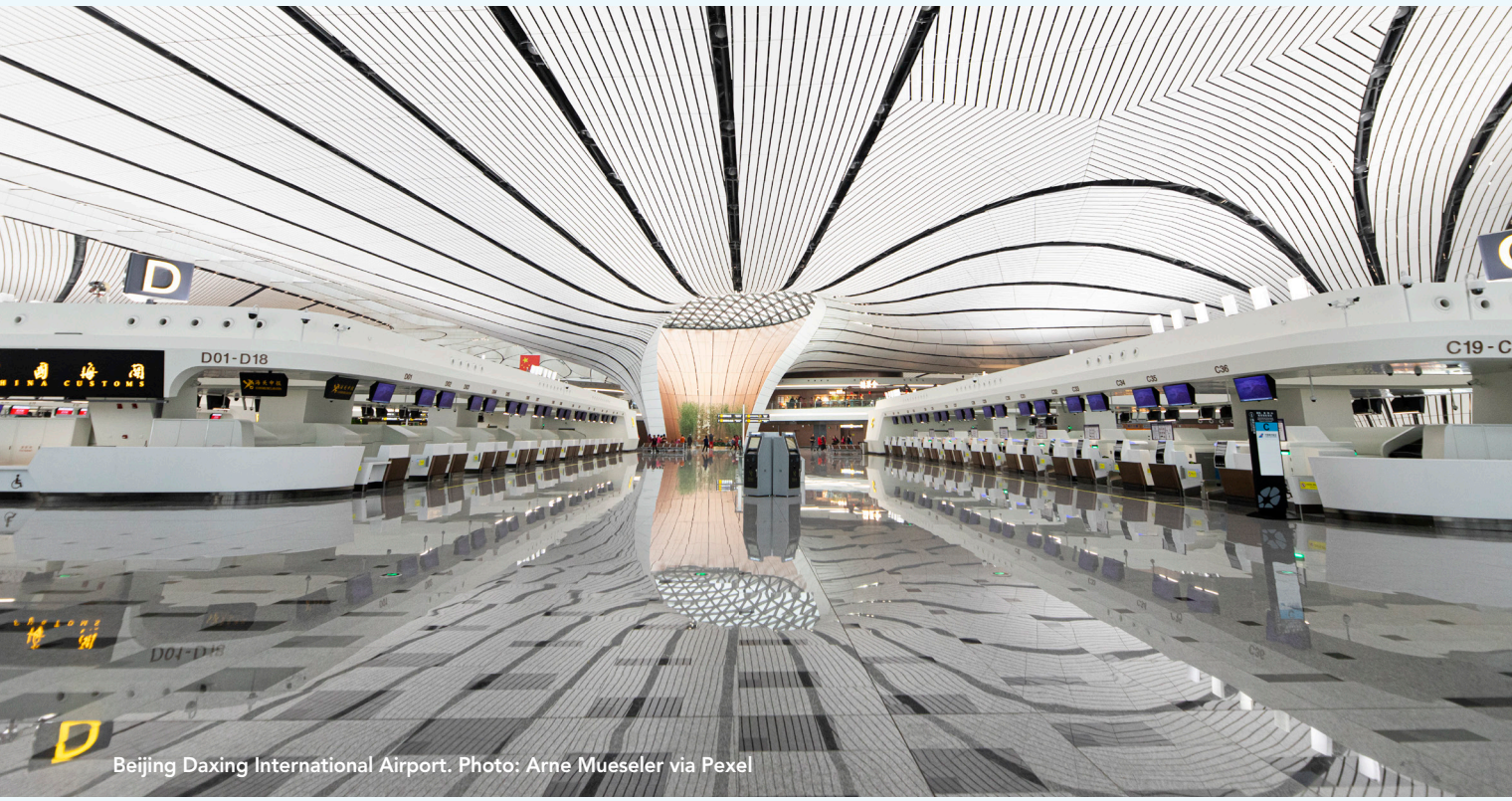


Beijing Daxing International Airport. Photo: Arne Mueseler via Pexel

FUTURE AIR HUB: NAVIGATING THE POST-PANDEMIC LANDSCAPE

Text by Joshua Ng, Alton Aviation Consultancy

Air hubs have been a vital component of the aviation industry for decades, serving as central points in the implementation of hub-and-spoke airline models. The COVID-19 pandemic, however, undermined the basis of this notion, as international travel demand plummeted and protocols favoured point-to-point travel for commercial air passengers.

