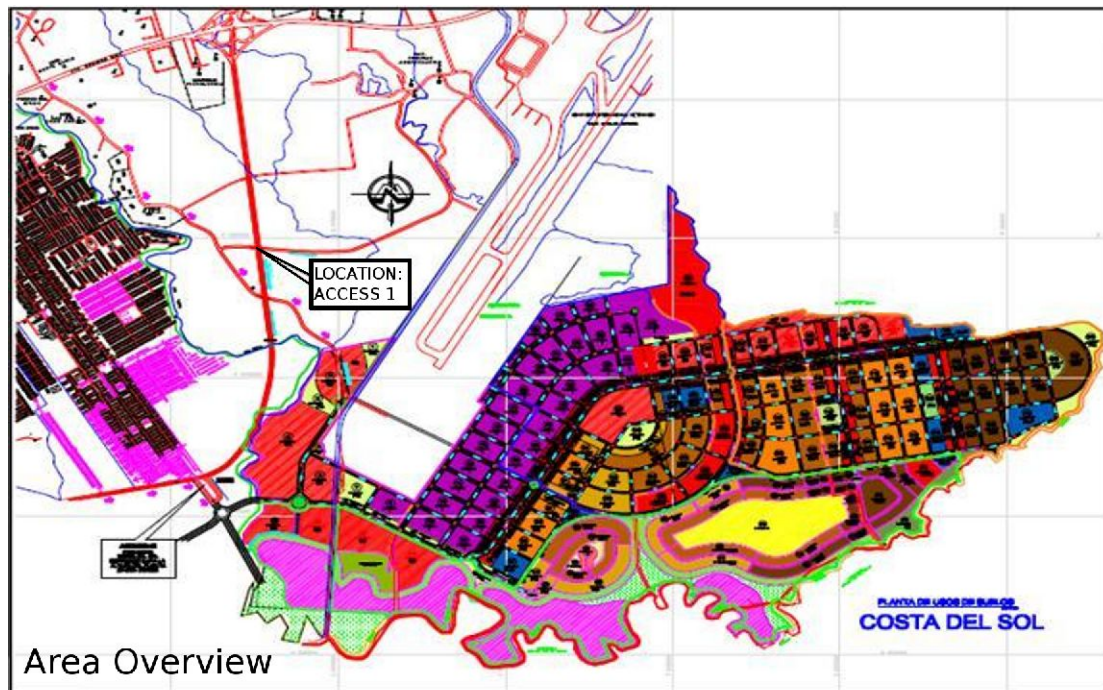


Exhibit 2.15. Transportation of Crops to Markets Requires Investment in Primary & Secondary Access Roads through Key Production Regions

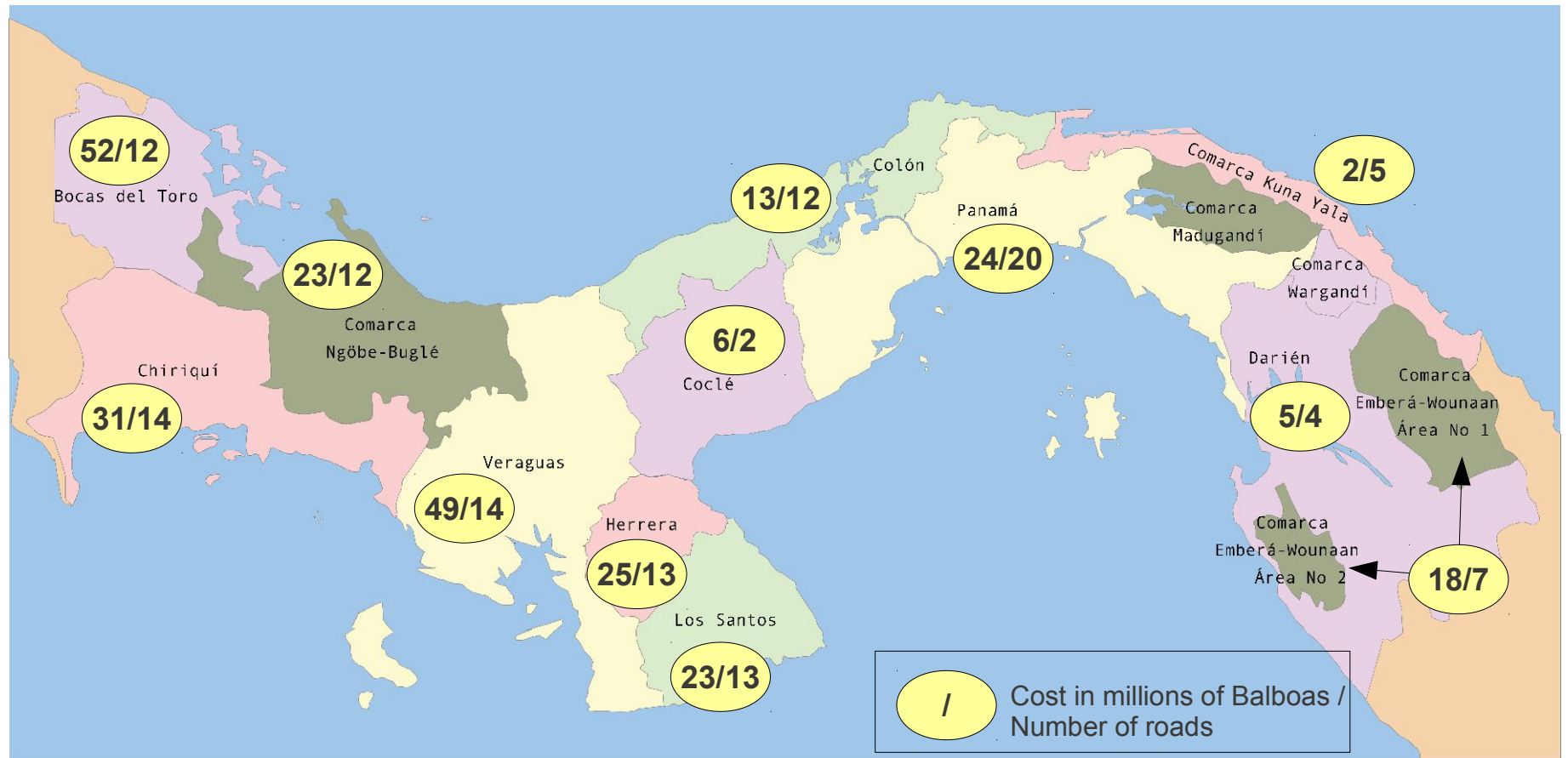


Exhibit 2.16. Focus by Stage with Modular Designs Provides Greater Flexibility in the Capacity of the Cooling Chain

