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NATIONAL INTELLIGENCE SURVEY

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Transportation and
Telecommunications

NATIONAL INTELLIGENCE SURVEY PUBLICATIONS

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SINGAPORE

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Transportation and Telecommunications

A. Summary

1. Systems (C)

Singapore, which more closely resembles a large city complex than an independent state, has dense, well-developed transportation (Figure 9) and telecommunication (telecom) systems. The systems are adequate for normal economic requirements.

The port of Singapore is the commercial and transportation center of Southeast Asia. Located on the vital shipping lanes between Europe and the Far East, it serves as the collection and distribution center for Malaysia and other neighboring countries. Sembawang (formerly Her Majesty's Naval Base, Singapore) is a significant repair facility for both naval and commercial ships, and Jurong is being developed as a major bulk-cargo handling facility.

The highways, which are used extensively throughout Singapore Island, are the most important means of transport on the island. Singapore is the focal point of the system, and an excellent network of paved roads radiates from the city to all parts of the island. The most important means of cross-island transport connecting Singapore and Malaysia is provided by a rail line and a branch line, both of which are operated as part of the Malaysian railroad system. Although totaling only 24 route miles, these lines are of major importance to Singapore's economy; they are the primary means of transporting raw materials from Malaysia to the industrial and shipping centers on Singapore and of moving imports from Singapore to Malaysia. Upon completion of the Jurong industrial complex and deepwater facilities, the Jurong branch line is expected to be the busiest of any of the lines operated by the Malaysian railroads.

Singapore has no significant inland waterways, and marine activity is associated mainly with the port of Singapore. Although most of Singapore's international

cargo and passenger traffic is handled by foreign vessels and planes, the merchant marine is growing rapidly and is of major importance to the economy and plays a major role in linking Singapore with Malaysia and other countries of the Far East. Scheduled services are provided throughout Asia and to Africa, Europe, the United States, and Australia. Civil aviation has traditionally played a major role in linking Singapore with West Malaysia and the East Malaysian states of Sarawak and Sabah. However, with the separation of the Malaysia Singapore Airlines into two independent airlines, Singapore Airlines has reduced many of its regional flights to points in Malaysia and sharply increased its services to foreign cities in both Asia and Africa. The telecom system is one of the best in Asia; its importance is attributed to the large number of diverse circuits with foreign terminals. The system consists of modern landlines, submarine cables, and radio-relay networks, which are supplemented by a satellite ground station and high-frequency radio-communication facilities.

A 3,500-foot causeway which carries both rail and highway traffic across Johore Strait to Malaysia, is Singapore's only international connection. Telecom circuits to Malaysia are extensive. International communications, via the SEACOM (Southeast Asia Commonwealth Communication System) submarine cables and a satellite station, provide communications with Malaysia, Hong Kong, Australia, Guam, New Guinea, Canada, the United Kingdom, India, Indonesia, Japan, Philippines, and Thailand.

Major projects underway or planned include constructing additional railroad spurs and sidings to serve the deepwater port and industries of the Jurong industrial complex; improving railroad equipment and facilities under Malaysia's economic plan; constructing a system of expressways, based on the Pan-Island expressway (Singapore-Serangoon) which is nearing completion; constructing major facilities at

Jurong port, expanding the merchant marine; increasing the capacity of the radio relay and automatic telephone exchanges; and installing international automatic telex exchange and a second satellite ground station antenna.

The rail lines in Singapore are owned, for the most part, by the Government of Malaysia and are operated by its Malayan Railway Administration. With the separation of the Malaysia Singapore Airlines into two independent national airlines in 1972, the Singapore Airlines is owned and controlled by the Government of Singapore. The highway transport industry is both government and privately owned, and ownership of the merchant marine includes government as well as domestic and foreign private companies. The government owns and operates most of the port and telecom facilities, with the exception of a part of the port of Sembawang and naval components, which are still under British administration.

2. Strategic mobility (S)

The land transport systems of Singapore and West Malaysia are the best in Southeast Asia. The railroad in Singapore is an extension of the Malaysian railroad which serves both countries as an integrated system. However, its importance to military operations in Singapore is restricted by its limited extent and by the fact that it is controlled by the Government of Malaysia. In the Singapore-West Malaysia region, the main rail line extends from Singapore to Gemas, where it divides into two routes extending through Malaysia to two internal connections with the Thailand network.

The excellent network of paved roads in Singapore radiates from the city and serves all parts of the island. The network is entirely adequate to support the movement and supply of a military force transiting the island. However, the only connection between Singapore and the mainland (West Malaysia) is the combination railroad and highway causeway across Johore Strait, which makes it the most vulnerable location for either mode.

Singapore is one of the major shipping centers of the world and a leading oil center. Its ports have a considerable military capacity and are adaptable for military use; repair facilities are available for both naval and commercial ships. The cargo-type ships (95 dry-cargo and one timber carrier) have a considerable potential for short-haul (up to 48 hours steaming) troop-lift and sustained logistics support in near-seas operations. These ships have a military lift and supply transport potential of 541,510 cargo deadweight tons. The self-loading and unloading capability of the dry-

cargo units is enhanced by 26 units having heavy-lift booms (40 tons or more), or large hatches (more than 50 feet in length), or both heavy-lift booms and large hatches. Many of the cargo-type ships are either foreign-owned or are in worldwide trade and might not be accessible for military support operations under emergency conditions. With expansion of the normal passenger capacity aggregate of 2,314, the five passenger and 19 combination passenger-cargo ships have a considerable potential for longer haul (more than 48 hours steaming) troop transport. The 12 tankers, with an estimated capacity of about 852,000 barrels (U.S.) of petroleum and related products, could provide a moderate fleet-oiler or other military support capability for a short period.