As the aviation industry looks towards recovery and the future, air hubs will face new challenges and opportunities. In this *Aerospace Singapore* feature, Alton Aviation Consultancy explains and illustrates the continued importance of air hubs in the post-pandemic era. The fundamental drivers, emerging trends and future-proofing strategies that will shape successful air hubs will also be explored.

AIR HUBS - KEY TO FACILITATING AIR CONNECTIVITY

Connecting traffic, stimulating untapped demand

A key value proposition of air hubs is connectivity. Connecting flights offered by air hubs provide dual advantages for air travelers. First, they offer a more cost-effective alternative to non-stop long-haul travel, given the propensity for airlines to discount connecting itineraries. Secondly, they are often the only link between two city pairs which lack sufficient demand for direct flights.

COVID-19 had severely disrupted connecting traffic as border restrictions reduced international travel demand and limited air hubs from serving foreign connecting traffic. Airlines also reduced service levels significantly, which in turn, diminished available itineraries for the average traveler.

With the lifting of border and other COVID-19 related restrictions and the restoration of routes and destinations, we can expect that the fundamental benefits of lower costs and more efficient routings will remain tangible savings and important considerations for air travelers, putting air hubs on firm footing in the post-pandemic era.

A passenger using the touchless e-security gate at Hong Kong International Airport. Photo: HKIA

Retaining local traffic, driving volume

Historically, strong air hubs have captured a larger share of local traffic, anchored by their hub carrier(s). Changi Airport in Singapore and Hong Kong International Airports are two examples of such hubs, capturing a significant share of international connecting traffic in the Southeast Asian region. These airport hubs tend to retain a much higher level of local non-stop traffic, as indicated by a lower percentage of "origin and destination" (O&D) spillover to other airports.

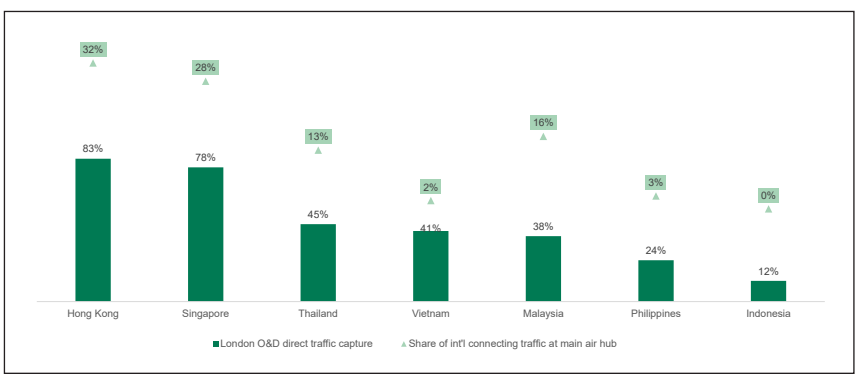
The London route provides a clear illustration of this. Hong Kong and Singapore, powered by their hub carriers Cathay Pacific and Singapore Airlines, respectively, have shown to be able to retain over 75% of O&D traffic on this route. This is not the case for passengers originating from countries such as Thailand, Vietnam, and Malaysia, as more than 50% of them opt to transit at a different airport.

Accommodating Next-Generation Aircraft

In recent years, the introduction of smaller widebody aircraft like the Boeing 787 and Airbus A350 has offered airlines the potential to fly longer, thinner routes at unit costs similar to those of "traditional" large widebodies like the A380, 747 and 777. New-generation long-range narrowbody aircraft like the A321XLR – due to enter service within the next few years – may further disrupt the market as they offer airlines the ability to operate medium-haul routes with lower demand and still maintain profitability, enabled by much lower trip costs.