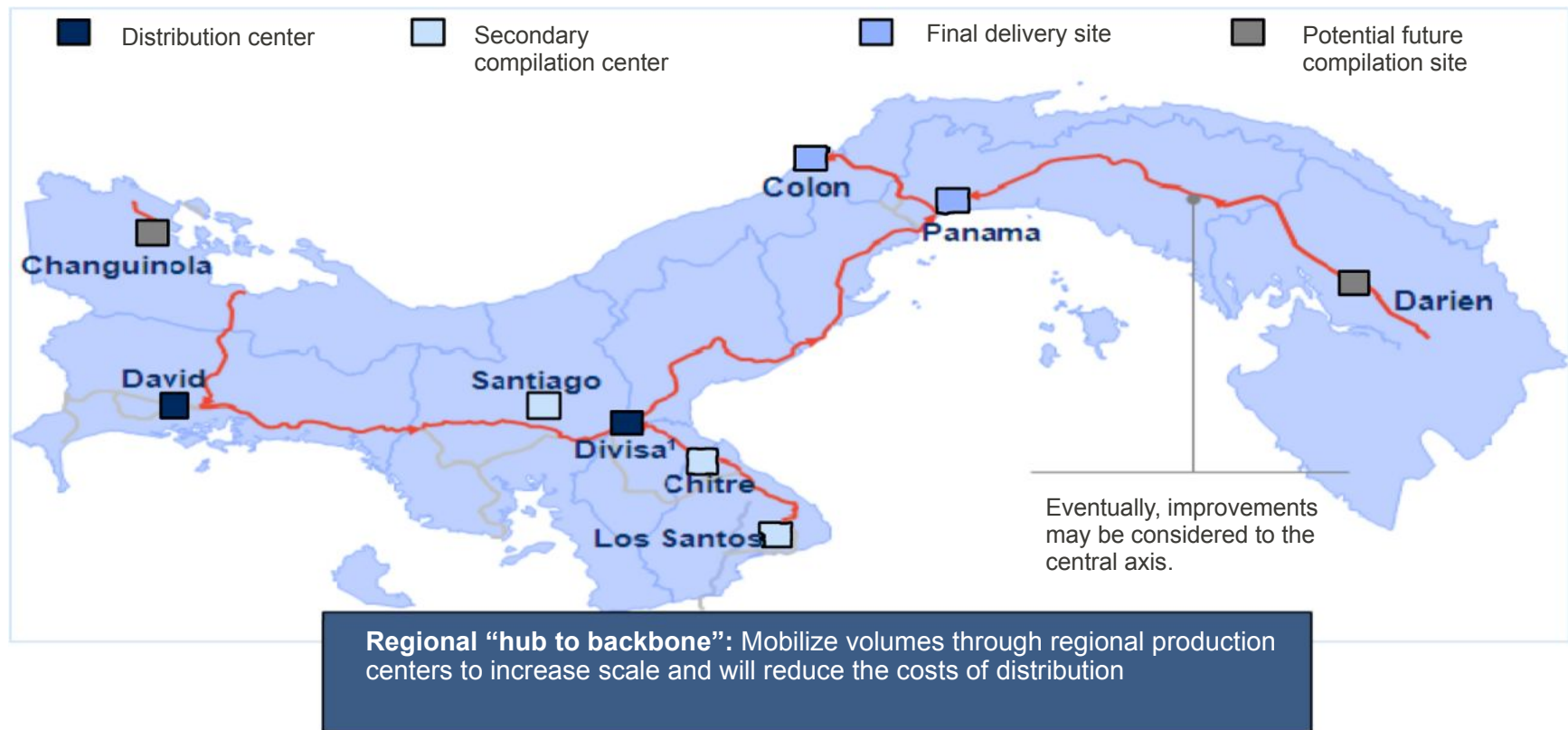


Exhibit 2.17. Transcontinental Rail in Panamá

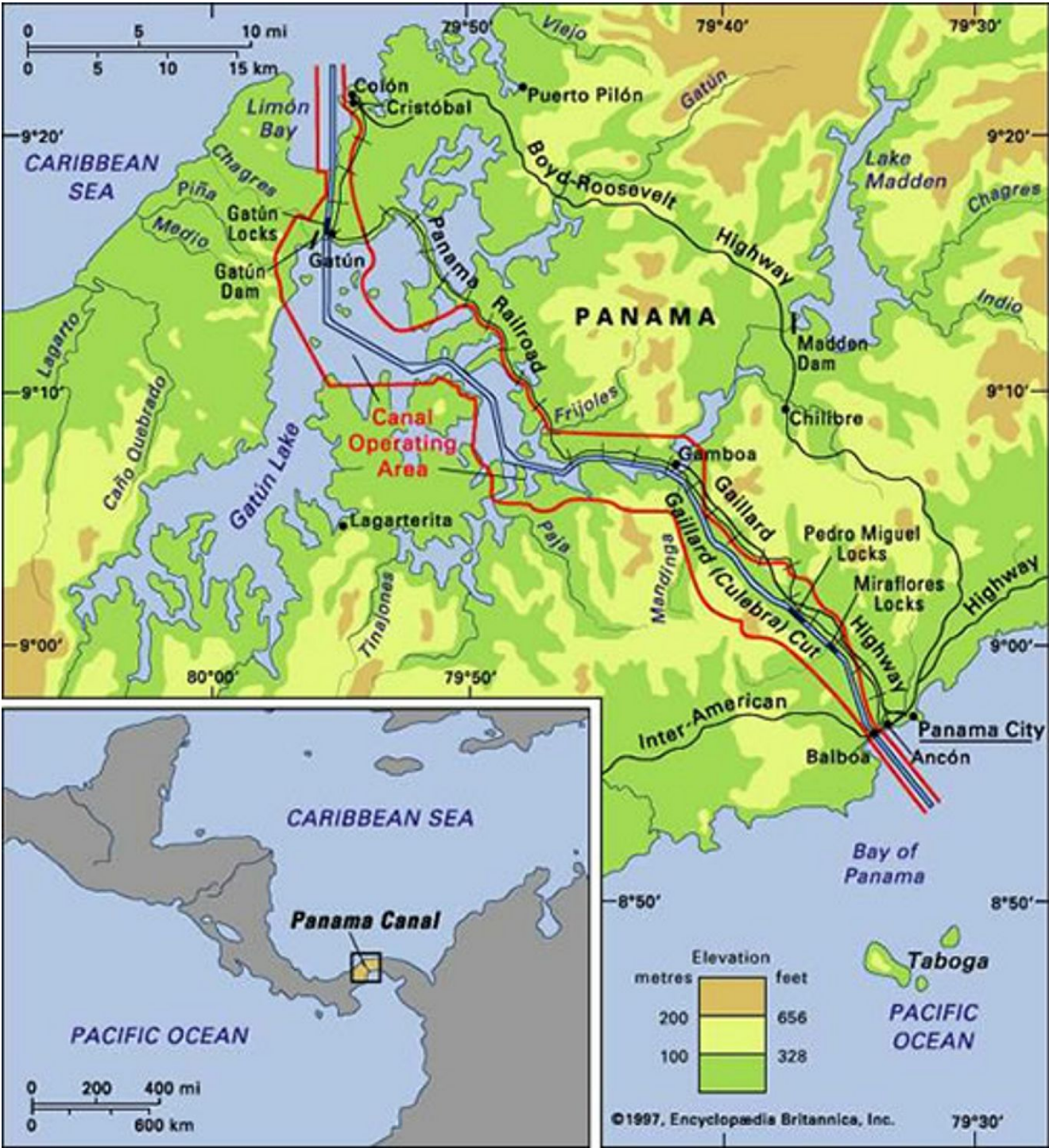


Exhibit 2.18. Driving Distances and Times from PTY to Ports

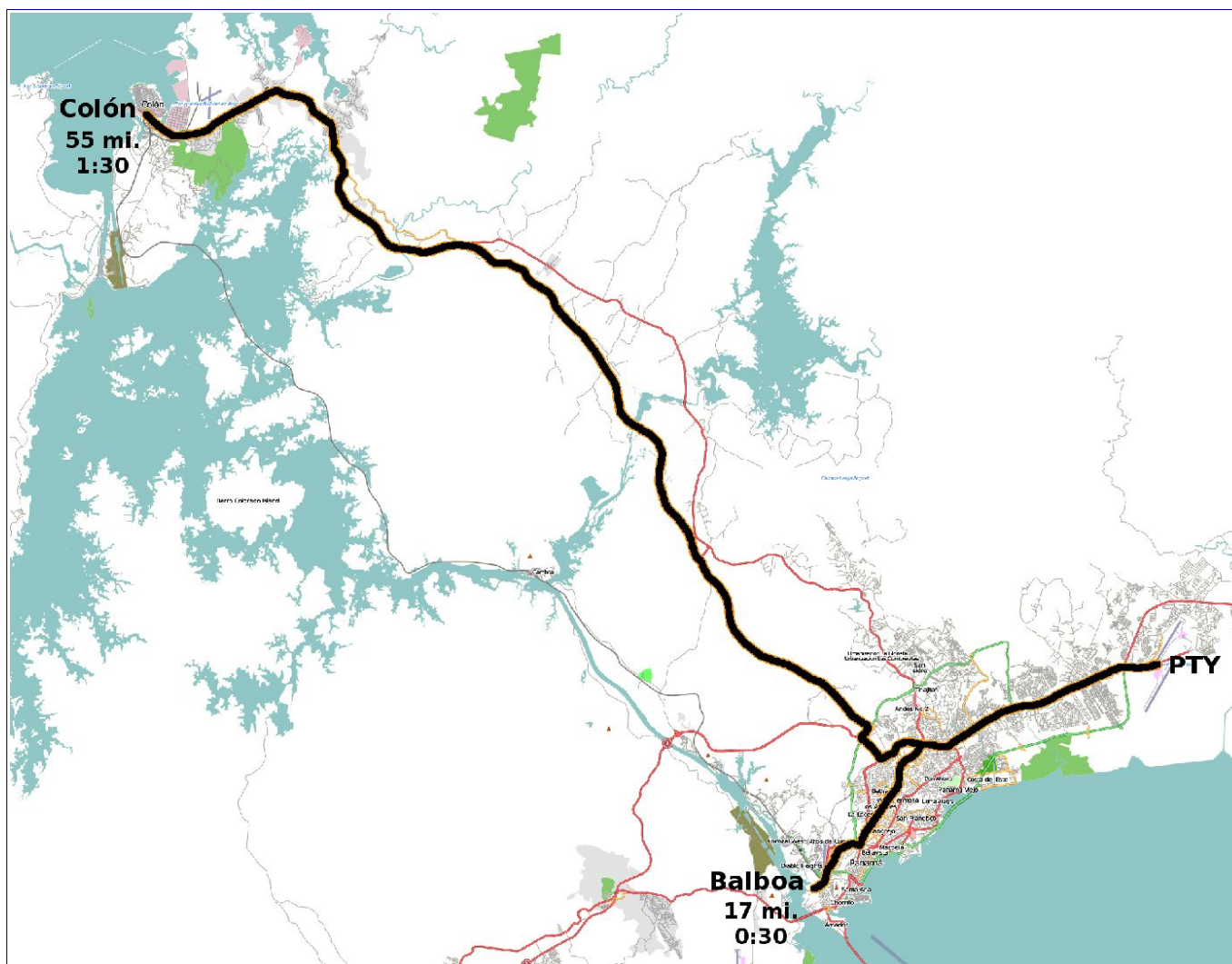


Exhibit 2.19. Potential Rail Spurs to PTY and Passenger Light Rail

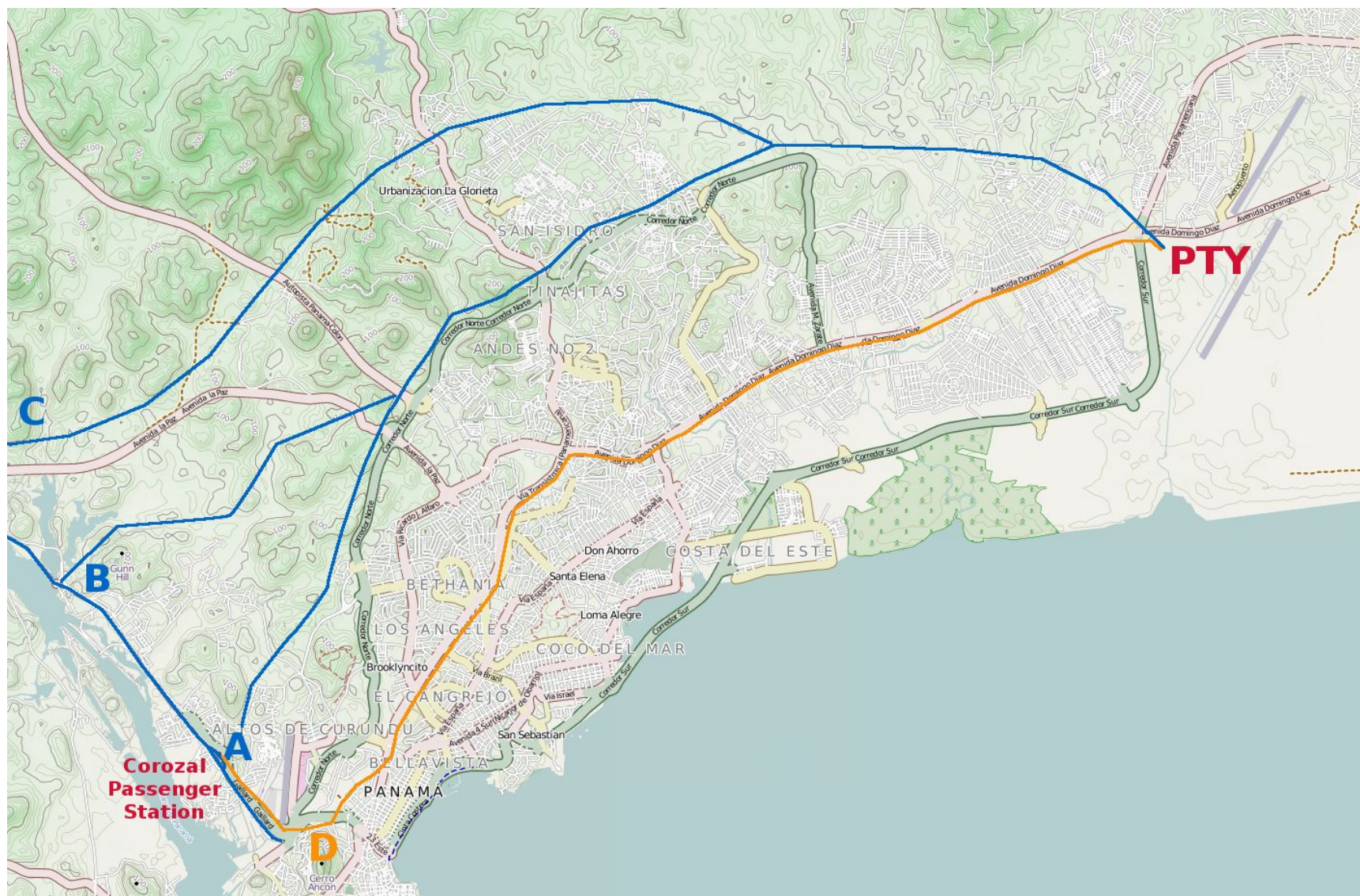


Exhibit 2.20. PTY Phase 1 Development — Present



Exhibit 2.21. PTY Phase 2 Development — Short-term, 2011–2020

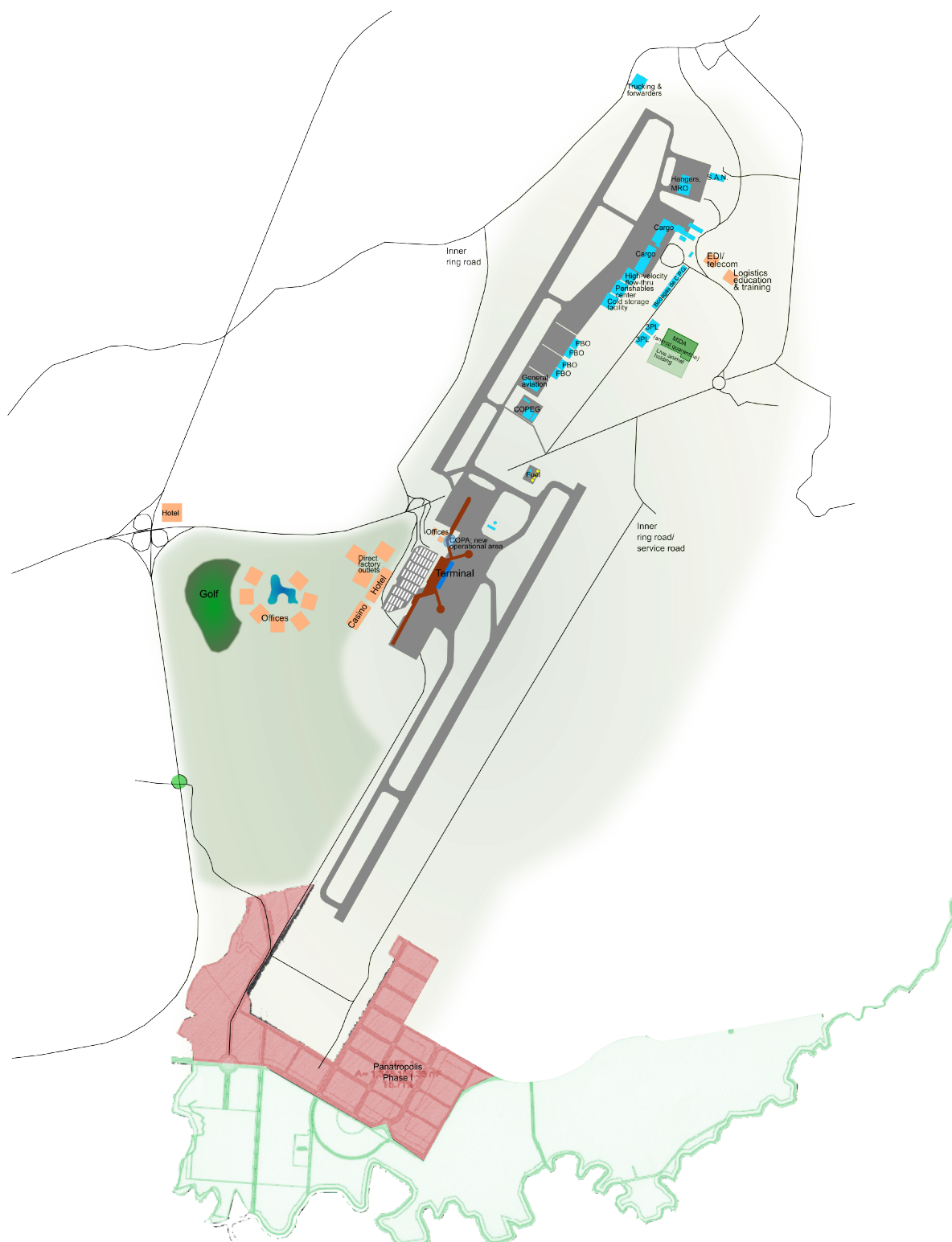


Exhibit 2.22. PTY Phase 2 Development — Mid-term, 2021–2030

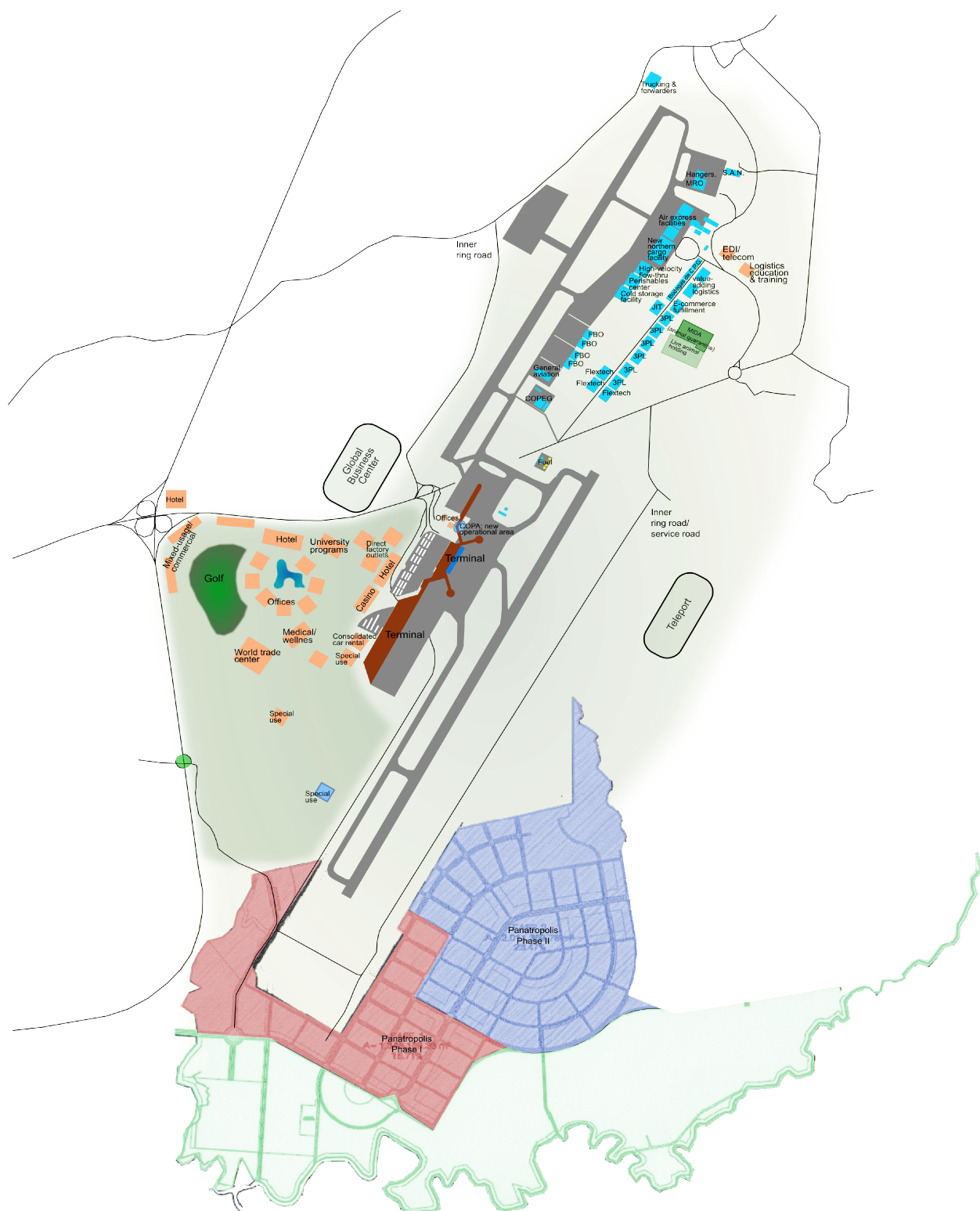


Exhibit 2.23. PTY Phase 4 Development — Long-term, after 2030

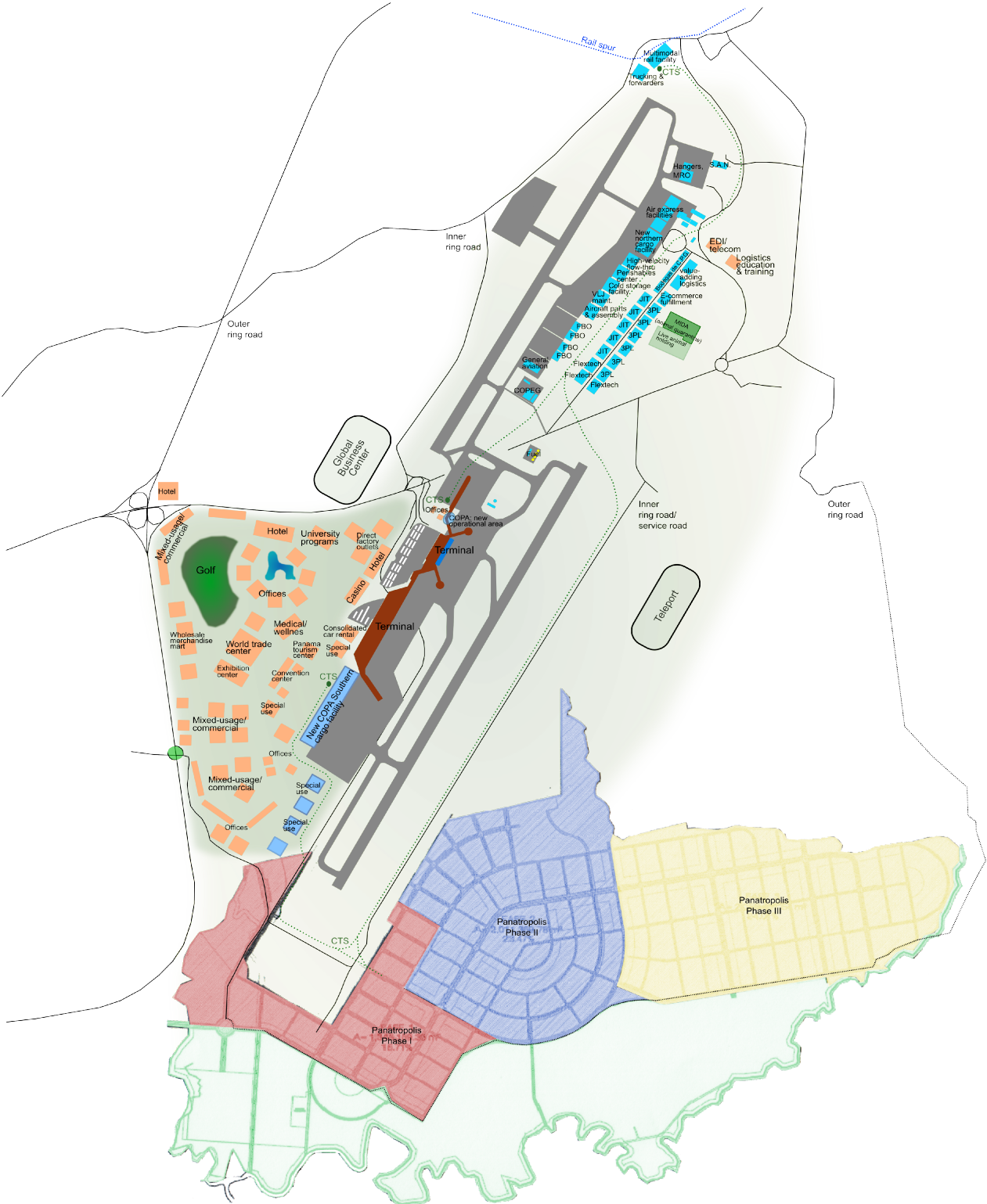


Exhibit 2.24. Detail of PTY Northern Area Phase 4 Development — Long-term, after 2030

