

Air Passenger Networks and the Trans-Pacific Spatial Economy

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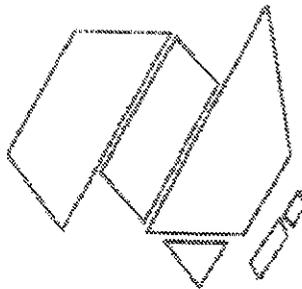
Abstract:

The emerging Trans-Pacific economy is examined through an analysis of air passenger networks. Initially a study is made of changes in networks between 1979 and 1989. Interest is then centred on short-term developments by focusing on technological changes, new airports and passenger reservation systems. Finally, attention is directed to the likely emergence of wayports in 2040 as the ultimate expression of the globalisation of the hub-and-spoke system that originally took root in the United States following the deregulation of airlines.

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Since the late 1960s a Trans-Pacific economy has emerged dependent upon the shift of direct foreign investment by transnational corporations from primary commodity production through import-substitution to export-led manufacturing. Within the Pacific Rim the bulk of this investment has been focused on East and Southeast Asia and, until the mid-1980s, most came from corporations with headquarters in the United States and Europe. Since then it has been dominated by direct foreign investment from Japan and Asia's newly industrialising economies, Korea, Hong Kong, Singapore and Taiwan. Although the United States has been targeted by investors to maintain access to markets most off-shore, labour-intensive manufacturing has been directed to locations in the Association of Southeast Asian Nations (ASEAN) which offer lower wage and other production costs. As reflected in the spread of the micro-electronics, motor car and construction industries, initial attention in ASEAN was directed to Thailand and Malaysia but it has now shifted to Indonesia, with the Philippines still largely ignored by investors. Increasingly, national economies have lost influence to global network corporations with intra-company personnel, goods and information linkages spanning the Pacific.

The emergence of a Trans-Pacific economy orchestrated by transnational controllers of money, goods, services and information flows raises a series of issues. How has this economic transformation polarised the spatial pattern of development? How can core and peripheral areas of this new economy be recognised? More specifically, how can a hierarchy of nodes in international networks be identified? How will these international networks develop over the next ten or fifty years?

These issues are addressed by using network analysis (see also Dick and Rimmer, forthcoming). Variations in economic activity are reflected in international network structures (or pattern of flows). The density of international networks (or intensity of flows) reveals a hierarchy of nodes. The core can be defined as where international networks are most dense (or the intensity of flows greatest). Conversely, the periphery can be identified as areas of low density (or low intensity). There is, however, no clear-cut distinction between the core and periphery. Gaps can occur in the former and major nodes in the latter.

An exploration of the effects of the so-called globalisation of the Trans-Pacific economy on the region's spatial structure can be undertaken by network analyses of emerging international transport and communications modes. Rather than undertake a series of cursory network analyses of specialised and general cargo shipping, land

transport, and telecommunications provided by satellite and optic fibres to show how national and local development are integrated into the global economy, interest here is centred on aviation. Even then, scheduled cargo flights are excluded and attention directed to the international network of passenger transport services. A concentration on air transport is warranted given the limited opportunity for international travel for business or pleasure by surface transport outside Mainland China and the Malay Peninsula. The dependence on air transport of large Pacific Rim population centres, such as Los Angeles, Seattle, Singapore, Sydney and Vancouver, is heightened by their limited hinterlands (O'Connor and Scott, 1991). As gateways on the international passenger air network, airports are pivotal to the development of a worldwide hierarchy of 'control centres' by global network corporations.

Between 1970 and 1986 the average annual growth of the Pacific Economic Zone's passenger traffic was more than 10 per cent compared with 6 per cent for the world as a whole (Westlake, 1992a, b). There is, however, no consensus between predictions of future growth. McDonnell Douglas, the aircraft manufacturer, anticipates world growth to the year 2010 to be 7.7 per cent compared with 11 per cent for the North and mid-Pacific, 10 per cent for Intra-Asia and 8 per cent for Far East-Europe. The International Air Transport Association (IATA) forecasts that Asia-Pacific traffic will grow between 10 and 14 per cent until 1995 and will double its share of all scheduled traffic to 40 per cent by the year 2000. The fulfilment of these forecasts would be sufficient to boost passenger numbers on scheduled flights from 89 million in 1990 through 132 million in 1995 to 189 million in the year 2000. By then, Asia-Pacific's share of the world's airline passengers will have increased over the decade by 8 per cent to 39 per cent with 51 per cent being anticipated in 2010. Before considering short-term developments in the early twenty-first century and long-term predictions for 2040, the magnitude of likely changes is derived by examining changes in linkages between 1979 and 1989.