Despite the introduction of such new generation "hub-busting" aircraft, the air hub is expected to remain functionally relevant as a key node in the air transportation network. The 787 and A350, for example, have enabled the inauguration of several previously un-served intercontinental routes. Yet, the majority of these routes are still operated between major air hubs or from air hubs to major end markets, as evidenced in the accompanying chart (Exhibit 2).

Exhibit 1. Southeast Asian Hubs: O&D Traffic Capture of Direct London Traffic, 2019



Source: Alton analysis, Cirium

In many cases, this new generation of aircraft has enabled hub airlines to operate trunk route services between hubs at higher frequencies to provide more attractive schedules, for example, replacing a single A380 service with two 787 services to meet the demands of business travelers. In the same manner, the A321XLR will also present new opportunities for hub carriers to start services to previously unviable medium-haul destinations or optimize capacity on existing routes. We can anticipate that air hubs and their airline partners will continue to adapt their networks to leverage new aircraft technologies for improved efficiency and better offerings for consumers.

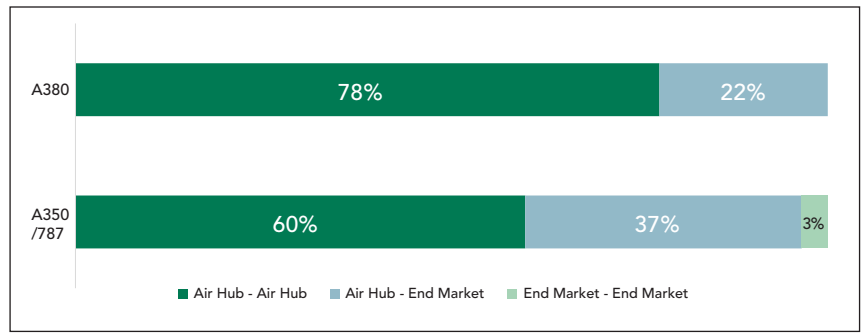
COVID-19: IMPACT, SILVER LININGS AND OPPORTUNITIES FOR AIR HUBS

Planning & positioning for competitiveness

COVID-19 had a devastating impact on long-haul international travel and by extension, connecting passenger volumes. In addition to restrictions which curtailed local O&D traffic, many air hubs were forced to suspend transit passenger operations as governments put in place transit bans on foreign travelers. As the number of services at air hubs fell, so did the number of possible connections and thus their overall connectivity levels.

During this time, several air hubs, most notably in the Middle East, strived to maintain their levels of connectivity. By implementing favourable government policies and leveraging their central location, these air hubs were able to provide much-needed connection to travelers, especially those traveling between secondary and tertiary markets. These airports became the de-facto gateways to countries whose national carriers had suspended most services. Consequently, these air hubs have found it easier to restore service levels to pre-COVID levels once air travel activity ramped up.

Exhibit 2. A380 vs. A350/787 Available Seat Kilometres (ASKs)[1] by Route Type



Source: Alton analysis, Cirium, OAG
Note: [1] Based on schedules filed for IATA S22 season

Focus on cargo and logistics infrastructure

In the absence of passenger traffic, air hubs, including both airlines and airports, shifted their focus towards developing their cargo businesses, which remained largely robust.

This was driven by multiple external factors, including consumers' heightened demand for goods over services during the lockdowns, driving the already high growth segment of cross-border e-commerce. Pandemic-induced supply chain issues also boosted air cargo demand with the spillover from other affected modes of transport such as sea freight. Combined with a sharp reduction in supply of air freight capacity due to a loss of passenger aircraft belly hold capacity, cargo airlines began to record new highs in yields and profits.