The military value of civil aviation in Singapore has been enhanced by dividing the Malaysia Singapore Airlines, formerly jointly controlled by the governments of Singapore and Malaysia, into two independent national airlines. Singapore now has complete control over a fleet of modern transport aircraft, which would be available in the event of military mobilization. Of the five airfields in Singapore, three are military and two are under civil control.

Singapore's communication links are relatively secure from disruption, assuming terminal sites remain intact. Also, the high-frequency radiocommunication facilities located at Jurong (transmitter) and Yio Chu Kang (receiver) are connected to the control in Singapore by underground cable and are available for backup communications in the event of disruption of other networks; however, communications would be reduced in quantity and quality. The services of the special-purpose telecom networks also would be available.

The armed forces of Singapore operate their own telecom network, which consists mainly of radiocommunication facilities. The SEACOM submarine cable also provides leased circuits for military use.

B. Railroads (C)

The 24 route miles of single-track meter-gauge (3'3") rail lines in Singapore consist of a 16-mile main line across the island (from the Port of Singapore to the Johore Strait into West Malaysia) and an 8-mile branch line connecting the Jurong industrial complex with the main line near Bukit Timah Village. The main line is owned by the Malaysian Government and is operated by Malaysia's Malayan Railway Administration. The Jurong branch line, opened in early 1966, was financed by the Singapore Economic

Development Board and was jointly constructed by this board and the Malayan Railway Administration, which operates the line. By agreement, the Economic Development Board loan will be repaid by the Malayan Railway Administration over a period of 10 years. An additional several miles of spurs and sidings serve the port and industrial facilities of Singapore, Sembawang, and the Jurong industrial complex. A new marshalling yard has six tracks and can accommodate 245 freight cars 25 feet long. The rail system is generally adequate for current economic requirements.

Rail weights range from 80 to 100 pounds per yard on the main line and are probably of similar weight on the Jurong branch line. Rail is flat bottomed and is spiked directly to creosoted hardwood ties. Ties are spaced 2.290 per mile, and ballast is limestone and sandstone laid 6 inches deep. Ties and ballast are obtained domestically, but rail is imported, principally from the United Kingdom. A Malaysian railroad-tie treating plant is located at Gemas, Malaysia. Axleload limits are 17.6 short tons on the main line. Humid tropical weather and heavy rains during the monsoon season produce some unusual maintenance problems.

Structures on the main line include 10 bridges that are 12 feet and over in length and the 3,500-foot causeway across the Johore Strait. The 10 bridges total 483 feet in length. The Jurong branch line has eight bridges and five underpasses (Figure 1). The bridges are from 23 to 303 feet long; the underpasses, from 110 to 199 feet. The underpasses, which pass under highways, are 17'9" high and 20'7" wide and have the greatest clearances of any structures on the Malaysian system.

Motive power and rolling stock are generally in good condition and are adequate for present traffic.

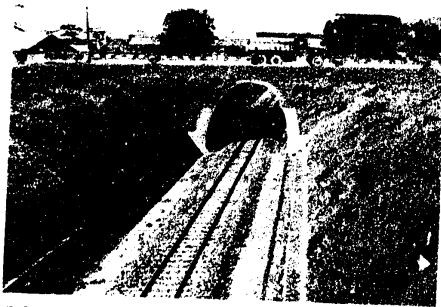


FIGURE 1. One of the five railroad underpasses on the Jurong branch line (U/OU)

Both steam and diesel locomotives are used on the lines in Singapore. Most equipment is obtained from Japan.

The water supply is plentiful and of good quality; no treatment is necessary for locomotive use. Fuel and diesel oil requirements are met by imports of crude oil from the Middle East and Brunei.

Train movement is controlled by the absolute block system. The main line uses the key-token system; the Jurong branch line, the train-staff-and-ticket system. Communications are by telephone and telegraph. The main line is an important part of the Malaysian system, and traffic is largely cross-island movement between the port of Singapore and Malaysia. Principal commodities hauled are iron ore, logs, cement, and rubber. The volume of rail transportation from the Jurong area is estimated to be between 2 and 3 million tons a year.

There is a shortage of skilled railroad personnel. Employees receive on-the-job training, and many receive additional training at the Railway Training School at Kuala Lumpur, Malaysia, and in British or Pakistani training centers.

C. Highways (C)

The highway system of Singapore, one of the best in the Far East, compares favorably with that of Malaysia and is the most important means of land transport. Singapore has an excellent network of paved roads that radiate from the city of Singapore to the suburbs, outlying towns, and all parts of the island. The road density is high in the city and towns but is relatively sparse in the rural areas, especially in the central hills and in parts of the western hills. The highway network is adequate for normal economic requirements. On most of the off-lying islands motorable roads are practically nonexistent. Singapore's connection with Malaysia, across Johore Strait, is its only international connection.

The highway network consists of 1,226 miles of roads, of which 773 miles are paved (mostly bituminous surface), 243 miles are crushed stone, and 210 miles are improved earth. The paved roads are located both in the city and in rural areas; crushed stone and earth roads are located in rural areas and on the off-lying islands.

Surface widths of the principal roads within the city of Singapore and those leading to the suburbs and principal towns range from 22 to 88 feet (Figures 2, 3, and 4); only the first mile of the 15-mile Coast Road to Bedok is an 8-lane divided highway that is 88 feet wide. In the rural areas surface widths range from 10

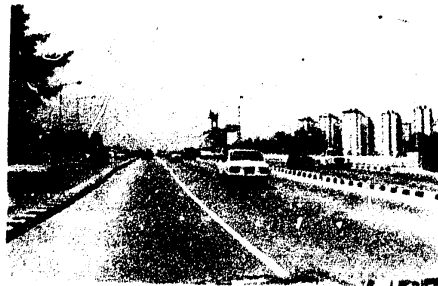


FIGURE 2. Nicoll Highway is concrete, 7 lanes wide, and divided by a 3-lane center section (U/OU)