1. Past Patterns

Interest in comparing air passenger networks in the Trans-Pacific economy is focused initially on non-stop services which exceeded more than twenty flights per month in August 1979 and 1989 (see O'Connor and Scott, 1991 for a discussion of post-war development prior to 1979). Interpretations based on the *ABC World Airlines Guide* (ABC, 1989a, b) for these months are difficult. There is no correlation between

passenger traffic and the size of a city's population for tourist centres, stopover points on intercontinental routes or hub airports acting as intercontinental gateways. Since the mid-1980s, however, hub airports have outstripped the growth rate of other airports (CAIC/ITSUCB, 1992: 2-7). Some centres are being superseded as hubs or stopover locations, because changes in technology permit airplanes to travel longer distances without refuelling. Although business travel was prominent in the late 1970s, it has been eclipsed by the growth of tourism in the late 1980s, notably from Japan, Korea and Taiwan.

Demand is also affected by bilateral agreements between governments (Findlay and Forsyth, 1992). These regulatory arrangements have been challenged by the growth of tourism (particularly since the revaluation of the yen in 1986); increased competition between airlines; regional airlines with a cheaper cost structure than those based in advanced capitalist countries; and the growth of strategic alliances between US mega-carriers and other airlines (e.g. Delta with blue-chip carriers Swissair and Singapore Airlines); and mergers and privatisation (Woods, 1990a, b; BTEC, 1992). The liberalisation of bilateral agreements between the dominant United States and Canadian airlines has led to a rapid expansion of traffic between North America and the Asia-Pacific region. These changes have to be kept in mind when interpreting flight activity in 1979 and 1989.

In 1979 flight activity was concentrated on linking East Asia and Southeast Asia, though China was isolated (Fig. 1). A distinct 'main street' existed between Jakarta and Taipei/Tokyo. Bangkok, Hong Kong and Singapore were major regional centres with both Manila and Seoul figuring prominently. Tokyo served as the major interchange between these airports and North America — a reflection of a liberal bilateral agreement between Japan and the United States. Clearly, Honolulu performed a role as a hub and Anchorage as a stopover point on intercontinental flights. Only San Francisco, at that time the corporate 'control centre' of North America's West Coast, reached the minimum threshold of twenty flights. The number of flights, however, may not have been a true reflection of the relative importance of airports at this time. Among the dispersed set of airports in North America, the advent of wide-body jets after the early 1970s (i.e. the 350-seat 747s which held double the capacity of the DC8s and 707s) reduced the number of flights needed. This phenomenon may also explain the limited number of direct connections with eastern Australia. Only Bangkok, Hong Kong and Tokyo had major external connections with airports outside the Asia-Pacific region.

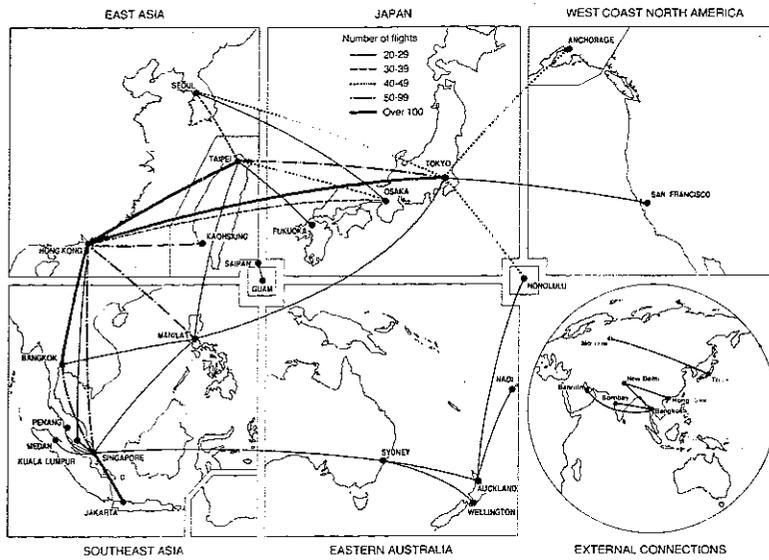


Figure 1. Twenty or more non-stop air passenger flights in the Pacific Economic Zone, August 1979 (Source: Rimmer, in press).