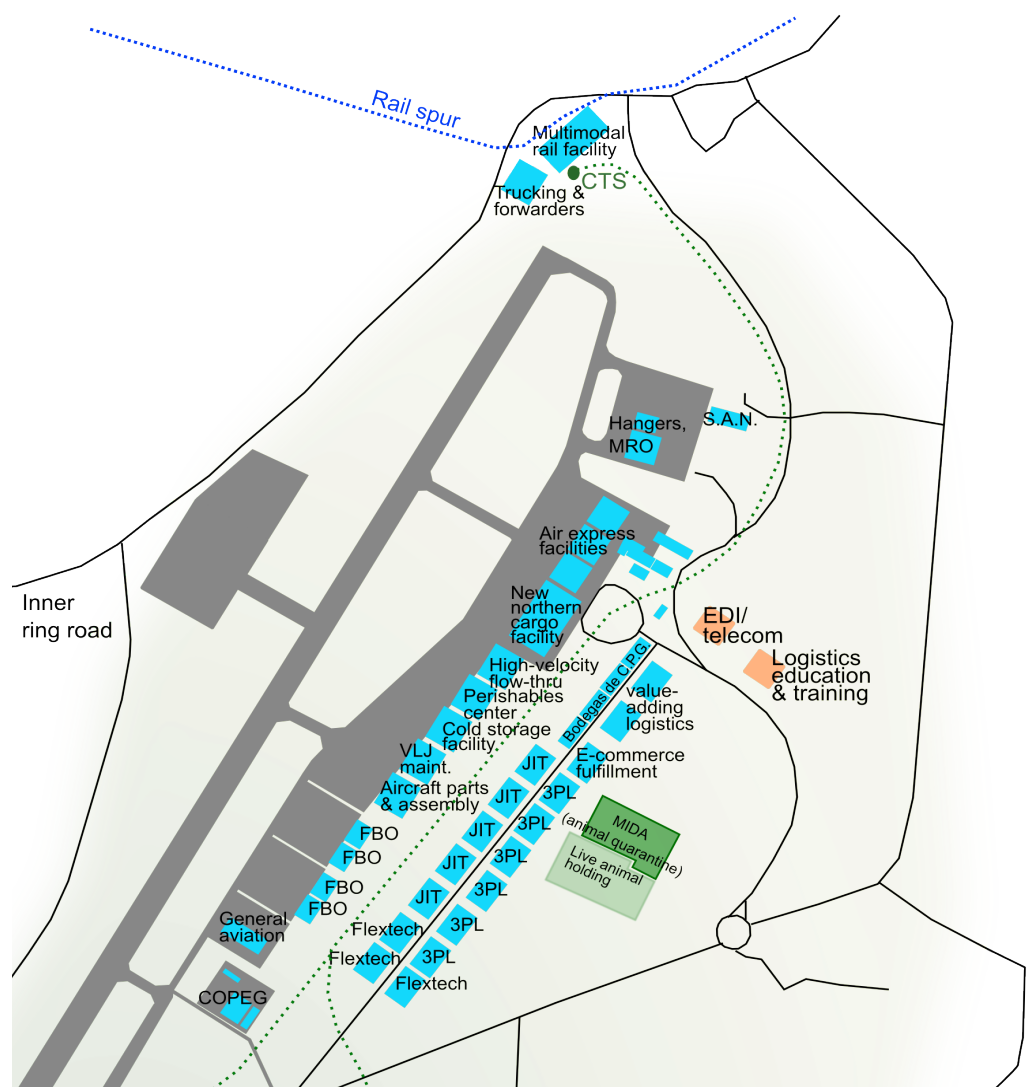


Exhibit 2.25. Detail of PTY Southern Area Phase 4 Development — Long-term, after 2030



Exhibit 2.26. Proposed PTY Intermodal Interfaces at Full Build-out

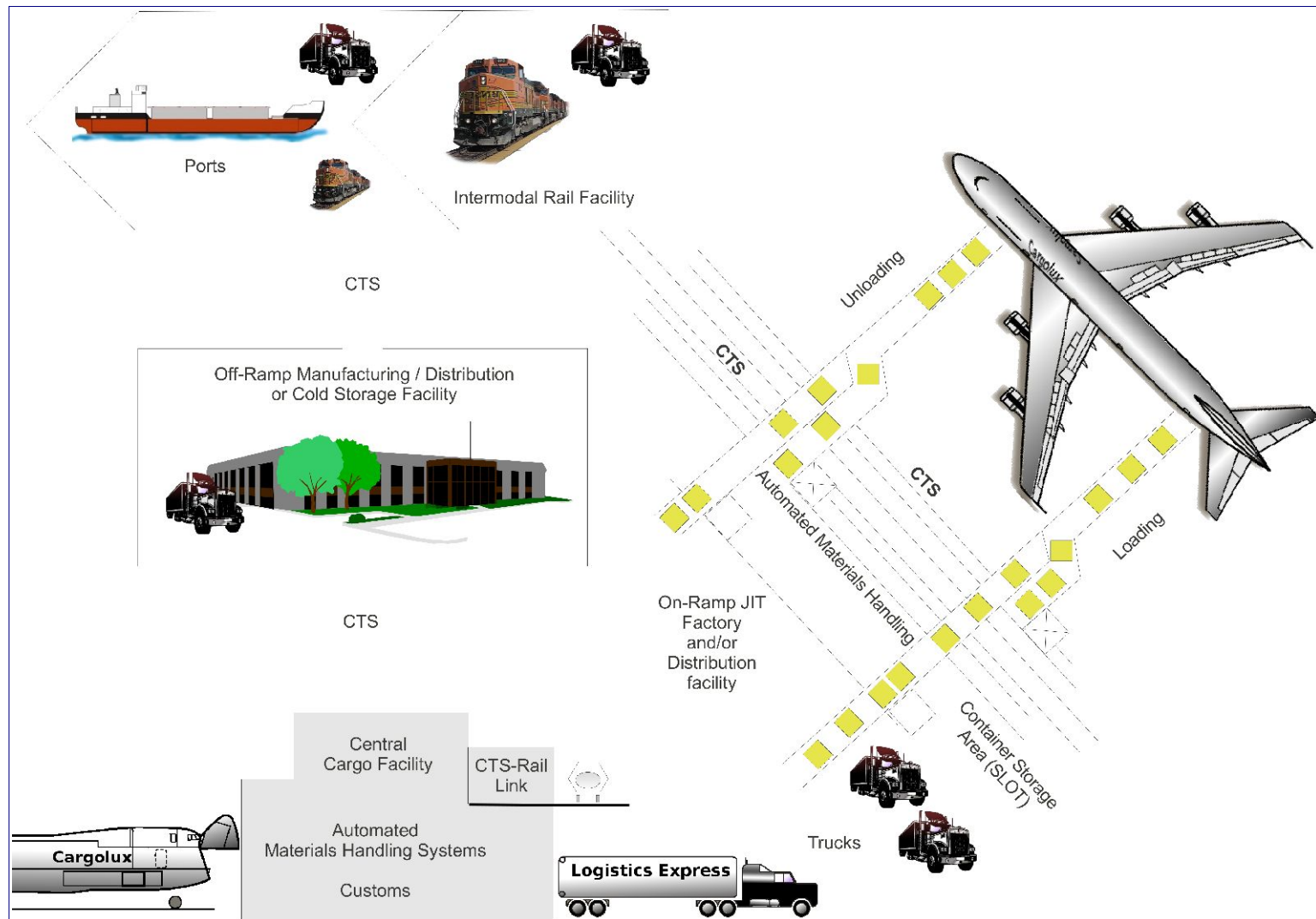


Exhibit 2.27. Transportation Linkages between a Tocumen Air Logistics Hub and Domestic and International Cargo Network

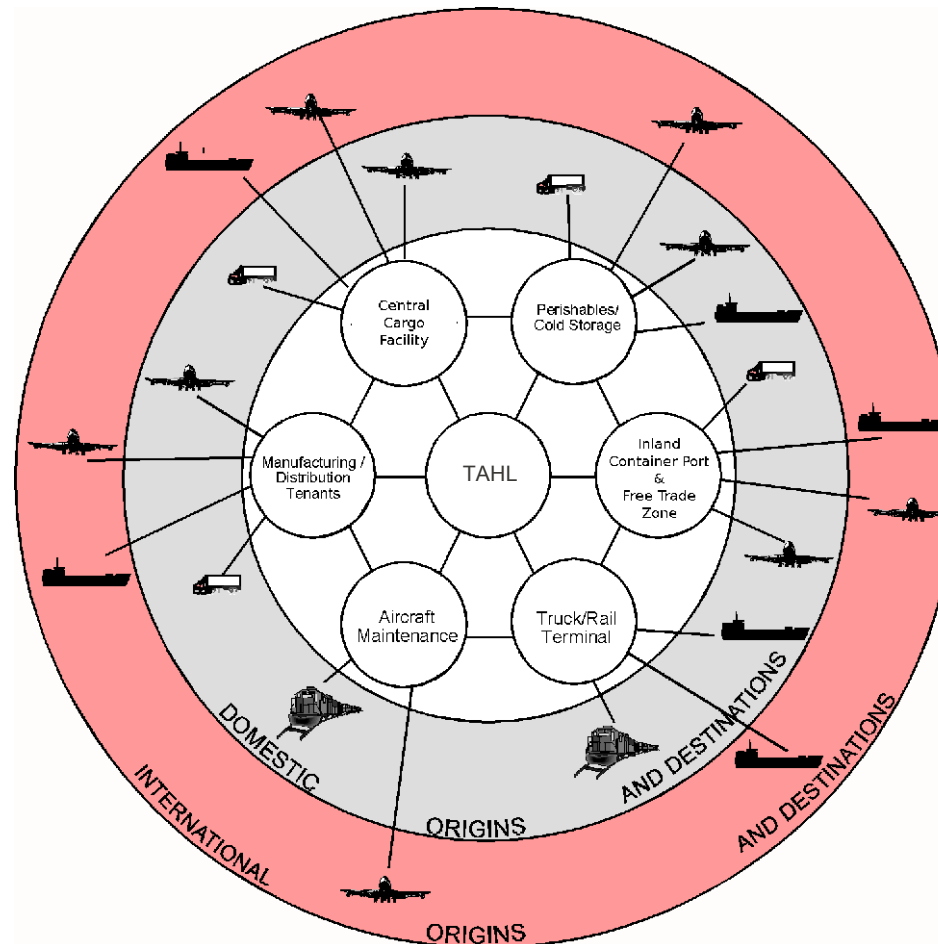
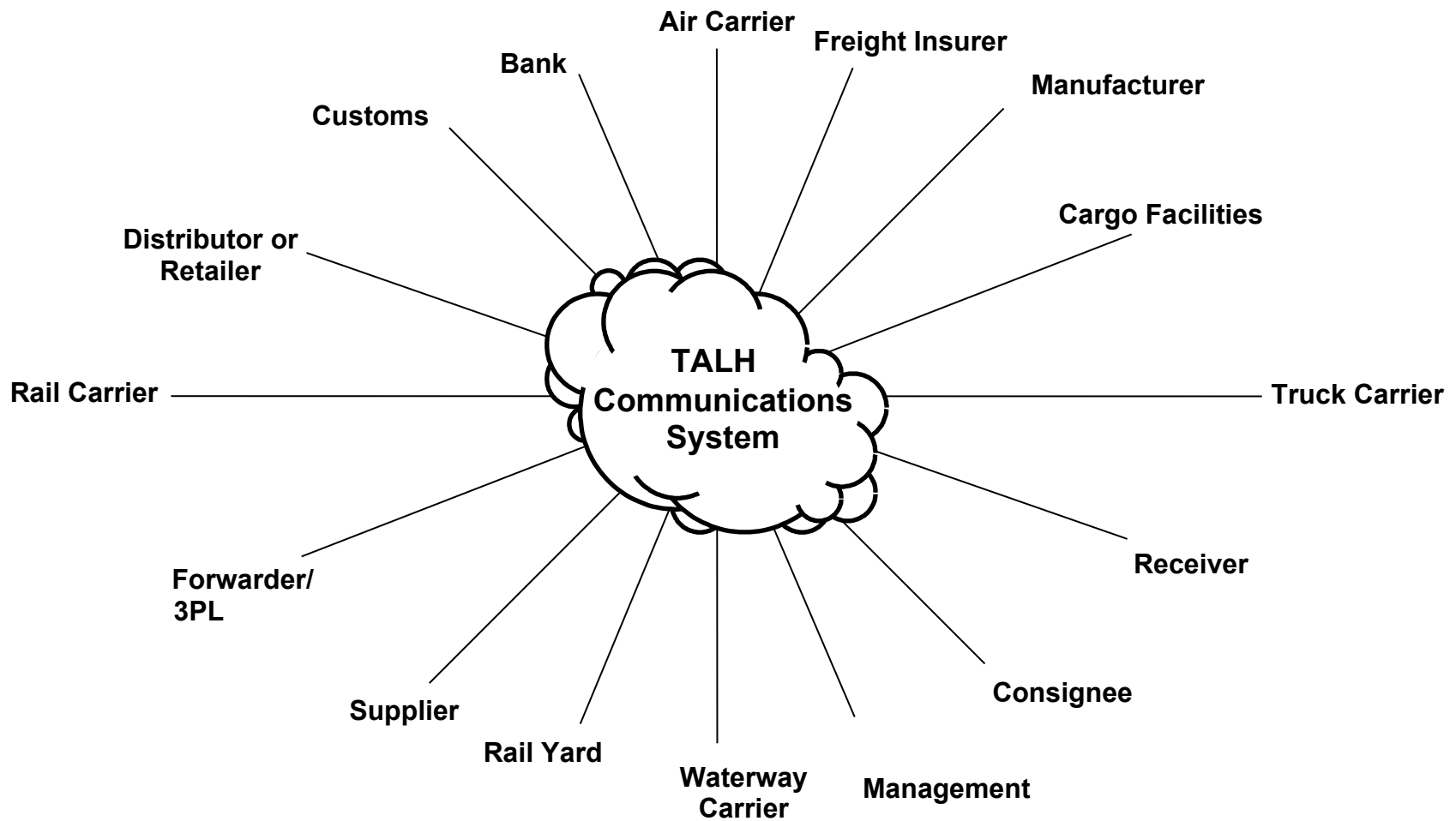


Exhibit 2.28. Overview of Tocumen Air Logistics Hub Communications System



Chapter 3

Tocumen Air Logistics Hub and Airport City/Aerotropolis Business Plan Guidelines

3.1 Introduction

In Chapter 1, I described how speed, agility and connectivity had become 21st century priorities for business and industrial success. The ability of Panamá companies to respond rapidly and flexibly to market opportunities will depend not only on their airport management and operational changes but also on the creation of the external business environment that makes new commercial practices possible. Exhibit 3.1 identifies the key business resource needs for a competitive business environment at and around the PTY and the broader Panamá Aerotropolis.

This business environment encompasses much of the hard infrastructure and facilities described in the prior chapter as well as soft infrastructure. Both hard and soft infrastructure are necessary business resources that must be synergized if optimal economic development outcomes are to occur.

3.2 Business Resource Needs

3.2.1 *Multimodal Transportation*

First, modern manufacturers require integrated multimodal transportation systems for efficient sourcing and distribution of parts, components and manufactured products. Seamlessly connected multimodal transportation systems have therefore become a key to modern supply chain management. Raw materials, perishables, manufacturing inputs, and outputs must flow among geographically dispersed firms in a fast, flexible and synchronized fashion. Air cargo facilities that are integrated closely with efficient highways and railways are needed to support the development and prosperity of logistics parks, industrial parks, high-tech complexes, agribusiness firms, distribution centers, and to more efficiently link them to their sourcing, production and customer networks.