FIGURE 4. Airport Road is a bituminous surface, 4-lane divided highway (U/OU)

to 24 feet, but widths of 16 to 18 feet predominate. The best roads have a broken-stone base course, 12 to 24 inches thick, topped by 6 inches of gravel or crushed stone and a bituminous surface 4 to 5 inches thick. Throughout Singapore, deep monsoon drains run along one side and frequently both sides of the roadway. Shoulders are narrow and sometimes nonexistent. All major roads are well maintained and are generally in good condition. There are no steep grades or sharp curves. Bridges on the principal roads are of steel, masonry, or reinforced-concrete structures, with the latter predominating. Wooden bridges are generally found in the rural areas; these are gradually being replaced with reinforced-concrete structures. Bridges at principal crossings are usually in good condition. The roads are fully bridged, neither ferries nor fords being used, but there are several underpasses in the city. Pedestrian overpasses cross nearly every major roadway but are high enough to provide adequate clearance for normal loads.



FIGURE 3. Paya Lebar Road is a bituminous surface, 6-lane divided highway (U/OU)

The roads, bridge, and drainage sections of the Public Works Department under the Ministry of National Development are responsible for constructing and maintaining roads and bridges. The roads section conducts surveys, prepares specifications, and is responsible for construction. It also undertakes miscellaneous projects such as road beautification and construction of bus bays, vehicle parks, and roadside guard rails. Since Singapore has an equatorial climate with heavy rainfall, adequate drainage is a problem. Numerous concrete culverts, 3 to 4 feet in diameter, exist throughout the highway system. However, at times of heavy rains these are inadequate, and the resulting floods can cause road damage.

Construction materials such as crushed stone, gravel, and sand are readily available from local sources. About 200,000 tons of cement and 40,000 tons of bituminous materials are produced annually. Singapore has no productive forests, and all timber requirements are imported, principally from Malaysia. Singapore is a major distribution center of the Far East for the world's leading makers of heavy equipment and parts. For this reason roadbuilding machinery such as bulldozers, scrapers, excavators, rollers, truck cranes, concrete mixers, asphalt pavers, and trucks are readily available and are used throughout the island.

Because of the rapid increase in the number of motor vehicles and the city's rapid urbanization, Singapore, in common with most Southeast Asian capital cities, is confronted with massive traffic congestion. Traffic density is centered around the island's commercial sectors, where population density may reach about 90,000 persons per square mile. Also, as in other cities, urban development has taken the form of intensive frontal development along major arterial roads. The activities generated by this development often conflict with traffic movement

along these roads. To cope with the increasing volume of traffic a supplementary system of expressways with well-designed interchanges based on the Pan-Island expressway will soon be completed. The Pan-Island Expressway is a limited-access, high-speed highway which connects the city of Singapore with Serangoon on the northern side of the island. The system is expected to ease traffic congestion throughout the island by linking the city with the satellite towns and industrial estates. Other work in progress is the construction of special bus lanes on existing roads and adapting more streets in the busy center city to one-way traffic. Roads are being widened where possible and outmoded traffic islands are being removed. Bridges are being widened, redecked, and strengthened. Lower quality roads in rural areas are being upgraded. Since pedestrians represent another element in the traffic problem, overhead bridges are being installed across some of the busiest roads. There are now 23 of these new pedestrian overpasses, and six more are to be built.

Climatic conditions are sometimes another traffic interruption factor. Despite numerous culverts and well constructed drainage ditches, heavy rains cause floods that temporarily halt traffic on some roads.

The Road Transport Department of the Ministry of Communications directs, promotes, and coordinates the various services and agencies concerned with land transport. Singapore has well developed and modern bus and truck services, but public transport facilities are considered inadequate for current demand. To increase the efficiency of the public transport system the former 11 bus companies have been consolidated into four companies to operate on a merged basis in the north, south, east, and west island regions. Priority has also been granted to increase the public bus fleet from 1,400 to 2,000 by 1974. Bus services are provided on practically all city streets and most country roads. Principal commodities hauled by trucks are agricultural products and livestock, timber and gravel, fuel and lubricants, machinery, and manufactures. Traffic volumes are concentrated mainly in the city, on the Bukit Timah Road, and on the Pan-Island Expressway.

On 1 March 1972 vehicle registrations totaled 207,000: 165,700 passenger cars, 2,700 buses, and 38,600 trucks. In addition there were 110,000 motorcycles and scooters. Singapore has no facilities for producing motor vehicles but has seven plants which assemble four-wheel vehicles and one plant which assembles motor scooters. All of these assembled vehicles are of foreign design; U.S., British, and West German models are the most important types. Since

about 1970, the three largest plants have usually accounted for more than half of total output. Total output of four-wheel vehicles in 1971 was 11,518 units. In order to improve safety, the government has imposed age limits on public service vehicles of 7 years for taxis, 15 years for trucks, 17 years for public buses, and 20 years for school buses.

D. Ports (C)

Singapore has three major ports, Singapore, Sembawang, and Jurong, all under the administration and control of the Port of Singapore Authority (PSA), a government agency.

Singapore, on the south shore of Singapore Island, is the largest commercial port (Figure 5) in Southeast Asia and one of the world's major shipping centers. Essentially a free port on the important shipping lane between Europe and the Far East, Singapore serves as the collection and distribution center for Malaysia and other neighboring countries. The port is emerging as Asia's leading oil center with the rapid escalation of refining capacity, the coming of numerous exploration firms, and the network of supply and servicing companies. New developments include: 1) opening of the partially completed container terminal in East Lagoon area of the port to the first container ship in June 1972; construction of a third berth at the terminal; 2) a planned multimillion dollar project to dredge the harbor and approaches; 3) reclamation of land for the Pasir Panjang warehousing project in the western side of the harbor ultimately to provide 4,200 feet of berthing facilities for lighters and coastal vessels and 2.4 million square feet of covered storage.