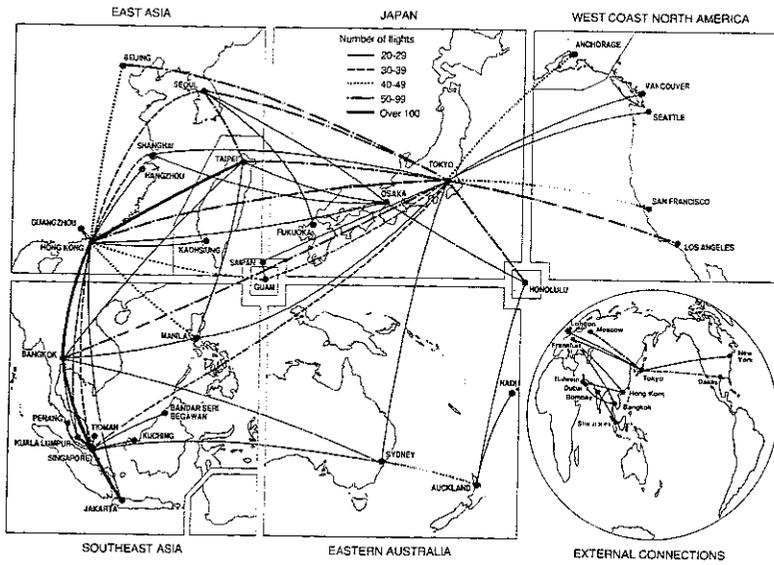


Figure 2. Twenty or more non-stop air passenger flights in the Pacific Economic Zone, August 1989 (Source: Rimmer, in press)

TABLE 1 TRANS-PACIFIC AIRPORTS RANKED ACCORDING TO THE NUMBER OF PASSENGERS EMBARKED AND DISEMBARKED 1983 AND 1990

1983			1990		
Rank	Airport	Passengers (000)	Rank	Airport	Passengers (000)
6	Hong Kong	8,850	5	Hong Kong	18,668
8	Tokyo New Intl	7,772	6	Tokyo New Intl	18,312
9	Singapore Changi	7,606	8	Singapore Changi	14,406
20	Bangkok-Bangkok Intl	4,926	10	Bangkok-Bangkok Intl	10,906
21	Los Angeles - Los Angeles Intl	4,910	13	Los Angeles - Los Angeles Intl	10,000
23	Taipei-Chiang Kai-shek	4,076	17	Taipei Chiang Kai-shek	8,929

Source: ICAO, 1984, 1991.

By August 1989, the pattern had changed with the intensification of connections between eastern Japan, East Asia and Southeast Asia and increased links between these sub-regions and North America and Australia (Fig. 2). Besides increased business and tourist links in the Trans-Pacific economy the 'main street' between Jakarta and Taipei persisted, with Hong Kong becoming an important pivot. In addition to Hong Kong, five other major airports could be recognised in the Asia-Pacific region — Tokyo-Narita, Seoul, Taipei, Bangkok and Singapore — which had become the bases of multiple designated airlines. Previously the sole airline operating from these airports had been government-owned. They have since been privatised and additional carriers designated (e.g. the privatised China Airlines and its partly owned subsidiary, Mandarin Airlines, in Taiwan and the additional carrier, Eva Airways). These airports handled two-thirds of all trips to and from Europe and four fifths of all Trans-Pacific trips.

Four airports — Bangkok, Seoul, Singapore and Hong Kong — have improved their positions as international gateways since 1979. More significantly, Tokyo-Narita was also confirmed as the dominant intercontinental gateway to Pacific Asia enabling it to match the importance of the major intercontinental airports — Frankfurt, London, New York and Los Angeles. In 1983 six Trans-Pacific airports were in the 'top 25' based on the number of passengers embarked and disembarked (Table 1). All had improved their rankings in 1990 though surprisingly Seoul was not ranked.