For example, the ability of agribusiness firms to get high value fresh produce, fresh-cut flowers or fresh fish to and from distant markets quickly and reliably requires cool-chain facilities and temperature-controlled cross-docking facilities that link Panamá's surface transport with aircraft servicing overseas markets. Similarly, manufacturers require cross-docking facilities that bring raw materials, parts, components, and semifinished goods efficiently to Panamá

production sites and facilitate the rapid shipment of assembled products to customers regionally and globally.

The aerospace sector (a potential Panamá industrial cluster) is a good example of how integration of aerotropolis multimodal transportation networks can serve a growing major industry. Boeing and Airbus continue to look for sub-assembly sites that include Central and South America. Both aerospace firms are now requiring linkages among major modes of transport in their site selection competition for new commercial aircraft assembly facilities. They are looking for large, uncongested airport sites with highway and nearby rail interfaces that link to ports. In the U.S. in recent years, major aircraft assembly or component facilities have been constructed or approved in Charleston, South Carolina; Kinston, North Carolina; and Mobile, Alabama. All sites have air, road and rail access with connections to ports. It was for this reason that I recommended in Chapter 2 that despite its likely high cost and additional environmental barriers, a rail spur be explored to the PTY area.

3.2.2 Advanced Telecommunications

Second, the Tocumen Air Logistics Hub (TALH) and its broader Aerotropolis require an advanced telecommunications and electronic data interchange (EDI) network (as described in the previous chapter) to obtain information on markets

and orders, trace, track and manage materials and inventory, and control movements of goods to customers. Such a network is also essential to attracting more sophisticated transportation-related and third-party logistics (3PL) companies and 4PLs (managers and integrators of 3PLs) to PTY and its surrounding Aerotropolis that will provide state-of-the-art logistics services to Tocumen users and tenants.

According to the Georgia Institute of Technology 2004 global survey of manufacturers and logistics providers, third party logistics firms are used by nearly 90 percent of large manufacturers to manage their outbound transportation. The survey also showed that 3PLs now regularly use web-enabled and other advanced communications in meeting manufacturer's needs for supply chain ordering and inventory control, shipment tracing and tracking, customs clearance and warehouse management. Similarly, electronic data interchange (EDI) is used by 3PLs for route optimization and carrier selection, fleet management, order fulfillment, customs brokerage, duty and tax payments and even factoring (inventory and trade financing).

The Tocumen Air Logistics Hub (TALH) and greater aerotropolis telecommunications system should feature information technologies served by fiber optics loops, RFID, Wi-Fi, Wi-WAN, and GPS satellite linkages that assist 3PLs and connect companies in the airport area and throughout the Panamá to their suppliers and customers and to their own branches, offices, and partners

around the country and the world. Through its telecom companies and connecting IT infrastructure, such as Pan American Cable, Maya 1 submarine cable, Cable Emergia and Cable Latin America I and II, the airport area and most of Panamá are fortunate to already have advanced fiber optics and telecommunications networks in place including Ethernet services, Wide-area high speed Internet access, Optical Ring Services, Enterprise Hosting, VoIP and Virtual Private Networks.

A teleport with advanced information and telecommunications management systems should serve PTY's and customer premise equipment (including rapid worldwide communication, EDI systems, business to business (B2B) exchanges, and new-generation video conferencing equipment) through communications satellites, fiber-optics, and high-speed digital networks. Operations (manufacturing process) research is showing that the telecommunications and information technology infrastructure external to a firm now heavily influences the effectiveness and efficiency of internal firm processes. This can be a key competitive advantage for Tocumen and aerotropolis area logistics firms and for business and industrial recruitment.

As anticipated international air commerce grows at and around PTY and throughout its aerotropolis, this telecommunications system must also support even faster express customs clearance and more efficient trade data processing. In this regard, it is important for PTY to implement software for an automated,

paperless customs environment needed by 21st century importers and exporters. PTY's new northern cargo area should likewise be used as a laboratory for new expedited customs clearance procedures and electronic data interchange to achieve high-speed, barrier-free international flows of agricultural products, parts and components, and manufactured goods as well as a one-stop trade data and information shop.

In the future, to speed customs clearance, PTY should extend its automated customs environment to the entire airport complex and beta test new, even more efficient practices. Through joint determination with Panamá Customs of appropriate technology, procedures, and staffing levels (and in partnership with participating private sector firms), PTY can take the lead in creating the Central America's fastest and most efficient customs clearance system—24 hours a day, 7 days a week. Instrumental to the logistics success of PTY and aerotropolis goods-processing firms will be speed and agility in moving high value to weight perishables and products to and from international markets via PTY. Much of this will rest on its advanced telecommunications systems.

3.2.3 Commercial Support

Third, the PTY and the Panamá Aerotropolis business environment require 21st century commercial support services. Since globally-linked manufacturers,

assemblers, and distributors must have access to state-of-the-art free trade zones it is highly recommended that the entire northern logistics and cargo area be designed as one. PTY's future tenants and external users will also require bonded warehouses at and near the airport, as well as financial institutions, marketing, sales and employment agencies, legal services, and trade and exhibition centers, some of which could be provided in Tocumen Airport City.

As noted above, expedited customs procedures are required to streamline and accelerate the import of raw materials, parts and components and the export of finished goods. One-stop government service centers (combining federal, and local agency requirements) are also necessary to expeditiously provide foreign investors with all required licenses, permits, and investment promotion privileges. Trade and exhibition facilities are needed to display and market products of the nation's and region's firms. These were recommended for the Tocumen Airport City.

Visiting executives require four- and five-star hotels with meeting rooms, high-speed data-ports and concierge business services conveniently located at and near the airport. In addition, the ability to attract professional managers and highly-skilled younger workers to the aerotropolis requires a full array of community amenities including modern housing, quality public schools, upscale shopping and fine restaurants, nightlife, recreational, and cultural facilities, smany of which are being plann3ed in Panatropolis. Clusters of higher-end

shopping, restaurants, nightlife, and leisure facilities are likewise planned for Panatropolis which will strengthen the draw of Tocumen as an attractive destination.

3.2.4 Knowledge Support

Fourth, many high-tech and other new economy industries must be located near or have ready access to knowledge resources that can generate or stimulate innovation and provide a reliable source of trained workers and managers. Among the most important knowledge-based organizations on which global businesses depend are top-notch community colleges and universities providing well-trained workers and educated professionals and some with research capacities. Consultancy and tech-transfer organizations that help commercialize technology, develop new products, and service local and multinational firms more effectively also contribute to an airport area's attractiveness. The Panamá City region has excellent higher educational resource that offer BS, MS, MBA and PHD programs including, among others, Florida State University–Panamá , Universidad de Panamá , Columbus University, Latina, Universidad Latinamericana de Ciencia Tecnología, and Universidad Católica Santa María la Antigua.

The Universidad de Panamá, UDI, USMA, ULACIT and Instituto Superior de Ingeniería all offer specialized degrees in logistics and transport. I earlier proposed that a logistics education and training center be located near Tocumen's northern cargo area to facilitate training as this area develops as a logistics complex. This center would provide logistics workers with the basics equivalent to what in the U.S. is community college training. Here it would be valuable for Tocumen administrators to work with Dr. Noel Greis, Director of UNC's Kenan Institute Center for Logistics and Digital Strategy, to establish the distance-education global logistics AA degree program she helped develop. This AA degree program has been successfully implemented around the world.

Related to the Logistics Education and Training Center and its distributed education AA global logistics degree program, for firm recruitment and support, a PTY distance education and training facility drawing on the airport's telecommunications network could provide real-time audio, video and tactile worker training on-site (and, via distributed education and training, to facilities throughout Panamá) from training centers in distant headquarter firm locations around the world. Thus, if Boeing decided to establish a major aerospace component manufacturing facility at PTY or in the broader Panamá Aerotropolis, on-site training could come directly from Seattle. Or if Mercedes wished to establish a high-value, JIT dashboard digital components sub-assembly facility in

the new expanded northern cargo sector of PTY, the on-site training could come directly from Stuttgart.

3.3 Functional Capabilities Required for a Tocumen Air Logistics Hub

The Tocumen Airport Logistics Hub (centered in the revitalized northern cargo zone) should represent integrated responses to the business resource needs described above. To succeed, it must incorporate six broad functional capabilities targeted to these needs. For each functional (business) requirement, examples of key hard and soft infrastructure elements are noted. (Refer back to Chapter 2 for more detailed discussion of the design/location of these elements.)

- 1. Multimodal Transportation System with Access to Local, National and Global Transportation Networks*

On-site cargo terminals and nearby inland ports with efficient intermodal capability should be linked to Panamá's major highway and rail systems and with its sea and air transportation networks. Primary integration capability for the TALH/ Aerotropolis must provide a seamless interface between transportation modes and between aerotropolis firms and major air cargo and ocean shipping routes so that goods and materials can flow uninterrupted from

any Aerotropolis location to PTY and ports quickly, at low cost, and with a minimum of human handling. This applies, as well, to air passengers moving between PTY and its Aerotropolis zones, especially time-sensitive business executives and professionals. Efficiently linking all the various modes of transportation is important to establishing a time-competitive infrastructure for the Panamá Aerotropolis and to attracting businesses and industrial investment to the airport area and the greater Aerotropolis.

Examples of such Aerotropolis business resource infrastructure needs include:

- Establishing modern distribution centers with truck cross-docks connecting to national highway, rail line and to Panamá's ports.
- Reducing choke points on Panamá City roadways, widening of the road that connects Vía Tocumen to Parque Sur and Panatropols, and improved connections to the PTY north cargo area.
- .Creating a rail spur to Tocumen with an intermodal facility near the northern cargo zone.
- Constructing a highway loop connecting the future PTY South Terminal with access to Panatropolis, as well.
- In the long-term (after 2030), possibly running a commuter rail line directly to PTY.

2. On-site Cargo Processing Capability

At the core of any air logistics hub must be a cargo processing facility with advanced material handling that can accommodate the needs of a variety of aircraft and industries. I noted that flexibility in both the processing capability and location of material handling activities is essential because of nonstandard aircraft and ground cargo-related equipment, and because of a dynamically changing and unpredictable cargo processing environment. Targeted mechanization at PTY's northern cargo operating processes, as discussed in Chapter 2, can be provided when it is productivity-driven and demand-justified.

Examples of key PTY cargo infrastructure elements include:

- New Northern Cargo Facility (NNCF) with advanced material-handling systems (MHS) and intermodal interfaces.
- High-velocity flow-through facilities with airside cargo access and truck cross-docking.
- Automated customs clearance procedures and facilities.
- In-bound breakdown and delivery staging areas.
- Cargo inspection, security, and holding areas.
- Facilities for value-added service provision, such as pick and pack, and temperature-controlled (perishables) storage.
- E-commerce fulfillment facilities.

3. On-site Cargo Transport System

A third need for fast-cycle logistics at PTY and to efficiently link all its goods-handling facilities in the future upgraded northern and western airport development zones is an on-site cargo transfer system (CTS). The CTS, as was illustrated in Exhibit 2.23, would connect all PTY goods handling facilities with air cargo and road access and to the other inside the fence manufacturers, distributors and logistics providers. These systems can be fully automated, semi-automated or manual depending on traffic flow profiles (cargo demand) and the specifics of the site and should be complemented by appropriate materials handling technologies.

Examples of such infrastructure elements include:

- Internal road and cargo tram system (CTS).
- Truck crossdocks.
- Automated storage/retrieval systems.
- Electronic RFID tagging of cargo and and EDI technology.

4. Shared Communications System with Transparent User Interfaces

Apropos the last bullet point above, computer-to-computer information transfer between companies (Electronic Data Interchange and B2B e-commerce) are quickly replacing paper and fax transmissions and even most traditional face to face supply chain transactions. This electronic

interchange of data and information requires message standards, translation software and transmission capability. Recent technology developments have created new opportunities to enhance inter-modal, inter-company and inter-industry communications with harmonized software, more powerful work stations, improved data transportation mediums, global communications networks and faster routers for electronic transmissions.

Incorporating these capabilities and new technologies at PTY and the Panamá Aerotropolis will greatly facilitate seamless relationships between future PTY tenants and users and their suppliers and customers – locally, nationally and worldwide. The net effect is to accelerate materials handling, customs processing and product transfers among commercial facilities, aircraft, trucks, rail cars, and Panamá's ports. A key planning challenge, as described in Chapter 2, is to design a communications system that is flexible enough to support the majority of PTY and Panamá Aerotropolis users, that offers rapid connection to local, national and global networks, that maximizes functionality (including effectively communicating across different transport modes), and that allows for continuous improvement and innovation.

Examples of key electronic commerce elements include:

- Electronic data interchange (EDI) and RFID interoperability across transportation modes
- Fiber optic, Wi-Fi, Wi-WAN and satellite networks
- Wide-area broadband and Ethernet service.
- Web-based harmonized software architectures and message standards

5. *Access to On-site and Remote Services for Commercial Support and Logistics Education and Worker Training*

In the new speed-driven economy, businesses are demanding access to a variety of support services that reduce the time and cost of logistical transactions. Desirable commercial support services include a variety of legal, financial, and government services such as the securing of permits, and export licenses. Some of these services can be provided electronically. Co-location of these services at PTY or at a strategic point in its greater Panamá Aerotropolis can provide a “one-stop-shop” support for PTY and aerotropolis tenants and users.

Similarly, electronic access to education and training facilities throughout Panamá and the world can provide substantial value to PTY tenants and users. As noted previously, the proposed distance education facility at PTY and Logistics Education and Training Center would provide agile support for custom training of the local labor force by

offering tenant and area companies real-time audio, video, and tactile access to knowledge and training resources from around the world.

Similar to the Boeing example, if Rolls-Royce wanted to locate a jet engine production facility at PTY's redeveloped northern cargo zone or elsewhere in the Panamá Aerotropolis, worker training could be conducted on site, via simultaneous audio, video, and tactile instruction from its European production headquarters.

Examples of such business support elements:

- Interactive audio/video capability.
- Wide area broadband information exchange.
- On-line interactive and/or automated support of negotiations and contracting.
- Education and training center with distance-learning capabilities.
- One-stop shop service center for investors permits, licenses, etc.

6. Arterial Movements Unencumbered by Congestion

Success of the Tocumen Air Logistic Hub (TALH) and its broader aerotropolis requires speed and agility of movement on local highway systems. As the area develops the potential for congestion rises. I discussed already key roadway widening projects and new roads needed in the immediate airport area and throughout the Panamá Aerotropolis.

Panamá government endorsed planned upgrades noted previously

including additional lanes in high-volume traffic areas. In the longer-term, they should also consider:

- Intelligent highway system technologies.
- Possible truck-only lanes on certain routes (such as near the northern cargo area).
- Encouraging cluster as opposed to strip commercial development along aerotropolis highways.

3.4 Tocumen Air Logistics Hub/Airport City and Panamá Aerotropolis Critical Success Factors

Effective planning requires not only vision but also an appropriate strategy.

Guiding the development of a master plan for the TALH and Airport City should be a set of critical success factors that, if followed, will greatly facilitate their ultimate success. Realizing these critical success factors will also provide almost all of Panamá with a major competitive edge in attracting business and industry. These critical factors are the ones most commonly found in successful air logistic hub and aerotropolis developments around the world. Tocumen Air Logistics Hub and Airport City planning and development need to emphasize these, as does its surrounding Aerotropolis.

Critical Factor #1

PTY Must Be Designed Around Emerging 21st Century Business Practices

Beginning with my frequently repeated fundamental point, master planning of PTY must reflect not only the best civil and aeronautical engineering practices but also the business practices and needs of 21st century global companies. I noted that dramatic changes are occurring in how companies transact their business, and especially in how today's most successful mega-retailers, high-tech manufacturers and logistics providers move goods and materials throughout the world in a fast and flexible manner. 21st century airports therefore cannot be designed and developed as separate infrastructures that reflect more traditional aerodrome and systems engineering objectives and traditional airport commercial practices. New business realities require new business infrastructures. Future airport commercial complexes such as the TALH must be geared to modern supply-chain management that fuse multimodal transportation, advanced telecommunications, sophisticated materials handling systems, and state-of-the-art business support services to offer unmatched speed and agility to its tenants as well as users from throughout Panamá. They must also provide business and leisure travelers with services and amenities that will substantially enhance their experience at the airport.