Sembawang came into existence in December 1971 when PSA assumed control of the port and a 1,200-foot segment along the northeast end of the Naval Stores Basin at Her Majesty's Naval Base. The remainder of the basin and most of the other naval components were retained for use by the Royal Navy. The naval dockyard at the base was handed over to the Singapore Government at the end of 1968 and is used for repairing both naval and commercial ships. The western part of the harbor contains a Royal Malaysian Naval Base and a POL terminal. An area near the center of the harbor is being reclaimed by the port authority for future development as an industrial area with wharf facilities.

The Jurong port was designed as a bulk-cargo-handling facility serving a number of industries making up the Jurong industrial complex 7 miles northwest of Singapore. The deepwater berthing, handling, and storage facilities (Figure 6) will be

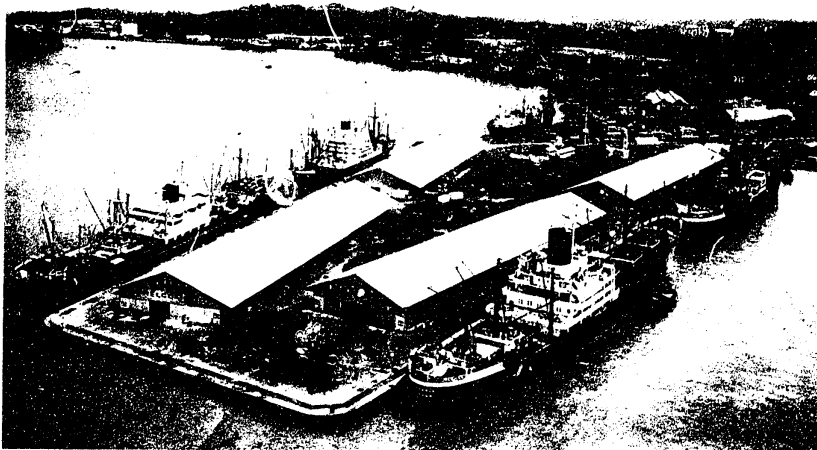


FIGURE 5. East Wharf of Singapore (U/OU)

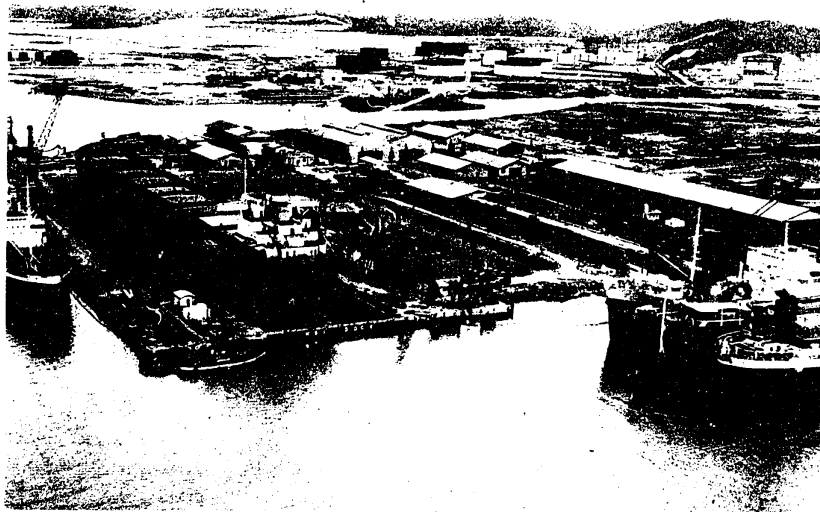


FIGURE 6. Port facilities under construction at Jurong in 1969 (U/OU)

significantly increased in the next few years to keep pace with the increased development. The Jurong Shipyard is being expanded to accommodate supertankers. Several large tanker berths are available at the POL installations in the port. The PGL terminal on one of the islands on the southern side of the harbor has a single-buoy mooring about 3 miles offshore to accommodate 250,000-ton supertankers. Details of the major ports are tabulated in Figure 7.

E. Merchant marine

Merchant shipping is of vital importance to the economy of Singapore, an island republic situated at the strategic gateway between the Indian Ocean and the South China Sea. An important entrepot and transshipment center in Southeast Asia, Singapore ranks among the leading ports of the world in terms of shipping handled. During 1971, of approximately 39,000 vessels of all sizes that entered and cleared the port of Singapore, about 39,500 were oceangoing ships; the aggregate volume of cargo discharged and loaded by all vessels amounted to 48.1 million long tons, of which a sizable proportion was carried by Singapore-registry merchant ships.

In April 1972, the Singapore-registry merchant fleet consisted of 143 ships of 1,000 gross register tons (g.r.t.) and over, totaling 763,338 g.r.t. or 1,022,918 deadweight tons (d.w.t.), as follows:

TYPE	No.	G.R.T.	D.W.T.
Dry cargo	95	455,851	640,805
Tanker	12	83,652	128,506
Combination passenger-cargo	19	90,120	93,722
Bulk cargo	7	72,035	103,785
Refrigerator	2	7,469	7,036
Passenger	5	41,622	33,320
Car carrier	2	9,982	11,894
Timber carrier	1	2,607	3,850
Total	143	763,338	1,022,918

Singapore-flag ships are characteristically old, small, and slow. Of the total fleet deadweight tonnage, 52% (79 ships) represents units that are 20 years or older, 37% (51 ships) are 10 to 19 years old, and only 11% (13 ships) are less than 10 years old. A total of 107 ships, comprising 53% of the total fleet deadweight tonnage are under 10,000 d.w.t. The largest ship in the fleet is a 20,600-d.w.t. tanker. Sixty-nine ships have service speeds of less than 14 knots, 69 have speeds of 14 to 17 knots, and five dry-cargo ships have speeds of 18 knots and over. Eight ships have oil-fired boilers, and 135 are diesel powered.