Tokyo's significance stemmed from its strong local market within eastern Japan and its position as a fuel stop on Trans-Pacific flights. Its non-stop connections with major gateways in North America have been enhanced at the relative expense of

Anchorage and Honolulu whose stopover functions have been superseded by the increase in the potential length of haul by airliners. Two factors have been responsible for Los Angeles overshadowing San Francisco in California and Seattle and Vancouver battling for dominance in the Pacific Northwest. These are: (a) rapid service expansion, associated with increased hub-and-spoke developments on the domestic network (created after the *Airline Deregulation Act*, 1978); and (b) the subsequent consolidation of international passengers.

The minimum threshold of twenty flights, however, masked an increase in the number of Trans-Pacific flights to non-Japanese destinations resulting from: (a) the noted capacity constraints at The New Tokyo International Airport at Narita; (b) the growth in East Asian and Southeast Asian passenger markets; and (c) unsuccessful United States pressure on Japanese authorities to ease its economic regulation of international aviation. Another key feature was the closer integration of eastern Australia and Asia, with Sydney experiencing marked growth.

A further outstanding change was the marked increase in non-stop ultra long-distance flights which are rapidly becoming the norm rather than the exception. Tokyo has frequent flights to New York, Dallas, Frankfurt and London underlining its importance as a global financial and management centre. Other important intercontinental gateways offering breaks after 10-hour journeys include Bangkok, Seoul, Singapore and Hong Kong. Not surprisingly, these hubs have developed as key regional financial and management centres. Bangkok's increased prominence has been enhanced by its function as a fuelling base on the one-stop Australia-Europe flights and also by Thailand's growing economy. Hong Kong's pivotal position between Northeast and Southeast Asia has been improved by renewed connections with China. Seoul has emerged as a hub on a Grand Circle routes connecting Europe and North America, with Northwest and United Airlines using it as an alternative connecting point to heavily congested Narita. Aided by a liberal, bilateral airline policy and the practice of expanding capacity ahead of demand, Singapore has developed as a regional gateway to Southeast Asia and an international gateway to Europe and Australia. Singapore enjoys better infrastructure than its Bangkok rival and an estimated 50 per cent of traffic is derived from its hub function with important spin-offs in tourism and aerospace activities.

Since 1989 the end of the Cold War has raised the possibility of new, non-stop air routes between Asia and Europe and North America. Already new non-stop routes have

been forged between Moscow and Hong Kong (Westlake, 1992b). Bangkok and Singapore are too far south for travellers to benefit from these non-stop routes. However, flights to North America would be one hour shorter with a European stopover rather than a Tokyo stopover. There is little advantage to the airlines from this arrangement other than the opportunity to substitute India's crowded air space for Russia's less crowded skies and the opportunity to fly at higher altitudes to save fuel. More extensive use of Russian air space, however, will hinge on lower overflight fees.

The greatest gain would stem from receiving permission to overfly China. It would then be possible to use Great Circle routes between Hong Kong and New York and reduce the travelling time from 19 hours and 30 minutes to 14 hours and 30 minutes. This link-up avoids the necessity of having a Tokyo stop and would break the monopoly over non-stop flights to the East Coast of the United States exercised by Seoul and Tokyo-Narita. Much will hinge on what happens to Hong Kong after China resumes control in 1997 and on whether direct flights will be resumed between Taiwan and the Mainland. The future of Hong Kong and Taipei, therefore, are problematic. As highlighted in a discussion of short-term developments in the Asia-Pacific region, plans are in place for a new airport in Hong Kong and to transform Taipei into a regional transport hub. Developments at Japan's congested airports are also brought out by featuring the New Tokyo International Airport at Narita and the planned New Kansai International Airport.

2. Short-term Developments

Given the likely continuation of double-digit growth of air services into the 1990s to accommodate passengers and tourists, changes in the pattern of flights by the beginning of the twenty-first century are expected to occur through: (a) technological developments in aircraft; (b) extensive airport developments planned for Asia-Pacific as population centres compete to enhance their international status; and (c) changes in organisational structure arising from the extension of passenger reservation systems.