Critical Factor #2

Development Plans for the TALH, Tocumen Airport City, and its greater Aerotropolis Must Give High Priority to Quality of Life Considerations

Unlike most other air logistics complexes around the world, the TALH/ Airport City should be developed as a multi-functional district that will support not only manufacturing and distribution activities, but also white-collar service functions, so important to raising salary levels in the airport area. This brings out the importance of quality of life considerations with respect to their broader built environment. By balancing industrial, commercial and environmental factors, the TALH/ Airport City can provide benefits not only to the companies that locate there, but also to nearby residents. High-quality design standards, beautified access roads, attractive commercial clusters, and environmental sustainability must be overarching objectives.

Critical Factor #3

Master Plans for the TALH/Airport City Must Be Flexible and Reconfigurable

I have stressed that master planning should not be viewed solely as detailed site and civil engineering plans to guide construction and development. Rather, the master plans for both PTY and its surrounding Aerotropolis should be developed as a flexible framework that can accommodate a wide variety of commercial facilities, tenants, and physical layouts. As suggested above, master planning must look to the long-term, with a design that is both environmentally

and economically sustainable, as well as aesthetically appealing. It must also be able to adapt to emerging business needs and incorporate new technologies and infrastructure advances. A basic planning principle is that, to the extent possible, PTY and its surrounding Aerotropolis should be designed as a flexible infrastructure system that can be adapted to current and future business requirements. While the features of the competitive landscape for the near term are in focus, competitive strategies and logistical requirements will undoubtedly change over time and the TALH/ Airport City as well as the broader Aerotropolis must be able to respond quickly to these new business needs and logistical requirements. A 20 to 30 year Tocumen/ Aerotropolis development horizon is not unreasonable to build milestones on. Panatropolis, in fact, has a 40-year horizon.

Critical Factor #4

PTY Must Establish Synchrony with Other Infrastructure Projects Around the Country and the World.

We are moving into an era in which networks of firms compete rather than individual companies. In this new commercial environment, Panamá Aerotropolis companies and PTY tenants must be able to access their suppliers, partners and customers quickly and effectively. This requires PTY air cargo synchrony with other air cargo systems around the county and the world, with harmonized communications systems and surface/ sea transportation networks.

Major 3PLs and forwarders are racing to set up efficient and seamless international networks. By aligning and integrating more closely into their international networks, aerotropolis goods-handling businesses will be able to participate more efficiently in the global economy that these firms themselves have become inextricably interwoven.

Critical Factor #5

PTY Must Emphasize the Importance of Logistics-Based Capabilities in Attracting Globally-Oriented Businesses.

As Panamá's emerging manufacturing firms companies search globally for quality parts and components at competitive prices, and as customers demand quick response and rapid delivery, access to multimodal air logistics hubs will be a major criterion for industrial location. Companies will certainly continue to require traditional economic incentives, such as investment offsets for land or facilities, federal, and local tax abatements and other promotional privileges. However, as the competitive priorities of speed and efficient response to changing customer demand predominate, the relative importance of these traditional factors will lessen. Increasingly, investment decisions will be made as much on the basis of the logistical capabilities of the site and access to global networks, as on government incentives. This could be PTY's and the Panamá Aerotropolis's trump card.

Critical Factor #6

PTY and Panamá Aerotropolis Planning Must Demonstrate National Benefits

To obtain broad-based public and governmental support, PTY and Panamá Aerotropolis development must be positioned as a vehicle for not only for the airport area's but the entire Republic's competitiveness and economic growth. The development of a Tocumen Air Logistics Hub that would attract successful business and industries to the airport and its environs should be a primary goal. But, ultimately, the success of PTY its surrounding aerotropolis will depend on how its capabilities can leverage businesses and industries throughout Panamá. It is therefore critical that both PTY and Panamá Aerotropolis master planning recognize this fact to design and implement an integrated logistics system plan that builds synergies among national transportation networks and commercial/agricultural centers. Likewise these plans must create distinct advantages to multinational firms to choose Panamá over other locations in Central and South America.

Critical Factor #7

PTY and Panamá Aerotropolis Master Planning Must Be Totally Integrated

This integrated planning must bring together airport planning, urban and regional planning and business site planning. Only through such integrated planning can aerotropolis development be economically efficient, aesthetically

appealing, and environmentally sustainable. It is therefore essential that constant and close communication and coordination occur between Tocumen SA and other airport area developers. Other pertinent stakeholders, such as Copa, the Ministry of Economics and Finance, and the Panamá Civil Aviation Authority, should be brought into the planning process, as appropriate.

Critical Factor #8

PTY Connectivity to Regional and Global Markets Must Be Substantially Expanded.

Driving Panamá Aerotropolis success will be increased passenger and cargo airline connectivity measured by the numbers of markets served by PTY and the frequency of air service to and from these markets. Such increases in route connectivity will only happen if 's commercial air service is concentrated at PTY. Otherwise, there will be a splitting of passenger and cargo volumes thereby undercutting the development of critical masses of traffic at PTY to justify new routes. This will dissuade air carriers from establishing or expanding routes at PTY to the detriment not only of the Panamá Aerotropolis, but also all of the Republic. A single major international airport in Panamá is thus essential to the competitive success of the Panamá Aerotropolis and the nation.

3.5 Marketing Principles and Guidelines

I turn now to guidelines for a marketing strategy to help the Tocumen SA and surrounding developers attract investors and more logistics service providers to PTY and the Aerotropolis. I will assume that for the immediate future Tocumen SA and Panatropolis management will play leading roles and responsibilities for promoting the Tocumen Air Logistics Hub, Tocumen Airport City, and the greater aerotropolis and for identifying and attracting viable business and industry to both. In the next chapter, I will make recommendations regarding ways to enhance the commercial success of PTY and the greater Aerotropolis in a complementary, reinforcing manner. Suffice it to note that Tocumen SA may wish to retain a master developer to help market, finance, develop, and manage its Airport City and logistics sectors of the airport, at least in the near term.

Among the master developer's primary responsibilities would be helping secure up-front investment capital and the promotion of the TALH including the creation of a marketing program for the Airport City and the air cargo/logistics complex, complete with public relations, advertising and publicity brochures and materials, to the identification, contact and recruitment of potential commercial and industrial tenants and users, as well as logistics service providers and possibly even help in recruiting airlines. The reason I endorse having the master

developer is simple. The core business of Tocumen SA is airport operation and management, not commercial real estate development.

In view of current commercial real estate realities, I first concentrate on the logistics marketing strategy tasks, I also address longer-term Airport City marketing goals and issues for the TALH related to appropriate promotion and development of the airport's industrial and logistics areas.

1. PHASED MARKETING THEMES

The ultimate objective of the TALH is to serve as a major air logistics complex offering tenants and users state-of-the-art infrastructure and commercial support. Based on experiences air logistics airports elsewhere, to achieve of this goal, the Tocumen Air Logistic Hub will likely evolve through a series of phases. In each phase, the marketing effort should be designed to attract a nucleus of appropriate facility users, which in turn serves as a catalyst to attract additional complementary companies to the complex and to the greater Panamá Aerotropolis.

The kinds of tenants likely to be attracted to the TALH will vary with each phase of the complex's infrastructure and facility development. Marketing activities should be planned to match these anticipated development stages and tailored to the kinds of tenants that are most suitable to each stage, and not outrun physical development stages. If marketing gets ahead of these

improvements, credibility will be lost and the targeted tenant will become disenchanted. The marketing time table is set to roughly correspond to development, but obviously precede it to some extent.

a. Near Term

The near term represents a period from the present through the next 5 years. Based on surveys of potential users of air logistics hubs elsewhere, the near-term marketing strategy should not only focus on real estate development but also on attracting additional air cargo service to complement Copa. Though I understand that some efforts by Tocumen SA have already been made to attract additional air cargo service, these efforts should be stepped up even further. Integrated air express carriers are also seeking new regional bases and close contact need to be maintained with these firms, as well as with Copa and other primarily passenger airlines. PTY has a superb strategic location for Central and South American air express service so strong continuing efforts could pay off in landing such a regional hub.

The Tocumen Airport City master developer needs to do appropriate land valuation and substantially notch up marketing. It needs to flesh out a fuller conceptual master plan following guidelines to undergird its marketing. For the broader aerotropolis area, basic zoning

and land-use planning should also be completed with conceptual master plans developed for each aerotropolis zone that complement commercial development plans for Tocumen Airport City. These conceptual master plans (a point I will return to later) could be valuable marketing tools in gaining the interest of potential future investors and developers. Close coordination is particularly required with Panatropolis developers to generate reinforcing synergies.

b. Mid-Term

The mid-term for PTY development represents roughly the years 6 through 20, including some earlier year overlay with near-term activity. This period's marketing strategies should be designed to continue to boost passenger and air cargo demand at PTY and then to further expand this demand by progressively widening and deepening the nature of goods processing and commercial service activities located at and around the airport. Key components of these strategies include:

- Attracting additional air cargo and passenger service.
- Targeting industrial and commercial users of those air services.
- Encouraging improved logistics management.
- Preparing for the full integration of production and logistics.
- Siting key firms in designated aerotropolis zones.

While the above strategies are broadly sequential, there would naturally be substantial overlap among them. Most important, the impact of this marketing will be cumulative, with efforts in one stage preparing a network of contacts and a PTY northern cargo complex to make it possible to begin moving the complex toward its next phase of evolution.

(1) Attracting additional air cargo service providers

For PTY to attract additional air cargo service providers, a critical mass for air cargo demand (load) is necessary on a regular basis. This includes backhaul. Previous surveys have indicated that charter air cargo operators (e.g., Atlas Air, BAX Global, Cargolux, Evergreen, and Polar) serve airports where they can be assured of a significant volume of airfreight. The key to building a critical mass of cargo demand will be to focus on promoting PTY as the preferred air logistics facility for industries in Central and South America that are airfreight dependent. The intent here will be to persuade the firms not necessarily to relocate to the Panamá Aerotropolis area, but to use PTY rather than any other regional airports for air cargo shipments.

To build cargo volumes will require closer working relationships with major freight forwarders and third-party logistics service providers. Initial marketing targets should focus on international 3PL's, freight

forwarders and shippers of time-sensitive products. The latter include aerospace and microelectronics companies, pharmaceutical firms, fresh cut flowers, fresh produce and seafood, and other high value to weight export products. Marketing strategies geared to shippers, freight forwarders, 3PL's and air cargo firms should emphasize the value-added that PTY can contribute in terms of lower cost and faster, more efficient operations. During this mid-term phase of marketing, PTY should become a more significant air cargo airport, featuring greater cargo volumes with highly efficient materials handling and transshipment capabilities.

(2) Attracting Additional Air-Intensive Commercial Users to PTY and the Panamá Aerotropolis

As PTY's air cargo service further expands, reciprocal marketing should focus on attracting shippers (i.e., manufacturers and assemblers of export products) and more international freight forwarders and third party logistics providers (3PLs) to locate at and around PTY. The goal will be to begin generating on-site origin/destination cargo shipments in terms of in-bound raw materials and components and out-bound intermediate and final goods flowing to and from the time-sensitive manufacturers and distributors that operate in or near PTY. Again, the emphasis should be

on demonstrating a set of real cost, speed, and service quality advantages to firms locating at or using PTY (including its proposed Free Trade Zone and PTY's new northern cargo area) that are compelling to shippers, forwarders, and 3PLs. Not the least of which will be increasing Tocumen's connectivity which is measured both by the number of international markets served and the frequency of service to these markets.

c. Longer-Term

The longer term (years 20 to 30 with some earlier year overlap) will focus on developing a full-scale logistical complex (including the redeveloped new northern cargo area) and attracting the necessary additional complement of aviation-related perishables shippers, manufacturers, logistics providers and air services to accomplish ultimate air logistics objectives.

(1) Improved logistics management (years 10 to 15)

Within 10 to 15 years the new northern cargo area will have begun to develop a complement of logistics support services. Pointing to the importance of these features for cost-effective logistics, plus the record of efficiency that PTY should have established for its tenants and users to

that date, marketing programs will begin to focus more on the advantages of PTY in overall logistics management. The marketing emphasis should be on helping industrial and commercial shippers and 3PLs find opportunities at PTY to coordinate the movement of materials and finished goods so that they can rapidly and flexibly respond to customer's needs as well as to cut costs and increase supply-chain management efficiency.

The possibilities of performing value-added logistics functions in the new northern cargo area such supply-chain sequencing, pick and pack, product labeling, and assembly of knock-down product kits should be stressed. Marketing targets during this phase should be the companies throughout Panamá, plus the whole spectrum of major freight forwarders and third-party logistics providers that serve shippers globally. The new northern cargo area's later capabilities in automated warehousing/distribution, electronic data interchange, and electronic tracing-tracking will be underlined for these logistics specialists. PTY's value proposition during this phase should not only emphasize cost and quality of service advantages, but also the enhancements to the speed and agility of supply chain operations that PTY will provide shippers and 3PLs.

(2) Integration of production and logistics (years 10 to 20 and beyond)

When PTY has developed an international reputation for world-class cargo handling and logistics management, a final stage of marketing can begin. The emphasis at this point would be essentially an intensification of the “improved logistics management” marketing theme set forth above, whereby the marketing program will concentrate on supporting shippers, forwarders, and 3PLs to find ways to integrate production and logistics so as to substantially reduce inventories and further improve manufacturers' supply chain management.

Promotional materials must seek to differentiate PTY and its environs from other industrial-logistics complexes as sharply as possible in terms of the price, quality, speed and agility benefits that it offers. PTY and its greater aerotropolis will at this point be marketed internationally to the most sophisticated shippers and 3PLs as a site where airfreight dependent manufacturers can fully coordinate and integrate their supply chains and overall manufacturing capacity with customer demands. The marketing message should also stress the PTY's world-class standards in total logistics management practices including multiple transportation modes (with connections to ports), and advanced telecommunications, sophisticated materials handling systems, and state-of-the-art commercial and knowledge support services.

2. TOCUMEN AIR LOGISTICS HUB/AIRPORT CITY TARGET INDUSTRIES

At every stage of marketing, the Tocumen Air Logistics Hub promotional strategy should be grounded in solid business research and planning. This will involve market research of a generic nature on likely PTY tenants and users, given its stage of development, as well as market research specific to Panamá as was conducted for the Strategic Plan of the Government 2010–2014. Research on commercial shippers from around the world points to five generic types of shipments where air transport is the consignees' mode of first choice. These are when:

- Flexible and customized production is the norm.
- The high value of the product compared to its weight justifies the extra cost of airfreight.
- The product is perishable – either in the organic or economic sense.
- Short production cycles and/or “just-in-time” inventories require air freight.
- Immediate delivery of spare parts, time sensitive documents or products is required.

Target industry analysis for air logistics hubs conducted by the University of North Carolina's Kenan Institute of Private Enterprise identified eleven industrial groups that are most likely to utilize the facility. Most of these would no doubt also be the best target industries for PTY and the Panamá Aerotropolis, as well. They include:

- Logistics service providers (forwarders, 3PLs).
- Semi-conductor and computer chip manufacturers.
- Pharmaceuticals and contract biotech and pharmaceutical lab testing facilities.
- Computer and electronic sub-assembly manufacturers.
- Aircraft assembly, aircraft parts suppliers and aircraft maintenance services.
- Garments and fashion accessory suppliers.
- Specific elements in the scientific or medical industrial supplies business, particularly those supplying small volumes of high value products, for example aromatics.
- Optics and small precision equipment manufacturers.
- Suppliers of perishable products – for example, fresh seafood, live animals, fresh fruit and flowers.
- Digital automotive component manufacturers and spare part suppliers.
- Gems, jewelry and watch manufacturers.

In targeting these firms and others in the industries, noted above, there are a number of services that need to be highlighted in a marketing plan for the Tocumen Air Logistic Hub and its aerotropolis environs. Many have already been discussed and some already exist, but let me provide a summary list of the key support services to be implemented and leveraged in marketing PTY and its surrounding aerotropolis.

- Expedited customs clearance and pre-clearance procedures.
- Full electronic data interchange capability.

- Free Trade Zone and in-transit bonded status for re-exports.
- New and improved highway access to PTY (especially its northern cargo area) and its surrounding aerotropolis.
- State-of-the-art materials handling services.
- Reliable utility services (e.g., electricity, natural gas, water, sewer).
- Industrial support services such as repair and maintenance and machine shops.
- Quality of life – good housing, schools, restaurants, recreation and nightlife.
- Knowledge and education support, including a distance education and worker training facility at PTY.
- Enhanced one-stop servicing for foreign investors.
- Expedited site and building permit approvals.