Ownership of the Singapore-registry "flag of convenience" fleet includes government, as well as foreign and domestic private elements, and is vested in some 49 beneficial owners (entities which assume the profit or loss from operations). The three largest owners (33% of total fleet deadweight tonnage), each with more than 100,000 d.w.t., are the government-owned Neptune Orient Lines, Ltd. (NOL), 112 ships, 112,031 d.w.t., and two privately owned shipping companies—Y.C. Chang (Pacific International Lines) (18 ships, 123,128 d.w.t.), and Singapore Cosmos Shipping Co., Ltd. (nine ships, 103,106 d.w.t.). There are 26 beneficial owners controlling a total of 45 ships of 400,039 d.w.t. under Singapore registry which have their main offices abroad. There are eight shipping companies known to be, or suspected of being, owned and/or controlled by the People's Republic of China, accounting for 38% (55 ships) of the total number of ships, and 41% (420,084 d.w.t.) of the total fleet deadweight tonnage. These shipping companies are:

SHIPPING COMPANY	No. OF SHIPS	D.W.T.
Y. C. Chang, Singapore	18	123,128
Guan Guan Shipping, Ltd., Singapore	16	90,466
Hong Kong Islands Shipping Co., Ltd., Hong Kong	3	27,662
Kie Hock Shipping, Ltd., Singapore	3	26,303
Rickmers Rhederei G.M.B.H., West Germany	1	15,552
Singapore Cosmos Shipping Co., Ltd., Singapore	9	103,106
Singapore Navigation Co., Ltd., Singapore	4	27,517
Singapore Shipping Development Co., Ltd., Singapore	1	6,350

Growth of the Singapore-registry fleet has been rapid and progressive since the flag of convenience legislation in January 1969. In April of that year, the fleet consisted of 45 ships of 1,000 g.r.t. and over, totaling 255,706 d.w.t. Since 1969, there has been a significant annual net increase of about 255,750 d.w.t. If this rate of increase continues, the government's goal of about 1.5 million d.w.t. will be reached within 2 years.

As of February 1972, 18 ships totaling 429,100 d.w.t. for Singapore registry were on order with delivery scheduled between 1972 and 1974. Included are five dry-cargo ships of 35,300 d.w.t., two container ships of 20,400 d.w.t., and three tankers of 284,600 d.w.t. to be constructed by foreign shipyards, and eight dry-cargo ships of 88,800 d.w.t. to be constructed by a domestic shipyard.

Trade operations of the Singapore-registry fleet are conducted principally in the Far East area; however, an increasing number of Singapore-flag ships are

FIGURE 7. Major ports (C)

NAME; LOCATION; ESTIMATED MILITARY PORT CAPACITY*	ACTIVITIES	HARBOR	BERTHS
Singapore 1°17'N., 103°48'E.; on S. shore of Singapore Island. 42,550	Transfer of general and bulk cargoes, particularly POL; container terminal; shipbuilding and repair.	Improved natural harbor, water area about 25 sq. miles; 3 principal divisions: Keppel Harbour; Western Anchorage; and Singapore Road, including East Lagoon container terminal.	Alongside—For 19 large, 8 standard, 4 small ocean-type cargo vessels; 2 standard and 3 small coaster-type cargo vessels; 74 lighters; 5 large, 6 standard, 4 small ocean-type tankers; 1 standard coaster-type tanker; 1 representative sound-and-river-type tank barge. Offshore pipeline berth—For 2 large ocean-type tankers. Mooring—Several buoys in Keppel Harbour for small craft. Anchorage—Numerous berths of all classes in Western Anchorage and Outer Roads.
Sembawang (formerly Her Majesty's Naval Base). 1°27'N., 103°50'E.; on N. shore of Singapore Island. 10,500	Transfer general cargo; maintenance and supply of British naval vessels assigned to Far East Fleet; naval operating base and headquarters of Commander, Far East Fleet; repair of naval and commercial vessels at former naval dockyard; naval base and headquarters Royal Malaysian Navy; POL transfer and bunkering.	Improved natural harbor occupying well-sheltered 7-sq.-mile section of Johore Strait extending about 10 miles E. from causeway connecting Singapore Island and Malaysia.	Alongside—For 3 small aircraft carriers; 1 each light cruiser, frigate, destroyer, and submarine; 7 large, 1 standard, and 2 small ocean-type cargo vessels; 1 each standard and small coaster-type cargo vessel; 3 lighters; 1 standard ocean-type tanker. Fixed mooring—For attack aircraft carrier and frigate and 5 standard ocean-type cargo vessels. Free-swinging—For small aircraft carrier. Anchorage—Numerous free-swinging berths of all classes in Johore Strait.
Jurong 1°19'N., 103°43'E.; on SW. shore of Singapore Island. 4,900	Mainly bulk cargo; POL transfer and bunkering; shipbuilding and repair.	Improved natural harbor occupying well-sheltered 5-mile section of Selat Sembilan (strait) between Singapore Island and cluster of islands to south.	Alongside—For 5 large ocean-type cargo vessels; 6 small coaster-type cargo vessels; 8 large ocean-type and 1 coaster-type tankers. Offshore pipeline berth—For single-buoy mooring for 250,000-ton supertanker. Anchorage—Numerous berths of all classes in strait and its approaches.

*The estimated port capacity is the maximum amount of general cargo—expressed in long tons—that can be unloaded onto the wharves and cleared from the wharf aprons during a period of one 24-hour day (20 effective cargo-working hours). The estimate is based on the static cargo-transfer facilities existing at the time the estimate is prepared and is designed for comparison rather than for operational purposes; it cannot be projected beyond a single day by straight multiplication.

being employed in trade in other areas of the world. Most of the ships are engaged in nonscheduled (tramp) operations, but many are in scheduled (liner) service or are under charter worldwide. Neptune Orient Lines, Ltd. (NOL), Guan Guan Shipping (Private), Ltd., Straits Steamship Co., Ltd., Kie Hock Shipping Co., Ltd., and Pacific International Line operate on a scheduled (liner) basis, maintaining service throughout Asia, Africa, Europe, the United States, and Australia. Singapore-register fleet passenger ships engage in passenger operations in the nearseas area.