Technological developments. Existing route patterns leading to the emergence of hubs reflect demand, bilateral traffic rights and an increase in size and range of aircraft. In 1992 more than 40 per cent of the orders for new aircraft were from in Asia — a reflection of the recession and fare wars in the United States and Europe. Recent developments in passenger aircraft have concentrated on the marketing benefits of ultra-

long-range, non-stop operations. Boeing has developed the B747-400, Douglas the MD11, and Airbus the A340. Asian airlines are ordering Boeing 777s and Airbus A330s in anticipation that stretched versions will be available so that they can become high-volume people-movers (Westlake, 1992a, b). Both companies are planning 'mega-jumbo' jets with 600-800 seats in the late 1990s aimed primarily at the Asian market — the Boeing will feature a full-length, double deck and the Airbus side-by-side double fuselages. McDonnell Douglas, however, has had problems in financing its MD12 and has proposed selling 40 per cent of its commercial activities to Taiwan Aerospace.

As a result of improvements in materials technology, fuel efficiency and additional fuel capacity all of these aircraft have an extended range of operation. This will benefit those routes on which aircraft have to periodically reduce payloads because of adverse weather conditions. Investigations are also being made into increasing the seat capacity of aircraft and folding wing spans to overcome constraints of cost, land availability and environmental considerations associated with expanding or building new airports to meet the expected rise in jet fleet numbers. According to Westlake (1992b), IATA predicts more than 85 per cent of the extra capacity will come from more seats rather than technological developments. Supersonic versions are unlikely to be in operation on Trans-Pacific routes before 2010. More aircraft will require additional routes and new and expanded airports.

New airports Only two of the major airports in the Asia-Pacific — Singapore and Taipei — are thought capable of being able to accommodate the forecast growth in demand. Both have been built on new sites since 1977 and planned expansion can accommodate new runways and terminals. Singapore, for example, is planning a third terminal at Changi. Capacity will be reached at Osaka's Itami Airport and Hong Kong's Kai Tak Airport in 1994, and Seoul's Kimpo Airport and Bangkok's Don Muang Airport in 1995. Kuala Lumpur's Subang Airport could offer some relief to Bangkok and Singapore but it too will reach capacity in 1998. Sydney, the region's other important airport, is also congested with parking bays near capacity. New replacement international gateways are planned. They include Osaka's US\$12 billion New Kansai International Airport (1994); Hong Kong's Chep Lap Kok (1997); Seoul's US\$4.5 billion airport at Yongyudo Island (1997) near Incheon, 30 km west of the city which will serve as a hub for Mainland China, North Korea and Russia; and Bangkok's US\$2.5 billion Nong Ngu Hau (2000) (see AR, 1992).