Exhibit 3. Passenger Network Development of Select Major Air Hubs

No. of destinations	Dubai (DXB)	Doha (DOH)	Frankfurt (FRA)	London (LHR)	Hong Kong (HKG)	Singa-pore (SIN)
Pre Covid (Dec 2019)	224	167	254	188	165	153
During Covid (Dec 2020)	174	149	186	162	83	77
Present (Dec 2022[1])	218	169	231	182	114	121
Net Gain/Loss over 3 years	**-6**	**+2**	**-23**	**-6**	**-51**	**-32**

Source: Alton analysis, Cirium
Note: [1] Filed airline schedules for Dec 2022 as of July 2022

In pivoting to cargo, major air hubs such as Brussels, Frankfurt, Chicago O'Hare and Singapore capitalised on the global rush to distribute vaccines. While many of these air hubs had cold-chain capabilities pre-COVID, the stringent temperature and shock tolerance constraints of COVID-19 vaccines required further investments and improvements to their existing capabilities. Such investments will provide these hubs with a competitive edge in cold chain logistics in the post-pandemic era.

Automation and digitalisation of processes

During the pandemic, airports had to contend with lockdowns and safe distancing measures, which reduced workforce on site. Such developments were a catalyst for air hubs to accelerate digitalisation and innovation efforts to improve manpower efficiency while maintaining a safe and sanitary environment. Air hubs rolled out automated check-in and baggage drop kiosks, as well as automated security lines, which reduced human-to-human interactions. Touchless technologies, such as facial recognition during the immigration process, also saw increased adoption at air hubs.

Additionally, due to the highly sensitive nature of COVID-19 vaccines, many vaccine manufacturers requested for increased visibility on vaccine shipment status. This led several air hubs to explore the implementation of new technology such as air cargo community systems (ACCS), which provide air cargo stakeholders and shippers with real-time end-to-end visibility on shipments across the entire value chain – using cloud-based applications to optimise operations and fully digitise the supply chain. All in all, air hubs that have been spurred to implement automated and digitalised processes are better equipped for post-pandemic challenges such as higher costs and manpower shortages.

KEY TRENDS SHAPING THE FUTURE OF AIR HUBS

Sustainability-driven air hub

Decarbonisation will be a core theme in the ongoing transformation of air hubs as countries and regulators around the world commit to net zero emissions.

Air hubs must begin to explore environmental sustainability by considering transitioning their energy requirements to carbon-free sources of energy, such as renewables. Solar energy arrays, for example, are well-suited to the wide swathes of land and terminal roof areas of airports. Air hubs situated in areas of high solar irradiance are particularly suited for these applications, an example being Delhi Indira Gandhi International Airport (DEL), which transitioned to solar and hydro power for 100% of its energy needs in June 2022, achieving the highest ACI airport carbon accreditation level in the process.

There are several other ways through which air hubs can improve sustainability standings, from water consumption reduction initiatives to the use of environmentally friendly asphalt and concrete produced using low-carbon processes, to encouraging the electrification of ground support and ground handling equipment. Air hubs can also consider leveraging local geographic and climactic features to facilitate net zero air hub emissions. Stockholm Arlanda Airport, for example, utilises water from a nearby underground aquifer to heat and cool terminal operations throughout the seasons to provide significant reductions in heating and cooling energy consumption.

Support infrastructure for decarbonisation

Increasing scrutiny and focus on carbon emissions from the air travel industry will drive demand for cleaner modes of transportation both in the air and on the ground. For air hubs, this entails planning for the infrastructure to support these energy transitions. The table at Exhibit 4 outlines the latest industry expectations around entry-into-service (EIS) dates for new propulsion technologies by aircraft category. Air hubs should be at the forefront of planning for adoption of these technologies.