Exports carried by the Singapore-register fleet include rubber, petroleum products, textiles, food products, machinery, and transport equipment; imports transported include textiles, industrial machinery, food products (live animals, rice, grains, fish, vegetables, and fruits), iron and steel, fertilizers, chemicals, and petroleum products.

In addition to ships of 1,000 g.r.t. and over, there are about 70 Singapore-register ships of 100 to 999 g.r.t., aggregating about 35,400 d.w.t., utilized primarily in coastal and nearseas trade. Most of these ships are engaged in trade with Malaysia and Indonesia. Among other countries served are China (PRC), North Korea, and North Vietnam; a substantial number of ships serving these areas are operated or chartered by Singapore shipping entities that are controlled or strongly influenced by China.

In 1969 the fishing fleet consisted of more than 900 small craft, which included 565 motorized units. Fishing operations extend from the inshore areas of Singapore to offshore areas extending into the South China Sea and the Indian Ocean.

Local interests beneficially own at least 36 ships of 1,000 g.r.t. and over totaling about 132,000 d.w.t. under foreign flag, including 22 registered in Panama, seven in Somalia, five in Malaysia, and two in Hong Kong.

Maritime matters are under the cognizance of the Marine Department of the Ministry of Communications. The Director of the Marine Department is the principal adviser to the Singapore Government on marine matters affecting merchant shipping, and is responsible for implementing maritime legislation.

The government encourages free trade and private enterprise, and no direct subsidization is provided the maritime industries; however, deferred terms of payment are offered to shipowners for domestically built ships designated for Singapore registry. Government policy encourages a viable, modern fleet capable of carrying a sizable portion of the nation's total seaborne trade aboard Singapore-register ships.

In consonance with this aim, the government supports Neptune Orient Lines, Ltd., in its bid to carry 40% of this trade as recommended for national shipping lines by the United Nations Conference on Trade and Development (UNCTAD). Singapore is a member of the Inter-Governmental Maritime Consultative Organization (IMCO) and a party to the following IMCO conventions: Safety of Life at Sea, 1948 and 1960; Prevention of Collisions at Sea, 1960; and Facilitation of International Maritime Traffic, 1965. Official policy discourages calls by Singapore-register vessels in the carriage of cargoes from Singapore to ports in North Vietnam; however, some Singapore-registered ships under charter carry cargoes to North Vietnam.

A flag of convenience registry was established in 1969 when the government amended the existing Merchant Shipping Ordinance to permit any person or company, irrespective of nationality and place of incorporation, to register their ships under the Singapore flag. Registration fees and tonnage tax rates under this legislation are lower than those offered by such well-established flags of convenience as Liberia, Panama, and Somalia. Shipping companies under Singapore registry are not subject to taxation on earnings, set fees are guaranteed for 20 years from date of registration, and a refund of 50% of the annual tonnage tax is granted if Singapore nationals comprise at least 25% of the crew.

As of March 1971, about 8,500 maritime personnel were registered for employment aboard domestic-flag vessels with the Singapore Seamen's Registry Board, a government agency. There is at present an overall shortage of trained Singaporean officers and seamen to man the merchant fleet. Compared with European standards, wages and other compensation for maritime personnel are low; however, certain fringe benefits complement the modest wage schedule. No maritime unions are registered in Singapore to represent seafaring personnel aboard Singapore-flag ships. The Singapore Employment Act of 1968, which affects maritime personnel, restricts workers' right to strike and also imposes wage restraints.

Maritime training facilities consist of the training ship, *Singapore*, and the School of Nautical Studies of the Singapore Polytechnic College. A 4-year training course is offered at the college with an annual enrollment of 185 cadets, including 75 deck, 80 engineering, and 30 radio operators. Upon successful completion of formal classwork, these new officers receive training aboard Singapore-flag ships. Ratings receive a 3-month training course aboard the training

ship in deck, engine room, and catering departments; about 500 of these seamen are trained annually.

F. Civil air (S)

Civil air transportation in Singapore has been developed entirely since World War II. Since that time the civil air fleet has played a major role in linking Singapore with Malaysia and its East Malaysia states of Sarawak and Sabah. These traditional routing arrangements were changed in late 1972 with the separation of the heretofore dominant Malaysia Singapore Airline (MSA) into two independent national airlines. Under this new arrangement, Singapore's national airline, Singapore Airlines (SIA), is entirely owned by the Government of Singapore.

The transition to an independent airline has caused SIA to temporarily issue a provisional timetable that will cover the first few months of the summer season. This timetable will reflect a shift in service whereby SIA will orient its services sharply toward international flights and reduce many of its regional flights to points in Malaysia. SIA officials have indicated they believe that service to the various cities of Malaysia was uneconomical; therefore, they voiced no objections when the Malaysians formed their own airline, known as the Malaysian Airline System (MAS), to serve Malaysia.

SIA has embarked on a vigorous program of expansion of international flights with service to 20 foreign cities in both Asia and Europe. Some of these services are operated in conjunction with pooling and operating agreements concluded in January 1963 with Cathay Pacific Airways, Ltd. (Hong Kong), and Thai Airways International, Ltd. Japan Air Lines and SIA have also worked out an agreement for joint operation of their route between Rome and Tokyo, with certain extensions both in Europe and in Asia.