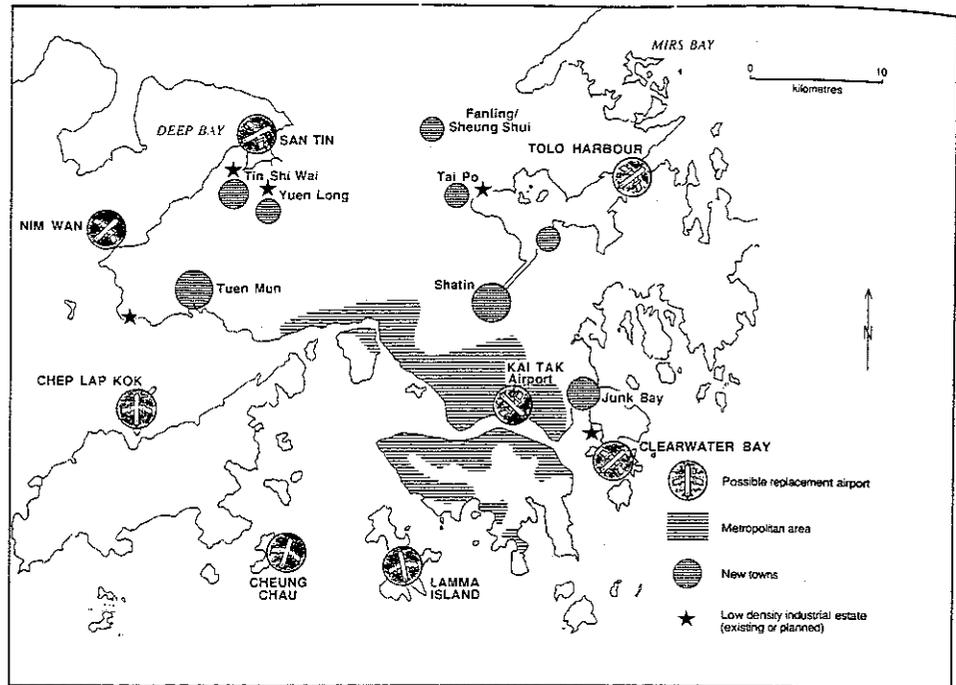


Figure 3. Alternative sites considered as a replacement for Kai Tak International Airport including Chep Lap Kok (Source: Rimmer, 1992: 39).

As illustrated by Hong Kong's planned state-of-the-art airport at Chep Lap Kok, there are problems of keeping projects on schedule caused by wranglings between British, China and Hong Kong governments (Rimmer, 1992). Chep Lap Kok was chosen because of its territorial position in relation to other developments (Fig. 3). The Colony's reversion to China in 1997 raises questions, however, about its continuing importance as a regional transport hub with three other fledgling airport competitors within a 150 km radius — Guangzhou, Macao and Shenzhen. On opening in 1997, the new airport will have one of two planned runways. Operating 24 hours per day it will be capable of handling 320,000 aircraft movements per year (37-39 aircraft per hour) carrying up to 33 million passengers per year compared with the existing Kai Tak airport's 24 million. The airport will initially have forty-two gates along the T shaped terminal and eighteen on the tarmac. When the second runway is completed in 2027, Chep Lap Kok will be capable of handling eighty aircraft movements per hour and 87 million passengers per year. Its capacity would then be reached and any extension would have to rely on the manipulation of arrivals and departures. Without the new airport it is unlikely that Hong Kong would be able to maintain its competitive advantage into the

twenty-first century which will be dominated by 'time-based' competition (i.e. just-in-time delivery, minimal inventories and faster turnaround of capital).

Further developments include a planned airport for Kuala Lumpur in 1998 and an expansion of Cengkareng's third terminal in Jakarta. Sydney, however, has been subject to a prolonged political debate over whether to expand existing facilities or build a new one on a green-field site. As expansion is preferred it will not operate round-the-clock like the other new airports. Even the new airports in the Asia-Pacific region, however, will still experience peak-hour bottlenecks because most non-stop flights from Europe and Trans-Pacific origins arrive early in the morning or late afternoon (Westlake, 1991). These new airports, along with the existing airports in Singapore and Taipei, are expected to accommodate the rapid growth in demand.

The Taiwan Government, however, is seeking hub status for the Chiang Kai Shek International Airport in Taipei to promote the city as an international financial and distribution centre (Rimmer, forthcoming). Although the Government must upgrade the airport facilities, it is the *airlines* that determine its success as a hub. Airlines organise routes, aircraft fleets, flying personnel and schedules around hubs, and airport management must be responsive to their needs (Philipps, 1987; Hansen, 1990; Kanafani and Gobrial, 1985). If Taipei became a hub location it would be 'used by an airline or airlines, passengers and/or cargo, as a coordinated connection point, with several flights arriving in a short time period to several destinations' (CATC/ITSUCB, 1992: 2-1). A feasibility study which examined Taipei's hub prospects to 2020 (CATC/ITSUCB, 1992), canvassed a large number of issues including airlines to use the hub; domestic services to be provided to mainland airports; levels of domestic service to be provided; new airport developments at other Asia-Pacific centres; and access to first freedom rights. These matters were considered in a modelling exercise which produced forecasts between the 'best outcome' of 61 million passengers in 2010 and the 'worst outcome' of 25 million passengers. During the 18 00-19 00 peak hour, there would be up to 25,000 passengers and 164 operations (NACO, 1992 provided revised estimates). Intangible benefits from Taipei being 'a central place and focus of activity, attention and awareness' cannot be quantified but are expected to exceed tangible benefits derived from hotels, increased tourism and improved air passenger (and cargo) services (CATCB/ITSUCB, 1992: 6-1). When completed, the New Taipei International Airport hub would stand to benefit from the renewal of direct connections with Mainland China and the inevitable spillover of connecting traffic from Tokyo Narita.