Finnair Cargo's cutting-edge Cool terminal at Helsinki–Vantaa Airport. Photo: Finnair

Exhibit 4. Timeline of Adoption for New Propulsion Technologies

	2025	2030	2040	2050
Commuter 9-50 seats <60 minute flights <1% of industry CO2	SAF	Electric and/ or SAF	Electric and/ or SAF	Electric and/or SAF
Regional 50-100 seats 30-90 minute flights ~3% of industry CO2	SAF	Electric or Hydrogen fuel cell and/or SAF	Electric or Hydrogen fuel cell and/or SAF	Electric or Hydrogen fuel cell and/or SAF
Short-haul 100-200 seats 45-120 minute flights ~24% of industry CO2	SAF	SAF	Hydrogen combustion and/or SAF	Hydrogen combustion and/or SAF
Medium-haul 200-250 seats 60-150 minute flights ~43% of industry CO2	SAF	SAF	SAF	SAF and potentially Hydrogen
Long-haul 250+ seats 150+ minute flights ~30% of industry CO2	SAF	SAF	SAF	SAF

Source: Alton analysis

In the near-term, sustainable aviation fuel (SAF) has shown considerable promise as a "drop-in" solution to tangible reductions in carbon emissions. SAF requires little to no modification of existing fueling systems at airports, including aircraft propulsion and fuel delivery systems. Nevertheless, significant investments are still required in the production and supply chain infrastructure to support this shift. Several major air hubs worldwide have begun initiatives to make SAF available for use.

In the long-term, hydrogen remains one of the industry's promising propulsion energy sources to drive decarbonisation of the industry. OEMs such as Airbus and Embraer are currently working on development of aircraft powered by hydrogen. Given that hydrogen, whether in gaseous or liquid form, requires a complete new set of infrastructure as opposed to conventional jet fuel and SAF, it is crucial that air hubs begin to evaluate the implementation of such systems in long-term planning to ensure supporting infrastructure is in place should the technology reach maturity.

With the gradual introduction of new technology such as electric and hydrogen aircraft, air hubs are poised to be the initial proving ground and lead industry's pivot towards greener energy. The low fuel weight of electricity and hydrogen allows for efficient refueling without adding significant weight to the aircraft's operation, enabling full-load fuel capacity to be carried on board for both legs of the journey (subject to the aircraft's range capabilities). Therefore, even if the destination airport may not yet have the necessary infrastructure in place to refuel these types of aircraft, air hubs equipped with the necessary fuel infrastructure will allow for the seamless operation of these greener aircraft.

Multi-modal transport initiatives

Airlines have long sought cost-effective means to expand the reach and effective catchment at their main hubs. This trend has been most evident in Europe, with airlines placing their codes on regional train services connecting the main air hubs to surrounding suburbs or cities. The recent focus on reducing carbon emissions from air travel has prompted European carriers to reduce domestic and regional flying, leading to increased collaboration in multi-modal partnerships such as rail-to-air and sea-to-air connections (less prevalent). These partnerships offer similar benefits to air hubs by expanding their catchment area.

Multi-modal transport partnerships provide a seamless travel experience for passengers by offering unified access to ancillary products, loyalty program benefits, and efficient service recovery options in case of disruptions. This integration not only benefits passengers, but also offers potential for growth in air cargo development. In logistics, road-to-air and sea-to-air transfers are commonly used to balance cost and speed of delivery. To effectively position themselves as multi-modal transport hubs, air hubs must undertake strategic operational and infrastructural planning.

Integrating Advanced Air Mobility (AAM)

Air taxis can potentially add another layer to the multi modal and green infrastructure of airports. There are several considerations when it comes to an air hub's strategy for AAM. Hub airports with strong local O&D demand may require both intercity and intracity AAM routes to enhance their traditional airline network and multi-modal transport networks. On the other hand, smaller airports may leverage AAM as feeder services to existing flights, or pitch AAM to enlarge the addressable market for potential new services.