The SIA air fleet consists of three Boeing 707-320B, two 707-320C, five 737-100, one 737-200, and two Fokker F-27-500 aircraft. Two of the 737's will probably be put up for sale as being superfluous to SIA's reduced regional needs now that MAS will be taking over that part of the operation. In 1972 SIA officials were considering the purchase of either Boeing 747 or DC-10 aircraft. However, three Boeing 707 aircraft were to be added to the SIA fleet in the latter half of 1972 for use by the airline pending the decision on whether to purchase the Boeing 747 or the DC-10 aircraft. The F-27's will be used for feeder and charter service.

SIA employs over 4,000 people and this number will probably rise sharply as the airline expands its

international operations. Pilots for SIA number 160, with an additional 24 pilot trainees undergoing instruction in different flying schools.

Aside from SIA, the chief air operator in Singapore is Saber Air, Ltd. Formed in 1966 as an air taxi service, Saber Air has undergone a number of reorganizations and name changes. In 1969, the Singapore Government acquired an 80% interest in its operations. In February 1971, a management and technical assistance pact was concluded with the U.S. supplemental airline, Overseas National Airways, in return for a 9% shareholding. Passenger and cargo charter and inclusive-tour flights are operated throughout the Far East with its air fleet of one DC-8, one DC-6, one Aztec, and one Cessna 337.

Twenty-three foreign airlines link Singapore with the rest of the world. Among these carriers are the Soviet airline, *Aeroflot*, and the Czechoslovak carrier, *Ceskoslovenske Aerolinie* (CSA). These air carriers operate into Singapore under a series of approximately 24 formal and informal agreements or arrangements.

Singapore is a party to the 1944 Convention on International Civil Aviation (Chicago Convention) and a member of the International Civil Aviation Organization. Within Singapore, civil air activities are administered by the Department of Civil Aviation, a government agency responsible to the Deputy Prime Minister's Office.

Private flying in Singapore is minimal, with only five or six independently owned and operated aircraft. There are some indications that the government is moving to encourage interest in aviation with the establishment of the Singapore Junior Flying Club and the University Air Squadron. The Junior Flying Club will use Cessna T-41 aircraft to train student pilots at Seletar airfield. The University Air Squadron will use six Vickers Airtourer-type aircraft to train students carefully selected from the University of Singapore. Another private flying club operating in Singapore is the Royal Flying Club, which owns a mixed lot of six light aircraft. This flying club has its own maintenance section and can overhaul light aircraft engines.

Singapore has complete service facilities for SIA aircraft except for engine overhaul. The engines are shipped abroad for major overhaul work.

SIA operates a Technical Training Center located in Singapore. This center offers pilot familiarization courses on the Boeing 707, 737, and F-27 aircraft. After World War II, about 100 aircrews and groundcrews from Singapore trained at Air Services Training, an aviation school in Perth, Scotland. Training for a number of SIA pilots has been provided

by the Indonesian Civil Aviation Academy at Tjurug, near Djakarta, and pilots and flight engineers for SIA's Boeing aircraft have been sent to the United States, New Zealand, and Australia for training. Singapore provides for training of its air traffic controllers at the Technical Training Center.

G. Airfields¹ (C)

The air facilities system of Singapore consists of five airfields and one seaplane station. Three airfields are military and two are civil; four have hard-surfaced runways. Details of the four best airfields are tabulated in Figure 8. The airfields are distributed throughout Singapore in a fairly even pattern, although a majority are in the eastern half of the island.

Singapore airfield, which has an 11,000-foot asphalt runway and facilities to support aircraft up to and including C-135 and Boeing 707 aircraft, has long been a pivotal point of global air traffic for Southeast Asia. Seletar, the other civil airfield, can accommodate Lockheed Constellations. Tengah airfield, which has a 9,000-foot asphalt runway, is the principal military base on the island. It can support sustained operations by jet light bombers and accommodated the Royal Air Force (RAF) V-bombers deployed there during the Indonesian confrontation crises. Changi, also a

¹For detailed information on air facilities in Singapore see Volume 25, *Airfields and Seaplane Stations of the World*, published by the Defense Mapping Agency, Aero Space Center (DMAAC) for the Defense Intelligence Agency.

significant military airfield, can accommodate C-121-type aircraft. Sembawang airfield, with a 2,250-foot pierced steel planking (PSP) runway, is the only temporary-surfaced facility in the country. Although of minor significance, it provides accommodations for helicopters, a photographic unit, and training facilities for a parachute and survival school. The one seaplane station is of limited value. In general, airfield maintenance is performed on an "as needed" basis and this will suffice to sustain the system at its present level.

There are no major development programs planned or underway which would significantly alter the present effectiveness of the air facilities system.

H. Telecommunications (C)

Singapore's telecommunication (telecom) system is one of the most modern in Southeast Asia, providing a variety of dependable domestic and international communication services. The telecom system consists mainly of modern landlines, submarine cables, and radio-relay networks radiating from the Singapore city area. These facilities are augmented by the Sentosa satellite ground station and the high-frequency (HF) radiocommunication network which maintains contact with most world centers.

The telecom system is operated under the cognizance of the Deputy Prime Minister. Supervisory responsibility is shared by the Department of Telecommunications, under the Ministry of Communications, and the Singapore Telephone Board; the latter operates the automatic telephone exchanges and

FIGURE 8. Selected Airfields (C)

NAME AND LOCATION	LONGEST RUNWAY: SURFACE; DIMENSIONS; ELEVATION ABOVE SEA LEVEL		ESWL*	LARGEST AIRCRAFT NORMALLY SUPPORTED	REMARKS
	Feet	Pounds			
Changi..... 1°12'N., 103°59'E.	Asphalt..... 7,985 x 150 10	60,160	C-121.....	Military. Aviation, jet fuel, and field maintenance available.	
Seletar..... 1°25'N., 103°52'E.	Asphalt..... 4,950 x 150 35	60,160	Lockheed Constellation...	Civil. Aviation, jet fuel, and depot maintenance available.	
Singapore..... 1°21'N., 103°55'E.	Asphalt..... 11,000 x 200 65	58,607	Boeing 707.....	Civil. International airport of entry. Aviation, jet fuel, and field maintenance available.	
Tengah..... 1°23'N., 103°43'E.	Asphalt..... 9,000 x 150 50	59,893	C-124.....	Military. Jet fuel and field maintenance available. Royal Air Force V-bombers were deployed here.	