As congestion is most pronounced in Japan, planned airport developments there are highlighted. Although designed for 7.5 million the volume of passengers at the New Tokyo International Airport at Narita has almost tripled from 6.4 million in 1978 to 18 million in 1988 (Damrot, 1990). As capacity is limited by the single runway, night curfews and the restrictive practices of air controllers, existing services have to be rescheduled and the introduction of new ones postponed (Hansen and Kanafani, 1990). The short-term resolution of this problem during the late 1980s was to expand the existing international airports at Osaka, Haneda (Tokyo International) and Narita by additional runways and new passenger terminals. Land acquisition at Narita has been slowed by political opposition and environmental concerns, and capacity at both the expanded New Tokyo International and Tokyo International Airports will be exceeded by 2005. A third Tokyo Airport will, therefore, be needed and alternative sites are already being canvassed including the 'Ark Airport 21' operating 24 hours per day on reclaimed land in Tokyo Bay (Edgington, 1991). The other more immediate strategy is to build the New Kansai International Airport.

The \$US7.7 billion (now \$US12 billion), one-runway, 'third sector' (i.e. public and private finance), New Kansai International Airport project is being constructed on 511 ha of reclaimed land in Osaka Bay and will be connected to the mainland by a two-lane bridge. It will incorporate a tri-level terminal building to integrate international and domestic flights and operate twenty-four hours a day to accommodate additional passenger, charter and cargo flights. Like the Hong Kong and Seoul hubs, Kansai's success will depend on 'connecting traffic' at Narita being diverted. This move would involve passing on Narita's higher terminal costs to passengers and removing some of the fifth-freedom landing rights enjoyed by United States airlines which permits them access to the Japanese market en route to other Asian destinations (Hansen and Kanafani, 1990). A higher than expected rate of settlement at the reclamation site, however, has led to cost and schedule problems and completion will be delayed until mid-1994.

Elsewhere in Japan, developments involve the wider range of international airports as part of a national, multipolar urban system envisaged in the Fourth Comprehensive National Development Plan (Edgington, 1991). The airports nominated to handle international traffic include Fukuoka, Nagoya and Chitose near Sapporo. Nagoya is due to be replaced by Chubu International Airport and Chitose by New Chitose Airport which is being envisaged as an Aeropolis — the international gateway to northern Japan.

(Hokkaido MITI Bureau, 1991) Other city-prefectures, such as Nagasaki and Kagoshima, are actively promoting international connections to boost flagging local economies. Japan's Civil Aviation Bureau, however, wishes to restrict activities at the fourteen major local airports to international charter flights. The popularity of local airports led to a reduction in Tokyo's share of international passenger traffic from 69 per cent in 1990 to 67 per cent in 1991 (Miyata, 1992).

Passenger reservation systems. Both single-user, computerised reservation systems and multi-user, global distribution systems have been developed to accommodate the massive passenger upsurge following the introduction of the B747s. Unlike air freight, the reservation system creates value by meeting a passenger's specific requirements in concluding a transport contract and supplying unidirectional and unilateral information between the airline as producer and the traveller as consumer. Competition between airlines to extend their respective passenger booking systems has led to a handful of companies in North America taking control. Computer reservation systems coupled with access to ground services (landing slots, airport gateways and baggage systems) have been referred to as 'soft rights' but could become the 'hard rights' of market access in the 1990s (Findlay and Forsyth, 1992: 4).

As this oligopolistic development is nearing completion, contestants are seeking predominant positions on a global scale. These airlines are merging into larger groups geographically based in Continental Europe and Asia. If nationality requirements for airline ownership are discarded in Europe and the United States, smaller Asian carriers would have the opportunities to buy into their markets (Westlake, 1991). This arrangement would prevent Asian airlines being reduced to niche status by the oligopolies. The air passenger network, however, is still an immature system. Indeed, the domestic hub-and-spoke system developed in the United States and described by Hansen and Kanafani (1988) is unlikely to find global expression before the middle of the twenty-first century.