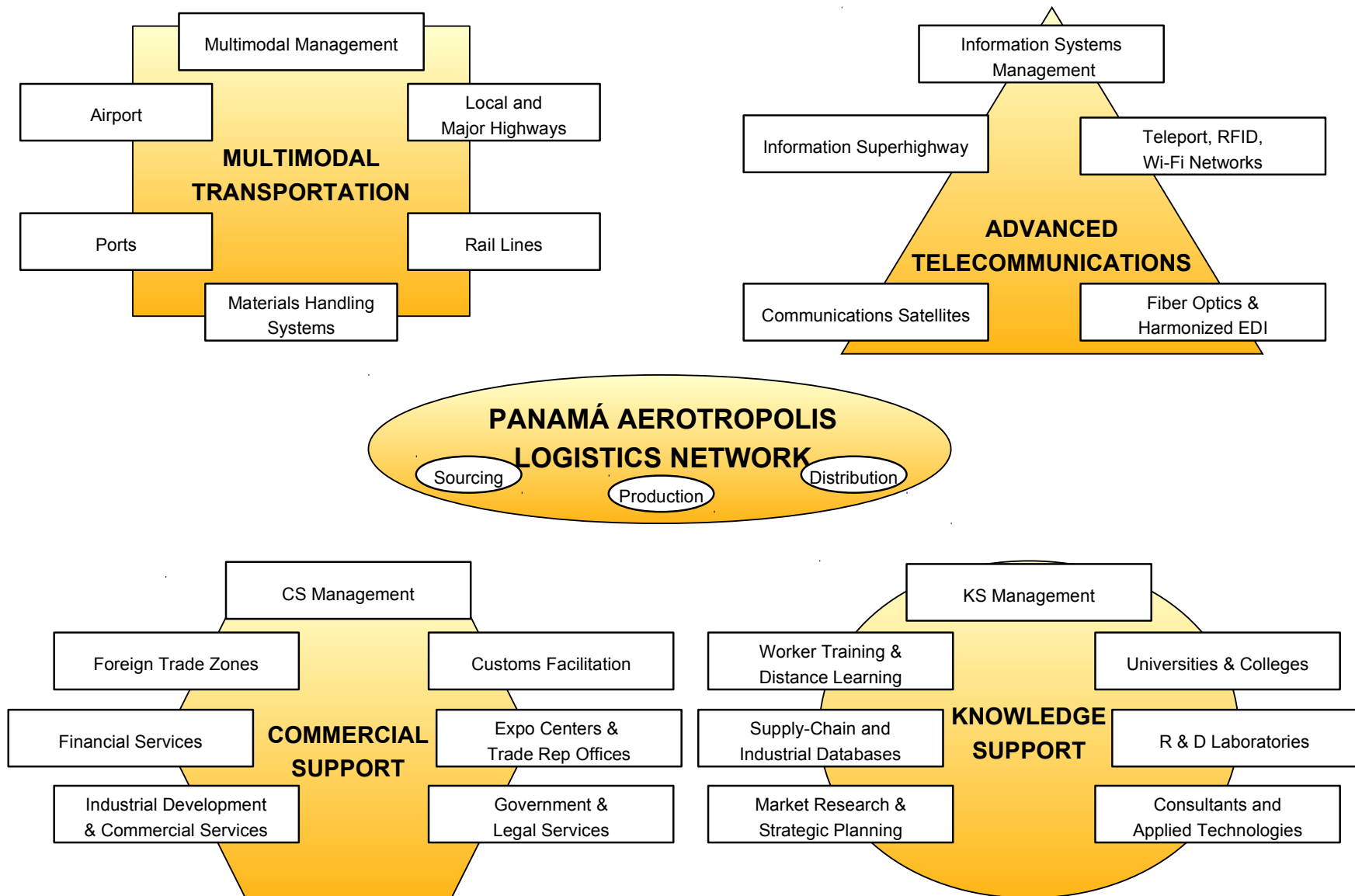
All of the above need to be woven into both the business plan and the implementation plan for PTY and its surrounding aerotropolis. They are not only essential to the marketing effort, but also to developing a successful multimodal air logistics hub and Tocumen Airport City.

3.6 Conclusion

This chapter presented the main elements that should guide development of a full business plan for a TocumenAir Logistics Hub and Airport City as well as for its surrounding aerotropolis, highlighting pertinent findings from related

studies. Emphasis was on creating a competitive business environment at PTY and surrounding areas, business resource needs, critical success factors, marketing strategies and target industries. Key to this competitive environment will be logistics-based capabilities at and around PTY and a Panamá-wide integrated logistics network that provides advantages of speed and agility to perishables and goods-processing firms throughout the aerotropolis region and the nation. In the final Chapter, I will present broader air logistics hub, airport city, and aerotropolis planning guidelines and provide a set of recommendations and action steps to design, finance, develop, manage and operate logistics and commercial sectors of PTY and the greater Panamá Aerotropolis to bring higher levels of returns to PTY, its surrounding Aerotropolis, and the nation.

Exhibit 3.1. Proposed Hard and Soft Infrastructure for the Panamá Aerotropolis



Chapter 4

Tocumen Air Logistics Hub/Airport City Implementation Plan Guidelines

4.1 Introduction

In the previous two chapters, infrastructure and facility plan guidelines and business plan guidelines were provided for a Tocumen Air Logistics Hub (TALH), Airport City, and greater Aerotropolis. Building on these two chapters, this chapter will present guidelines for an implementation plan, including (1) phasing TALH and Airport City development; (2) design standards to promote PTY aesthetics, place identity, and sustainability; (3) elaboration of infrastructure and marketing phasing; (4) incentives to attract and leverage appropriate air service providers and industry; (5) communication, coordination and cooperation among key stakeholders with airport and aerotropolis oversight; and (6) alternative mechanisms for financing and managing TALH development and operation. The latter will public/private partnership approaches to financing and managing the new northern cargo area, pivotal to TALH success. The chapter concludes with 30 recommendations for Tocumen SA, appropriate Panamá government agencies, and other stakeholders/planners to improve

prospects for successful development of the proposed Tocumen Air Logistics Hub, Airport City, and greater Panamá Aerotropolis.

4.1.1 Infrastructure Phasing and Industrial Development Timetable

Whereas the TALH/Airport City is conceived ultimately as a fully integrated multimodal logistics, telecommunications, manufacturing, and logistics support system and airport-based commercial complex, the reality is that it will likely evolve over a 5- to 25-year-period through a series of overlapping development stages. Understanding this is necessary for marketing and to making prudent investments in infrastructure and facilities timed to business, logistics, and industry demand. Below I present initial development actions and guidelines for institutional, infrastructure and facilities implementation, beginning with PTY development needs and then guidelines for greater aerotropolis development.

4.2 Initial Development Steps

The Tocumen Airport City planning and development process should commence a complete land valuation and market opportunity assessments, parcel development priorities, and regulatory approvals. Internal roadways and utility corridors should be laid out and general commercial land use plans

proposed for the next 25 years. This includes confirming, correcting, and elaborating infrastructure and facility locations and development guidelines presented in Chapter 2. A multimedia parcel availability marketing campaign should be operational by August 2012 and initial economic impact analysis underway. Panatropolis, along with other planned nearby developments, should do the same for sectors under their responsibility. Logistics (forwarders and 3PLs), airline, and overall business recruitment efforts should remain high priorities from the start.

During the second half of 2012, site improvements should commence for Tocumen Airport City commercial development, including utilities and internal access roads, facility site grading and soils issues. Additional passenger and cargo service providers should be solicited and additional tenants sought for the new northern cargo and logistics area which will be upgraded.

A broad Panamá Aerotropolis master plan should be fleshed out during the following two years codifying all developable parcels and suggesting their highest and best use similar to what Panatropolis has already done for its property, but extended to areas well beyond this property. Improved highway access projects to the airport area should be accelerated, especially to the northern cargo area.

Apropos broader aerotropolis planning, a three-component roadmap must be developed. This roadmap will (1) strategically assess what to do (as

determined by a comprehensive SWOT analysis), (2) guide aerotropolis infrastructure and facility development, including specifying who will do it and pay for it, and (3) detail how it will get done building on integrated urban planning, airport planning and business site planning (see Exhibit 4.1).

In all three elements, integrated aerotropolis planning must take place vertically (federal and local agency planning coordination), horizontally across jurisdictions in the broader Panamá Aerotropolis, and functionally across the key attributes of urban planning, airport planning, and business site planning (see Exhibit 4.2). These range from integrating master planning processes, to environmental impact assessments, to leveraging commercial cluster analyses.

Regarding the above, all Aerotropolis specified zones and their proposed land uses must be based on solid market analysis, including demand for particular types of commercial facilities based on market trends and opportunities, costs, likely revenue generation, and overall financial feasibility in both the near- and longer-term. This would include a competitor analysis of similar facilities elsewhere in the area and coordination with planned Tocumen Airport City commercial development to insure that outside the airport fence commercial facilities complement rather than compete with inside the fence facilities.

The process would include further analysis and more detailed specification of commercial facilities in the functional zones currently proposed

for Panatropolis along with continuing to pursue potential investors and tenants. Similar to this process (including rudimentary financial pro-forma), a Tocumen Airport City conceptual master development plan should extend the first-order suggestions of commercial facilities I presented in the phased developments in Chapter 2 (see Exhibit 2.25). This should include, among others, land parcelization, functional use designation, design standards that craft an aviation “theme” or brand identity for the Airport City, infrastructure and utilities requirements, and initial renderings of buildings and physical layout, including landscaping.

The aerotropolis master plan should also contain a marketing approach to brand and promote the Panamá Aerotropolis and its functional zones and recruit investors, developers, tenants and users. Panatropolis has already commenced the former for its property but this needs to be expanded over a much broader area.

Related to marketing (and aesthetics), aerotropolis planners should also provide basic design guidelines and environmental standards including initial codes, covenants and restrictions in development for further marketing and promotional efforts (as well as securing local community and federal stakeholder buy-in). An aerotropolis economic impact analysis should be conducted demonstrating potential gains in investment, jobs, incomes, taxes, as well as additional revenues to existing businesses in the Panamá Aerotropolis.

4.3 Fostering a Successful Panamá Aerotropolis

I have observed airport area development around the world and have usually found it disappointing. Much airport-linked development to date has been spontaneous, haphazard, unsightly and ultimately unsustainable, leading to increased airport area highway congestion and choke points, long aerotropolis worker commutes, excess air pollution, and isolated living environments. If overall Panamá Aerotropolis development is to be more efficient, productive, attractive, and sustainable, a physical and social environment should be planned that will:

- Facilitate speedy, seamless multimodal surface connectivity among the airport and both the downtown and major commercial nodes throughout the Aerotropolis.
- Align businesses in proximity to the airport in relation to their frequency of use of it.
- Locate commercial and residential developments that are sensitive to noise and aircraft emissions outside high-intensity flights paths.
- Emphasize aesthetics and cluster development rather than encourage strip development, and provide green space between the clusters.
- Create mixed-use commercial/residential communities where airport and airport-area employees can commute easily to work while residing in affordable, human-scale environments that are supported by retail and service businesses and community facilities.

The Panatropolis plan provides a good model here. Its planing principles should be replicated (albeit on a smaller scale) for other significant developments in the broader aerotropolis.

Regional planning has historically been hampered by a lack of enabling legislation. In the absence of an empowered supra-municipal aerotropolis government body, uniform permitting, zoning, and regulation will remain a matter of negotiation. This really needs to be looked into in Panamá Aerotropolis planning.

To guide growth in a unified and expedient manner, all jurisdictions within the Panamá Aerotropolis and beyond should consider adopting coordinated land use and transportation plans. Perhaps one of the more effective strategies for ensuring compatibility, if not absolute consistency, in local regulations would be to create an informal regional partnership. As a consensus emerges on the broad outlines of the vision, specific zoning and regulations could be enacted to support that collective vision. Not only will such coordinated plans help ensure consistent development in consonance with the general plans outlined in the aerotropolis vision, better planning could expedite the development approval process, reducing considerable cost of contemporary real estate development.

In addition to land use codes and zoning that coordinate with present and planned transportation infrastructure, many regions are considering adopting

form-based codes. While a consistent Aerotropolis “look and feel” is desirable, there is no reason development form must be entirely consistent throughout the Panamá Aerotropolis—or necessarily throughout a particular zone. Form-based codes help localities implement their specific visions. They are a mechanism for informing potential developers of the expectations, avoiding one of the major stumbling blocks to real estate development, and maximizing overall benefit. Such codes complement widespread zoning attention to permitted uses for particular sites and the separation of incompatible uses – which is especially important in airport-linked development that could eventually impede necessary future airport growth.

Coordinated plans are essential to achieving the aesthetic standards that are increasingly required to make large-scale real estate developments competitive. Flexibility is critical, however. Schiphol's Aerotropolis strategy, emerged only after significant private investments, deviating from earlier plans, were already in place. Adapting to market conditions and special opportunities that arise for industrial/commercial development at PTY and in areas miles beyond requires such flexibility. In short, plans should never be set in stone but serve as helpful guidance.

4.4 A Suggested Process for Deciding upon Aerotropolis Design Standards

A large body of research pertaining to aesthetic judgments and urban form exists. Unfortunately, the results are so contingent and the findings so contested that, in general, no clear guidelines for design standards have emerged. Instead, urban design standard decisions are often made by contest. Competitions have been held periodically for airport terminal designs. To my knowledge, only one Aerotropolis design competition has been held for an entire, cross-jurisdictional Aerotropolis. This was held at the University of Michigan's School of Architecture for the Detroit Region Aerotropolis. The competition was part of the school's annual design challenge and resulted in a series of helpful planning charrettes.

The Panamá City area lacks a tradition of design competitions. Nevertheless, I recommend that Tocumen SA and surrounding developers consider mounting a similar design challenge for the Tocumen Airport City and Panamá Aerotropolis, perhaps tailored to the strengths of particular universities and architectural firms in the Panamá City region, and perhaps even internationally.

The purpose of such a competition would be to generate ideas pertinent to specific design challenges facing the Tocumen Airport City and the Panamá

Aerotropolis. A panel of judges and members of the public might also weigh in with opinions. This local community input might contribute useful feedback and greater local citizen buy-in. A public design challenge would also raise the profile of the Tocumen Airport City and Aerotropolis within Panamá (and likely around the world), helping to generate investor interest in these planned developments.

4.5 Phasing and Development Timetable

The short-term (2011-2020), mid-term (2021-2030), long-term (beyond 2030) infrastructure and facility phasing at PTY was described in Chapter 2. The appropriate marketing phasing was described in Chapter 3. Suffice it to reiterate that the phased marketing should not get too far ahead of actual development. Otherwise overall project credibility could be seriously damaged among potential investors and the public.

I had this experience with the North Carolina Global TransPark which came under heavy criticism when actual development lagged well behind what was originally promoted. A similar situation appears to be occurring at Dubai World Central where its marketers hyped the scale of the project and its development timetable only to be in the uncomfortable position with the Emirate's current financial crisis to put the brakes on.

It is also important that infrastructure be in place (or at least guaranteed to be completed) at PTY and the broader aerotropolis when businesses and industries are being recruited to locations where such infrastructure is required. Simply put, no business will be willing to make a major facility investment in an area without this guarantee.

4.6 Providing Appropriate Investor Incentives

Regarding the Tocumen Air Logistics Hub (TALH), since it's ultimately designed to attract and grow industry (outside as well inside airport property), incentives will play a role. To date, Panamá has provided solid financial incentives for business development where investors enjoy tax advantages and other promotional privileges. This includes incentives and tax relief to multinational corporations establishing offices or facilities in Panamá (e.g., Law 41 of 2008), exemption of Panamá income taxes of foreign executives, liberal visa policies, tax stability, and industrial promotion certificates that lowers both tariffs and taxes of companies investing in Panamá.

Virtually all countries are in the incentives game, though, so its relative advantage in attracting major industry is declining. New incentives to attract and grow industry must be pursued. The TALH, itself, can be one of the most powerful incentives. This is because operational incentives will be at least

equally important, and in the longer term likely even more significant, than tax incentives in attracting goods-processing and distribution industries.

What the TALH should be designed to accomplish is to provide Panamá Aerotropolis industries with speed and agility in their supply chain management, unmatched by most other locations. As the TALH evolves through its stages, it will drive greater amounts of commercial and industrial development at PTY and throughout the broader Panamá Aerotropolis. This additional development, in turn, will generate increased volumes of cargo and passengers at PTY via reinforcing airport-aerotropolis synergies.