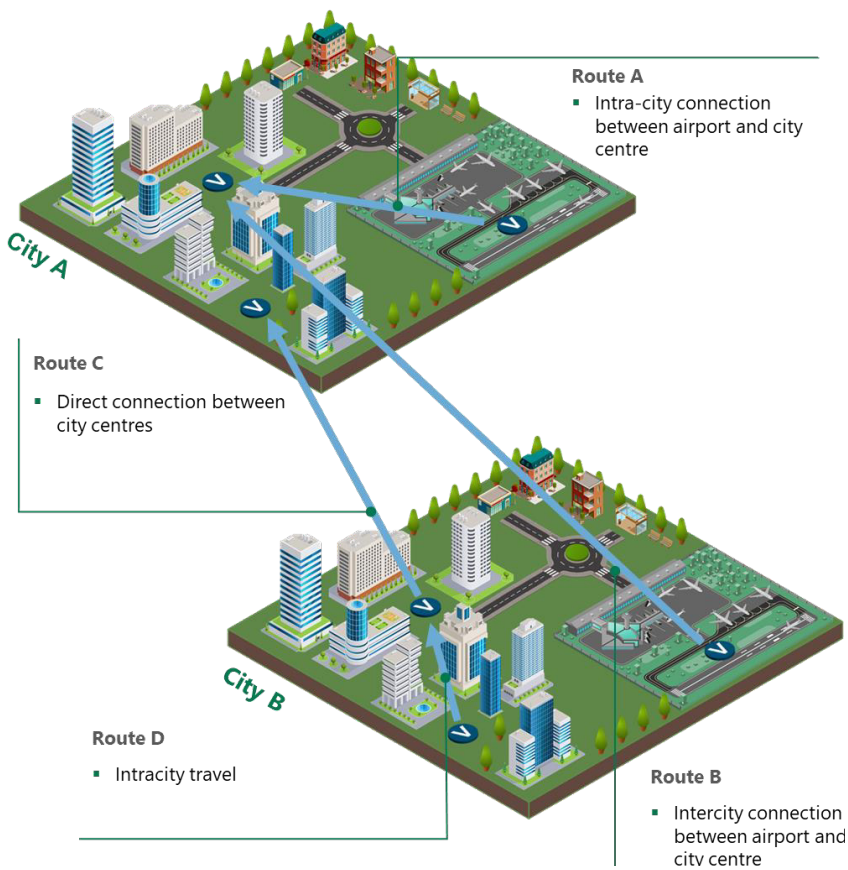
Air hubs will need to evaluate overall network strategy in considering the future role of AAM in their respective ecosystems. A balance should be struck between integration and operational costs, while ensuring that traffic stimulation will outweigh any potential cannibalisation of existing routes. Hubs should also consider the affluence of its core catchments in evaluating AAM services, given that initial unit costs of AAM is expected to be much higher than existing commercial air services, making it more suited for corporate and premium travelers who are able to afford a premium for shorter journey times.

As of today, airspace management systems and flight planning are largely focused on single-aircraft optimisation, with the outcome focusing on the best available flight plan optimised for cost and network considerations. As AAM will require a quantum shift in airspace management, regulator support for reform of air traffic management protocols will be key to ensuring operational success.

With the potential for future airspace to be further populated by smaller aircraft such as AAM systems, community-based traffic systems in which users have flexibility to manage operations within set constraints may become the norm. Air hubs should be prepared to embrace collaborative tools to support the optimisation of airspace, especially as it becomes increasingly congested. Such systems would be predicated on layers of automated information sharing and data exchange between operators, vehicles, and ANSPs.

SAF being loaded directly onto departing Singapore Airlines aircraft in July 2022. Photo: ExxonMobil Asia Pacific

Exhibit 5. Potential AAM Service at Air Hubs



Source: Alton analysis

CONCLUSION

Despite recent challenges, air hubs will be key players in the commercial air transport value chain moving forward, as connecting traffic will continue to be a major component of intercontinental and long-haul travel. Nevertheless, achieving success as an air hub in the future will require more than just a strong commercial flight network. Rapidly developing trends such as the drive to sustainability, a new generation of air vehicles that offer a step-change in mobility within an airport's catchment, as well as the advent of multi-modal transport hubs will shape the development of existing and aspiring hubs. With increasing digitalisation of processes and the continued relevance of pandemic-related health and safety concerns, air hubs must adapt to stay ahead. The persistence of de-globalisation may also impact the role of air hubs in regional trade and connectivity, making it crucial to have a well thought out strategy.