3. Superhubs

Air passenger numbers are likely to triple by the year 2040. At that time, it is anticipated that six predictable issues will dominate airport construction: the growth of both passengers and cargoes; changes in airport technology; more runways and better terminals; integration of security and terminal designs; an increase in the importance of

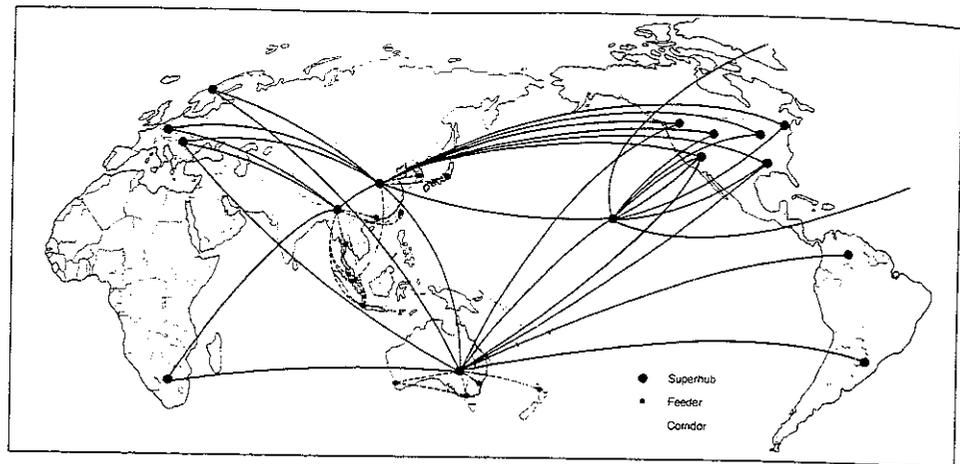


Figure 4. A future superhub air network (*Source: based on Hoyt, 1990: 237*)

environmental concerns; and better integration between ground and air networks (Hoyt, 1990). As moving airports from congested inner-city areas to peripheral locations within 50 km or 80 km of existing areas has not provided a lasting solution, a new air transport system is being planned. It is based on a set of superhubs for handling new classes of aircraft (e.g. supersonic and hypersonic). These vast airports will be located between 160 km and 800 km from existing population centres as shown in Figure 4. No account, however, is taken of the possibility of off-shore airports (and cities).

Domestic links will be provided by: (a) supertrains and high-speed ground transport; and (b) tilt-wing or tilt-rotor aircraft which are able to land and take-off vertically and carry between fifty and seventy-five passengers to and from inner city terminals sited on small parcels of land. At the airport automated people movers, capable of carrying between 1,000 and 16,000 passengers per hour, will make the necessary transfers at the central terminal between domestic feeder systems and long-haul aircraft stationed at remote piers (or satellites). Parallel automated and programmed rail systems able to operate at 55 kph will handle baggage between landside and airside areas. Although it is feasible to send baggage twenty-four hours ahead of a flight, passenger security necessitates the two being identified together. Past experiences with both domestic services in the United States and international services suggest hubs are not stable as carriers divert to secondary airports once they are congested. Will this happen with superhubs after 2040; or is this the ultimate hub-and-spoke system? By then these

superhubs, according to Kasarda (1991) could also be the centres of global air cargo/industrial complexes dependent upon the worldwide sourcing of materials and just-in-time distributions systems. It is a moot point whether passenger wayport or the global air cargo complex comes first.

4. Conclusion

Predicting the way in which air passenger networks and the Trans-Pacific spatial economy will develop between the 1990s and 2040 represents an ongoing challenge for strategic planners. The rapidity of change in the network and status of hubs over ten years has been highlighted in an analysis of the strength of passenger aircraft connections in both 1979 and 1989. Investigations of short-term developments in network configuration over the next one or two decades are already in progress based on trends in demand, airline strategy and new airport investment. Models for the period to the year 2000 or 2010 attempt to accommodate technological changes in aircraft and new airports in their forecasts. Once these short-term projections are known, attention can be directed to more speculative considerations about the emergence of superhubs and their implications for the existing urban hierarchy between the years 2010 and 2040, particularly in the context of China's expected rapid economic growth. Will the distribution of superhubs follow the pattern shown or will there be fewer wayports such as one each in Australia, Japan and the United Kingdom and three in the United States? Specific interest will be centred on the desirability or sustainability of Tokyo's Narita Airport in maintaining its status as Asia's dominant trans-Pacific gateway. Much will depend on the important role of government in civil aviation which determines the degree to which market forces — airline costs and passenger preferences — shape the networks.

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