4.7 Coordination and Harmonization with Similar Facilities Elsewhere and with Key Actors, Government Units, and Organizations

If parts, components, and finished goods are to flow rapidly and seamlessly between PTY (and other transportation facilities within the Panamá Aerotropolis) and facilities throughout Panamá, it is essential that their information technologies and materials handling systems be harmonized. This requires using standardized EDI messages with compatible, open architecture software systems, as described in the prior chapter.

Containerization, as noted, must also be standardized across shipping modes so, for example, that containers arriving at one of Panamá's ports or the

proposed airport intermodal rail facility can be transferred efficiently by truck to the airport or other key nodes in the aerotropolis. Since containers may also be air freighted via wide-body aircraft from PTY, they must be made compatible with materials handling equipment for loading on all-cargo aircraft. Multimodal materials handling harmonization will require close coordination between the TALH and all other modal points.

When purchasing material-handling equipment, and building key infrastructure such as PTY's new northern cargo facility or proposed future intermodal rail facility, careful consultations should be made with major air cargo, sea cargo, and surface cargo handlers throughout world. It would be a terribly expensive mistake not to coordinate design of facilities at the TALH with the predominant technologies, materials handling equipment and space utilization standards at major ports and airports which will serve as Panamá's trading partners.

In terms of recruiting additional air cargo service providers to PTY, it is recommended that Tocumen SA work with major freight-forwarders and 3PLs, and visit other major air cargo hubs to examine systems in operation there. Through the latter, an excellent vision can be obtained of the direction that air cargo handling is taking with a variety of automated and semi-automated cargo operations as well as other processes and procedures being implemented at these airports to speed the flow of goods through the airport.

Let me add that air express companies usually have their own facility design firms. Contact should be made with these companies and advice received before any such facility development contracts are planned at PTY. As a special incentive to a prospective air express or air cargo firm locating at PTY, Tocumen SA may wish to offer to build a cargo facility to suit with a long-term lease-back contract. For example, Amsterdam Schiphol Airport attracted Polar Air Cargo by offering to build a permanent cargo facility to house the airfreight carrier's transshipment needs and then lease it back. The North Carolina Global TransPark acquired a major grant from the State's Golden Leaf Foundation to build the Spirit AeroSystems A-350 fuselage and wing facility at the TransPark and lease it back at a nominal fee.

Finally, it is essential that a process be established that brings all key actors, government units, NGOs, and other stakeholders together with a three-stage outcome: (1) communication, (2) cooperation, and (3) coordination. Without this happening, the whole aerotropolis planning and development process can be set back and potentially jeopardized.

This gets back to the issue of governance and community relations. All stakeholders must feel they are part of development planning from the start. Aerotropolis regions such as Memphis and Detroit in the U.S. have established cross-jurisdictional public-private steering committees to move aerotropolis planning and development forward. Encouraging local community,

environmentalist, and other NGO participation early on can avoid major confrontations and project delays down the road while potentially contributing to a more acceptable, appealing, and sustainable Airport City, logistics hub, and aerotropolis development process

4.8 Placemaking and Branding the New Tocumen Airport City and Broader Aerotropolis

Placemaking and branding are essential elements for PTY and Panamá Aerotropolis commercial development. They are fundamentally processes of marketing communication. In academic terms, these processes signal an underlying reality. The most effective signals are expensive. That is, visible features that could not exist without real place advantages are the best elements of placemaking and branding. Standalone advertising and promotional campaigns, because they are relatively expensive and not integrated with everyday realities, are generally not effective at placemaking and branding. Advertising and promotional campaigns can be effective when the audience can readily verify their veracity and when independent parties spread the message.

Demonstrated success is perhaps the most effective branding strategy. For example, air cargo processors sometimes count the number of trucks in a region as an indicator of their business prospects. Their reasoning is that, if

goods are being moved nearby, they have a chance at tapping into that market. As I noted above, the presence of successful firms in a location is a very effective brand creator. Real estate developers are therefore often willing to make large concessions in order to attract prominent tenants to their properties. In this section of the report, I consider two additional proven placemaking and branding strategies: urban design and concerted visible collective governance actions.

Urban design, a key component of aerotropolis design, is located at the intersection of planning, architecture, landscape architecture, and transport planning. It is primarily concerned with three-dimensional design but human reactions to noise, smell, and feelings of safety/ danger or of being welcome are also important. Each of these design considerations is salient in Airport City and Aerotropolis development.

Sometimes seen as a mediator between architecture and planning, urban design focuses on external space and the relationships between different forms of movement and physical space. Architects have expertise in terminal design and, increasingly, airport site development. Industrial engineers know how to plan manufacturing and logistics facilities. Transportation planners help facilitate the movement of people and goods. Many planners also have experience in analyzing regional land use needs. In between each of those often separate

concerns is a design problem that can significantly affect the economic efficiency, environmental sustainability, and aesthetic appeal of urban areas, the three key objectives of airport city and aerotropolis planning and development.

Surprisingly, many of the basic principles of Airport City design have been known and discussed since at least 1950. Their history even reaches back into the 1920s when Le Corbusier, inspired by Berlin's Tempelhof Airport which was in operation until October 2008, tried to integrate air travel into urban design. The advent of commercial jets created a disruption but even this does not explain the poor planning and urban design surrounding so many airports around the world.

Architecture provides an important component of aerotropolis aesthetics. Another consideration is "wayfinding." As airport cities and aerotropolis regions increase in size and the number of local destinations increases, particularly visiting air travelers need help in finding their way. Moreover, airport access corridors, like passenger terminals, are important urban and regional gateways. Airport access corridors should provide interpretable paths that welcome residents and visitors and lead them to their destinations. They should also reinforce the image and assets of the city and region, rather than detract from them.

Form-based codes should establish general design standards for airport area buildings, walkways, travel lanes, landscaping, and public space. Placemaking and wayfinding enhanced by thematic architectural features, public art, and iconic structures should make aerotropolis developments interpretable, navigable, and welcoming.

These principles and guidelines need to be applied to Tocumen Airport City and the Panamá Aerotropolis as a whole. The problem is more complex, however. PTY needs to be interpretable to goods transportation personnel: the truck drivers ferrying shipments between logistics facilities and airports. Tourists must be guided in a positive fashion, as well. They need to be able to “feel” their paths as they approach. Here is where form-based codes, setting standards for building and landscape appearance, have become an integral component of placemaking and branding both Tocumen Airport City and Panamá Aerotropolis planning and development.

4.9 Institutional and Management Plan for the Tocumen Air Logistics Hub (TALH) Development and Operation

Considerable thought and work has been done to date on appropriate institutional and management plans for financing, developing and operating a multimodal air logistics hub. One approach used in the U.S. is to create a special

public authority to finance, develop, market, and operate the hub complex. This organization is typically semi-autonomous and has authority to control and coordinate all planning, infrastructure development and facility construction to ensure timely completion of the project. The Authority could also negotiate building service contracts needed to manage the day to day facility infrastructure requirements, as are regularly used by the private sector.

The advantages of this institutional option (Option 1) include the following:

- A single organization such as a TALH Authority may be better able to coordinate and manage all aspects of the development of the project since it has a singular focus.
- A single line of authority would perform agency coordination, contact with engineers, designers, construction contractors, tenants, users and suppliers to the TALH.
- The development of the project could be constructed in a series of phases which reflect market demands with limited multiple organizational conflicts.
- The organization would closely coordinate with Tocumen SA and other public agencies on work accomplished to date.
- The creation and hiring of staff and management positions can be flexible according to need, recognizing that some political clout will be necessary to accomplish all Authority objectives.

The disadvantages of this option include the following:

- Adding another layer of government bureaucracy will likely be resisted.

- Special Panamanian enabling legislation may be required to set up the new organization that could take some time.
- The new organization might be staffed by recruiting qualified personnel away from other agencies; and the stewardship role of Tocumen SA would be compromised.
- There is no element of privatization, other than some private-sector representatives, and government funds would be utilized for most shared infrastructure and facility development

4.10 Option 2: Private Enterprise Builds, Operates then Transfers the TALH to Tocumen SA.

A private enterprise could build and temporarily operate the TALC for a stipulated concessionary period (say 30 years) then, in accordance with an agreement with appropriate public sector agencies maintain concessions but transfer ownership of the TALC back to Tocumen SA. This option would eliminate the requirement for Tocumen SA to undertake the initial construction with its own or borrowed resources. The Tocumen SA would provide an exclusive contract with a private enterprise to design, build and operate the TALH complex for a given period of time.

In this option, the private sector could develop the air logistics center using private-sector financing with or without government involvement. They would operate the complex, collect income from the operation and pay a

concession fee to Tocumen SA for a determined period of time before transferring the TALH back to Tocumen SA.

With Option 2, on-site construction would be performed by the private sector and off-site infrastructure (i.e., highways, electricity lines) and utilities (i.e., water lines, telecommunications services) would be provided by the appropriate government agencies. This may require a mandate from governments to the selected firm in this build, operate and transfer (BOT) approach to provide full cooperation to the project.

The advantages of Option 2 include the following:

- The project would be implemented by private enterprise, which may be more efficient, flexible, responsive and productive than government agencies.
- The timing of the development of the project could be accelerated to meet market demand.
- No new organization would have to be established.
- There would be no requirement for local public sector or other government financial resources to the project other than to support the provision of off-site services and external infrastructure.

The disadvantages of Option 2 include the following:

- New legislation would likely be required to enable private sector BOT at PTY.
- The private sector could have difficulty securing adequate financing for development and operating cash flow due to the size and complexity of the project.

- The private sector would expect to make an adequate return on its investment prior to the transfer back of the complex, leading to high service fees and long concessionary periods.
- Local jurisdictions might not be able to provide adequate off-site infrastructure to facilitate the operation of the complex.

4.11 Option 3: Public Sector Builds and Transfers to Private Enterprise

This option is a reversal to the previous alternative. Tocumen SA would be responsible for the construction of the logistics complex and would then transfer it to a private enterprise for operation and maintenance. Government resources finance initial development of the project but would then utilize the market-driven expertise and related financial strength of a private enterprise to market and operate the TALH.

The advantages of Option 3 include the following:

- Public resources can be used to immediately jump-start construction of facilities, commencing with expanding the current TALH.
- No special legislation would be needed and no new organizational structure would have to be established.
- The private sector would not be required to secure significant financing for the construction phase of the project.
- The specific expertise of agencies such as Tocumen SA would be employed in the design and construction phase.

- These agencies would have only limited responsibilities for marketing or operating the TALH, which would be done mostly by the private sector whose core competency relates to commercial real estate development.

The disadvantages of Option 3 include the following:

- Extensive up-front public resources would have to be allocated to the project.
- An appropriate agency beyond Tocumen SA might have to be organized and prepared to coordinate and manage the planning, design and construction of the TALH.
- It would be difficult to construct the project as a phased development. There could eventually be conflict between the private developer and Tocumen SA if construction continued after transfer.
- The need for close and significant coordination during the design and build phase between the private developer and Tocumen SA could create delays and added costs, which in turn could create problems during the transfer process.
- The efficiency, flexibility, relative high productivity and responsiveness of the private enterprise are utilized only during the operating phases of the project.

4.12 Summary Recommendations and Action Steps

Let me conclude by presenting a set of recommendations and action steps for the Tocumen SA, and other local business and government organizations to consider to assist, support, and attract the type of commercial and industrial development to and around PTY leading to a successful Panamá Aerotropolis. I will begin

with strategic recommendations for the nation, followed by the proposed Tocumen Air Logistics Hub (TALH), Tocumen Airport City, and Panamá Aerotropolis, then move to more focused operational, management and promotional issues.

1. It will be increasingly difficult in the future for Panamá as a whole to attract new business and industry and generate quality jobs on cost factors and traditional government incentives. Competitive advantage will come through strategic focus on connectivity, speed, and agility. These should become Tocumen's, the greater airport area's, and the Republic's primary competitive tools.
2. Competitive advantage based on connectivity, speed and agility requires a new economic engine. The engine proposed is a Tocumen Air Logistics Hub (TALH) at Tocumen International Airport (PTY) that will cornerstone and help drive a Panamá Aerotropolis. This multimodal air logistics hub will eventually integrate air, highway, rail and sea transportation modes with advanced telecommunications, sophisticated materials handling systems, and state-of-the-art support services to provide TALH and Panamá Aerotropolis tenants and users superior capability to respond rapidly and flexibly to changing markets in Latin America and worldwide. Upgraded local highways

and airport area roadway connectors, and new rail lines are required to integrate PTY with aerotropolis business clusters and major national and international transport modes. Similarly, state-of-the-art broadband, fiber optics, Wi-Fi, Wi-WAN and satellite uplinks and downlinks are needed for Tocumen's aerotropolis's companies to trace, track, and control product movements, which in the future will increasingly be monitored and managed through RFID (radio frequency identification), GPS (Global Positioning System), and intelligent software agents (via computer chips embedded in products, parcels, and containers).

3. Just as today's most successful business are innovative, flexible, and rapidly responsive, so too must infrastructure and facility master planning and design at PTY and its surrounding Aerotropolis. Master planning of PTY and its surrounding Aerotropolis thus should not be so much a fixed physical plan as it is a flexible framework for accommodating a wide variety of tenants, users, facilities and layouts that can be modified when new technologies, industries, and infrastructure emerge. For example, the future redesigned northern cargo area at PTY should employ a modular layout for maximum flexibility and phased development. On-site cargo processing facilities

should employ flex-tech principles and be reconfigurable to allow for expansion (or even contraction) as demand warrants. Ground transportation systems should incorporate redundant routings to minimize impact of congestion or accidents both within PTY and connecting transport systems. PTY management (Tocumen SA) itself must be agile, prepared to respond rapidly and creatively to evolving tenant and user needs and to coordinate “one-stop-shop” support from a variety of government and institutional sectors to firms wishing to locate in its airport city and northern cargo zone.

4. Panamá Aerotropolis’s intermodal transportation infrastructure should be designed to allow seamless and flexible flows of materials among convergent transportation modes and industrial and other commercial facilities both in the core and peripheral areas of PTY. A future cargo transfer system (CTS) should be considered linking the New Northern Cargo Facility (NNCF) to cargo related tenants throughout the airport as well as to a nearby intermodal rail facility and via future rail spurs to an inland port and onward to Balboa Port. It could connect to Panatropolis as well permitting “thru the fence” efficiencies to its logistics and industrial zone. The NNCF would provide off-ramp PTY tenants and off-site production facilities,

warehouses, and distribution centers with efficient sorting capability, customs clearance, and air freighter access. The new northern cargo facility should be a shared facility available to all foreign aircraft, and if it wishes, Copa.

5. PTY should be served by an upgraded ring road encircling it, providing quick access to all parts of the airport (especially the northern cargo area) and greater aerotropolis to local and national highway systems and to a future intermodal rail facility. Internal roads should likewise be designed efficiently to link the southern portions of the airport to the redeveloped northern cargo area and to the expanded airport ring road and its connectors to Panatropolis and other aerotropolis developments. The updated ICAO master plan should give priority to specifying all such arteries. Traffic congestion and choke points along via Tocumen to Parque Sur and Panatropolis should be addressed not only to solve current problems but to meet much larger traffic flows that will occur in future decades as PTY and the Panamá Aerotropolis grows.
6. The new ICAO airport master plan (or follow-on study) should give attention to engineering, geological and topographical work plan for the 300 hectare Tocumen Airport City and provide first order

estimates of the costs of constructing internal roads, utilities and preparing each for commercial use.

7. The ICAO updated airport master plan should also provide preliminary site design for the entire new northern cargo area so it can obtain an initial feasibility and cost assessment for logistics, cargo, transportation, manufacturing, and commercial infrastructure and facilities recommended at the full build-out phase of the Tocumen Air Logistics Hub (TALH) as described in Exhibits 2.23 and 2.24.
8. Free Trade Zone status should be acquired for the entire TALH, especially the new northern cargo zone. Yet, PTY must be planned as much more than an airport with Free Trade Zones. Its full potential and ultimate success rest on creating a multimodal infrastructure and supporting business environment that will substantially improve sourcing, production, and distribution activities of all its tenants and users. In the longer-term this includes an enhanced automated customs environment operating 24/7 with open architecture electronic data interchange (EDI) capability, and an on-site distance education and worker training facility, one-stop-shop investment support, and high-quality road infrastructure and utilities throughout PTY and its environs.

9. Master planning for PTY and its outlying aerotropolis areas should give high priority to aesthetics and environmental sustainability. PTY must support not only logistics activities but also leisure and business air travelers. To the extent possible, logistics, manufacturing, trucking, and cargo handling should be physically separated from flows of business and leisure travelers. High-quality design standards should be established in the broader airport area for buildings, landscaping, and industrial clusters. Entranceways and signage should be aesthetically pleasing. Since first impressions are often enduring, physical appearance is extremely important. Therefore, to the degree feasible, the TALH and immediate surrounding commercial and industrial clusters should be designed to look more like university campuses or research parks than old-fashioned industrial, warehouse or logistics parks.
10. PTY's accessibility to people and businesses beyond the Panamá Aerotropolis must be improved. Highway upgrades described in Chapter 2 must be pursued vigorously and consideration given to the recommended long-term passenger rail and freight rail access to PTY.
11. Apropos the above, long-term (2030 and beyond) planning should consider bringing a commuter rail line directly to PTY. It is recognized

that this spur will require a huge public investment and that resources and revenue-effective passenger demand may not exist for decades. Yet, if rights of way are not reserved now, this opportunity will likely be lost forever.

12. PTY's passenger terminals are the front door to the country for long-distance travelers. It is therefore imperative that they provide the most positive, attractive first impression. New terminals are coming on-line and on-going internal face-lifts of the existing terminal will help, but some additional external cosmetics are needed. When one looks out the window of aircraft at the airside facades of Tocumen's passenger terminals, they don't give the same "wow" factor as the gleaming, architecturally distinctive airside facades of many new airports in the Asia region. Avoiding costs of major structural changes, I believe that the appearance of the central terminal could be aesthetically improved to give arrivals a more positive visual impression of Panamá's international gateway.

13. Likewise, all main access highways to PTY must be designed and/or improved as more than a fast and efficient transportation links to the airport. They also can serve as a marketing asset and positive first impression builder of the aerotropolis and the Republic. They should

have aesthetic landscaping and visually appealing yet informative signage, including tasteful billboards and electronic art highlighting the culture, history, people and economic assets of Panamá. High design standards for all new structures along the highways and screening of unsightly structures and areas should be considered. Just as PTY will serve as both the calling card and goodbye handshake for over ten million of annual future travelers to Panamá, so too will its primary surface connectors to the airport.

14. Technical and financial feasibility studies should commence immediately on bringing a freight rail spur to the PTY area. Land must be reserved for a future intermodal rail yard and inland port near the northern edge of PTY as described in Chapter 2.
15. PTY has little or no wide-body air freighter service. This limits cargo volumes. As the air logistics hub develops such air freighter service will become more important. To attract wide-body freighters and develop as an international cargo complex consideration should be given to regulatory liberalization such as open skies policy for freighter aircraft, change of gauge rights, co-terminal rights, self-handling rights and possibly even 7th freedom rights, the last enabling

foreign air express and air cargo carriers to establish regional hubs at PTY.

16. Strong efforts must also continue to attract additional international passenger service to PTY. Airlines must be viewed not just as companies, but more as basic transportation infrastructure, no different from roadways and rail. Airlines, like public infrastructure, are shared by all (business, tourists, etc.) providing “highways in the sky” that rapidly connect a country to the world. These highways in the skies are “public good” infrastructures that do not have to be maintained by public money as do roadways and much other public infrastructure. Tocumen SA should consider reducing landing fees and other airline charges as much as possible to attract more air passenger service and additional incentives should be considered, as well.

17. To compensate for its lower airline fees, Tocumen SA should explore further non-aeronautical revenue sources. Following airport city and aerotropolis principles described in Chapter 1, PTY must be thought more in terms of a multifunctional commercial entity. This would involve Tocumen SA developing additional revenue generating activities in its passenger terminals ala Pittsburgh (AirMall),

Amsterdam Schiphol or Frankfurt. Tocumen SA should also move forward on developing its 300 hectare Airport City for additional non-aeronautical revenues. Innovative airport revenue sources might likewise be developed with off-site businesses and industries that would substantially benefit from expanded passenger and air cargo airline service at PTY.

18. Suggestions have been made to commence new or expanded existing international passenger service at Colón's airport. This would likely siphon off passenger and cargo from PTY and make it more difficult for this airport to attain the passenger volumes to expand its international air routes essential to Panamá Aerotropolis success. Any steps to add long-haul international air service at Panamá's other airports should therefore be taken cautiously with the recognition that expanding international air service at these airports (if feasible) may well undercut PTY and the Panamá Aerotropolis.

19. Future marketing of PTY should emphasize the importance of its logistics-based capabilities in attracting time-sensitive goods-processing businesses. Such businesses will certainly continue to seek traditional investment incentives such as tax relief, investment offsets for land or facilities and subsidized workforce training. However, as

noted above, as the competitive priorities of connectivity, speed and agile market response grow in importance, the relative power of traditional government incentives will lessen. Increasingly, firm siting decisions will be made at least as much on the basis of logistical capabilities of the site and access to regional and global networks as on traditional government incentives. Such logistics-based marketing must be based on development realities of PTY, though, and therefore phased, predicated on its stage of logistics capabilities. In each phase, the marketing effort should be designed to attract a targeted segment of PTY tenants and users based on capabilities offered at the phase which, in turn, would serve as a catalyst to attract additional complementary firms to the complex and surrounding Aerotropolis.

20. Attracting time-sensitive manufacturing and distribution industries will require a thorough understanding of modern supply chain management principles and the fast-cycle logistics. To offer a truly marketable competitive advantage, Tocumen SA with the assistance of Panamá's universities and economic development agencies, should bring together experts in logistics and supply chain management, multimodal infrastructure development and information technology to help design applications that would properly integrate and leverage

all PTY elements for fast-cycle logistics. Few locations in the world are doing this, so PTY can have a first-mover advantage in attracting logistics, high tech, high-value perishables, and other time-critical industries if it takes the lead in seizing this opportunity.

21. Tocumen SA has three options for its new northern cargo area operation: (1) complete managerial control, (2) outsource control to a 3PL, and (3) create a joint venture or PPP with a sophisticated 3PL clearly specifying the division of labor and responsibilities. In all cases, FTZ status should be sought for the new northern cargo zone. Since effectively and competitively operating an airport FTZ now requires sophisticated 3PL services, it is recommended that Tocumen SA explore forming a strategic or joint venture partnership with a world-class 3PL that has demonstrated superior FTZ management and operational skills.
22. Tocumen SA should establish a close working relationship with major corporate relocation and site selection consultants, making them aware of PTY's land assets in its airport city and northern cargo area, and regularly updating them on development progress. In most cases, large companies looking to expand or relocate rely on site selection specialists to provide them with a short-list of potential locations to

choose from, along with the location's strengths and weaknesses.

Likewise, major commercial real estate firms such as Colliers International, CB Richard Ellis, and Jones Lang Lasalle and international real estate investment trusts (REIT's) such as Prologis often work closely with multinational corporations in their site selection and eventual commercial development.

23. Because entry appearance, project architecture and other symbols also send an important message, all PTY gateway entrances should receive special emphasis in design and image appearance. These entries must set the tone for the development within which the PTY's and its Airport City's identity will be reinforced through distinctive building architecture, signage, landscaping, and roadway configuration. Form-based codes should set design standards and assist in "way finding" and "placemaking" as described earlier in this chapter. New electronic art technologies with laser lighting designs might be used to project the airport's and aerotropolis' image in a futuristic, but non-gaudy manner. Aerotropolis themed design standards need to be incorporated into surrounding local developers' plans as well as the PTY's Airport City site design standards. This "image-making" or branding is a pivotal marketing strategy.

24. There are lessons to be learned by Tocumen SA and Panamá's economic development agencies from commercial development approaches around Amsterdam Schiphol Airport. Recognition by local jurisdictions in the Netherlands that Amsterdam Schiphol Airport was at the center of an expanding territorial complex of airport-linked industrial and commercial development led to the establishment of a public-private partnership to guide the development of available sites near the airport. This organization – the Schiphol Area Development Company (SADC) – directly manages some of these projects while coordinating others. It also operates as an informal development assistance agency for the broader Schiphol aerotropolis.
25. Whereas creating an inter-jurisdictional development organization such as SADC may not be well received in an area already served by a number of public economic development agencies, it is recommended that a non-bureaucratic alternative be implemented to improve chances of coordinated efforts. One would be to institute periodic working sessions with local jurisdictional officials, executives of PTY and greater aerotropolis developers to inform them better about the nature of airport-linked development and explore how their specific

jurisdiction or development might complement and leverage that taking place at PTY.

26. Tocumen SA should give priority to a marketing and development plan for its 300 hectare Airport City to achieve objectives as noted in Chapter 2. In addition to designing and constructing all infrastructure and utilities needed, new approaches to attracting investment must be pursued that will provide incentives to the commercial real estate and investor community. It is my assumption that Tocumen SA cannot pay commissions to private sector realtors or site selection consultants for investment they bring to airport property. Very few for-profit entities are willing to promote someone else's project without remuneration. Likewise, most potential investors want to own their property and this does not appear possible at PTY. New legislation or very innovative ways to address these current constraints are required for the commercial real estate development at PTY in a timely manner. In addition to being able to pay commissions to realtors and site selection consultants, PTY property investors should be given options for 30 plus 30 year renewable leases should they not be able to own their site.

27. Powerful environmental movements are spreading that could threaten commercial aviation and airports on a range of noise, local pollution, and global greenhouse gases issue. Tocumen SA and its nearby developers should take the lead in green airport planning and area development. This will position PTY and the Panamá Aerotropolis favorably during likely intensifying debates on aviation and airport impacts on the environment. New master planning should consider these issues.
28. Panamanian government officials have a responsibility to guide land-uses around PTY so that they leverage and are leveraged by the airport. Encroachment by residential development and conflicting land-use that could hinder required future airport expansion must be prohibited through stricter zoning and enforcement of this zoning.
29. It is further recommended that a new Panamá Aerotropolis planning approach be taken that integrates airport planning, urban planning, and business site planning. As was illustrated in Exhibit 4.1, this integrated planning approach would involve strategic assessment (what to do?), decisions and guidance (who will do it?), and implementation (how will it get done?)

30. Early in Panamá Aerotropolis planning, it is essential that a process be established that brings all stakeholders (Tocumen SA, Copa Panatropolis, the Civil Aviation Authority, Ministry of Economics and Finance, NGOs, airport area local governments, etc.) together with a three-stage objective: (1) communication, (2) cooperation, and (3) coordination. Without this happening, the whole aerotropolis planning and development process could be set back and jeopardized. An aerotropolis will form and grow regardless of such joint efforts but it will not form and grow in an organized, mutually efficient and beneficial manner.

Exhibit 4.1. Three Stages of Aerotropolis Planning and Development

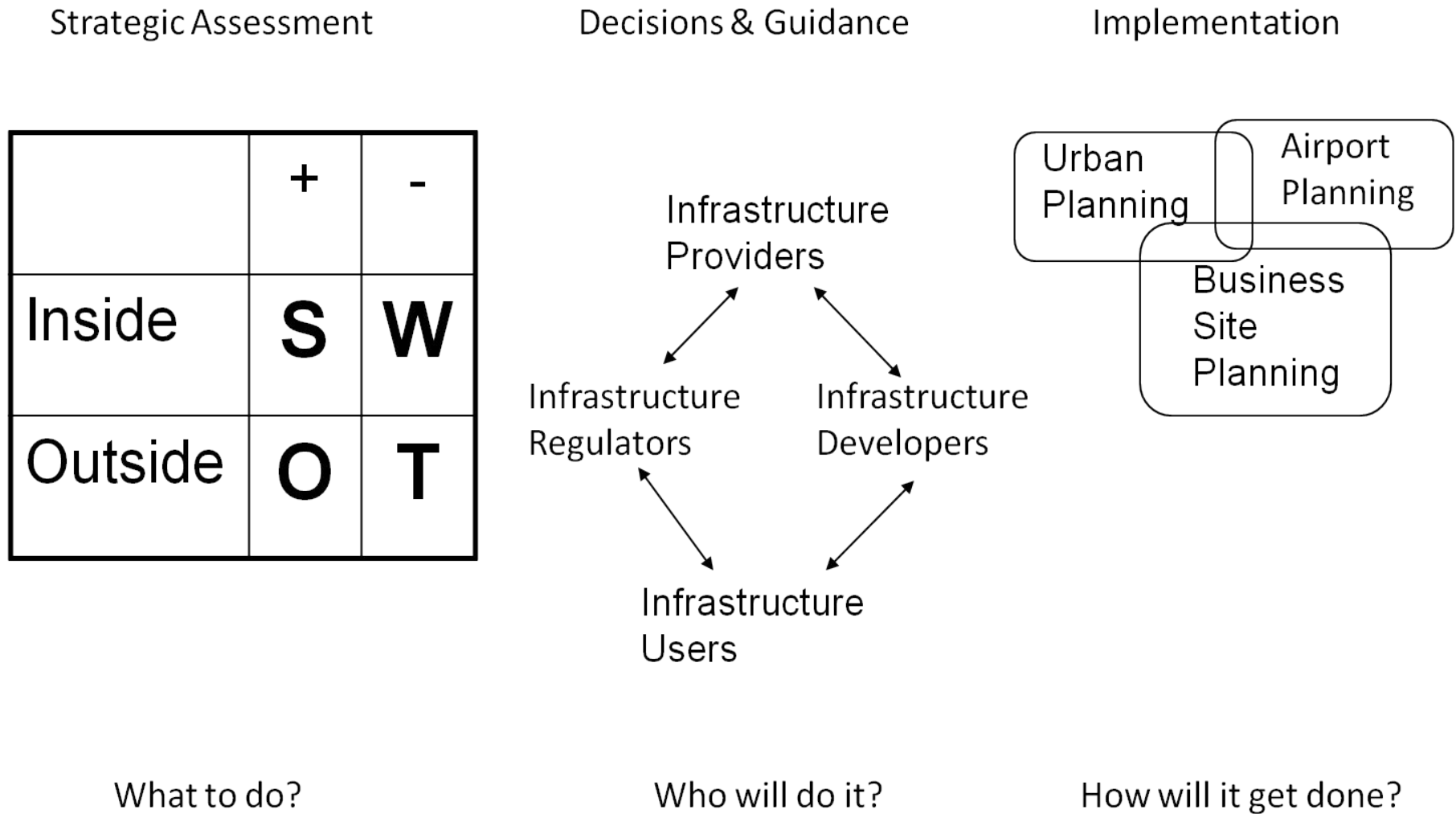
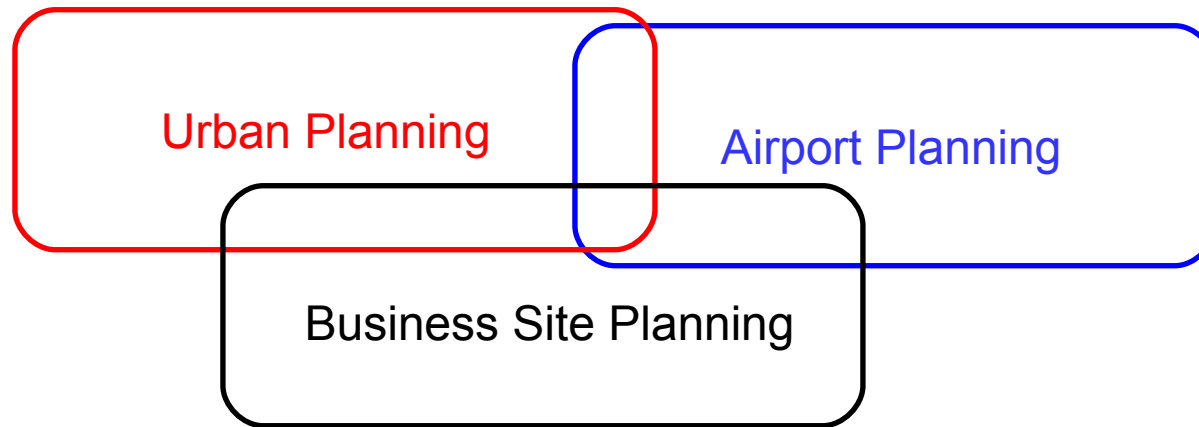


Exhibit 4.2. Integrated Aerotropolis Planning

- Ground transportation planning
- Land use planning
- Environmental impact assessments

- Master planning
- Traffic generation
- Facility and infrastructure planning



- Investment planning and risk analysis
- Regional positioning and marketing
- Cluster analysis