*Equivalent Single-Wheel Loading: Capacity of an airfield runway to sustain the weight of any multiple-wheel landing-gear aircraft in terms of the single-wheel equivalent.

their cable equipment. The Broadcast Division, under the Ministry of Culture, operates the broadcast services; however, a commercial firm, Rediffusion Singapore, operates the wired-broadcast network. Special purpose telecommunication facilities are administered by the Department of Telecommunications. A new Telecommunications Authority of Singapore was established on 1 April 1972. Its mission is to provide, operate, and develop telecom services within and external to Singapore and to cooperate with other independent authorities in the expansion and improvement of such services.

Singapore has one of the highest telephone densities in Southeast Asia. As of 1 January 1972, there were 189,847 telephones, equivalent to nine telephones per 100 inhabitants. Telephone service is available to the public via 12 automatic telephone exchanges which have 154,600 lines of installed switching equipment and an ultimate exchange capacity of 192,159 lines. Over 1,200 public telephones are available for use throughout the island. Singapore's telephone system has been modernized and includes direct-dialing services. This system also is being updated to employ push-button dialing, with more than half the exchanges already equipped. Sophisticated cable systems have been installed which provide for the exchange of computer data. International direct-dialing service is being increased to include more foreign terminals, especially in Malaysia.

Singapore has a variety of international circuits connected to foreign terminals and is Southeast Asia's most important relay center. Perhaps the most significant addition to Singapore's international communications capability is the satellite ground station located on Sentosa. It is connected to Fort Canning (the island's major radio-relay terminal) by a microwave radio-relay link. The Sentosa facility has an installed capacity of 132 communication channels, but as of January 1973 only 54 circuits were in use for communications (via the Indian Ocean INTELSAT-IV satellite of the International Telecommunications Satellite Consortium) to Australia, Hong Kong, India, Indonesia, Japan, Philippines, Thailand, West Germany, and the United Kingdom. A second antenna is scheduled for operation (via the Pacific Ocean satellite INTELSAT-IV) by January 1974. Also, Singapore has been selected by the International Telecommunication Union (ITU) as one of the nine major worldwide transmit centers on the ITU Telephone World Routing Plan. Unfortunately, traffic previously intended for transmission via the SEACOM cable system, which links Singapore with Australia via East Malaysia, Hong Kong, Guam and New Guinea,

already exceeds its capacity of 80 telephone channels. A portion of the traffic overload has been diverted to the Sentosa satellite ground station. A single-conductor submarine cable provides very low-capacity telegraph communications to Pinang, Malaysia. Of considerable importance, however, are the regional radio-relay networks, which provide high-capacity communications to Malaysia and which are augmented by the existing HF radio facilities.

The regional communication circuits to Malaysia are extensive, and circuit capacity is being steadily increased. A low-capacity VHF radio-relay link originally connected Singapore with Malaysia. This was followed by installation of a 600-channel microwave radio-relay network, operating in the superhigh-frequency (SHF) band which links Alor Setar, Malaysia, with Singapore and provides telephone, telegraph, facsimile, data, and other traffic. Later, a 4-Gigahertz microwave radio-relay network, for the distribution of TV broadcasts only, was installed between Singapore and Kuala Lumpur, Malaysia. A 960-channel-capacity microwave radio-relay network, under construction between Kuala Lumpur and Singapore, was scheduled for completion in 1972.

Singapore maintains numerous special-purpose telecom networks. The most comprehensive of these is operated by the military, and mainly includes radiocommunication facilities. The SEACOM submarine cable also provides leased circuits for military use. Two coastal radio stations serve harbor craft and ships at sea and make Singapore the most important relay point for maritime communications in Southeast Asia. A modern civil aeronautical radiocommunication facility at Singapore international airfield provides excellent communication services. Both the police and meteorological departments have telecom networks; the police employ an extensive very high frequency (VHF) network and the weather service has a VHF radio-relay network for facsimile transmission. Mount Faber is the primary VHF radio installation for maritime communications. Additional leased VHF radio circuits are provided for other government agencies and private concerns.

AM, FM, and TV programs for domestic and international distribution originate at Singapore's complex of radio and TV facilities located on Caldecott Hill. AM broadcasts are transmitted from Jurong by five transmitters ranging in power from 7.5 to 100 kilowatts. FM broadcasts are transmitted by four FM transmitters of 12-kilowatt power, also located at Jurong. Television is broadcast by two

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transmitters, with a power of 80 kilowatts, located on Bukit Batok. The transmitters operate on Channels 5 and 8 and use the European 625-frame standard for transmission. Television programs are originated, and also are exchanged with Malaysia. Singapore also utilizes TV as an educational medium. By late 1972, approximately 268,000 licensed radio sets (and perhaps an equal number of unlicensed sets) and 193,120 TV sets were in operation. As of 1972, the wired-broadcast network served about 60,000 subscribers.

All equipment, except the telephone exchange equipment housed in air-conditioned buildings, is tropicalized to offset the harmful effects of the hot, humid climate. Intra-land cable connections are usually buried and are pressurized to reduce transmission interruption due to cable damage. Pressurization of cable facilities also insures continuity of service and assists in detecting and locating any faults. Equipment maintenance is excellent. Also, duplicate radio equipment and standby generators are installed at all radio-relay stations to insure continuous service.

Singapore may be a world leader in the employment of technically advanced automatic telephone exchange and cable facilities by 1975. Plans scheduled for completion by 1975 include construction of 960-channel-capacity radio-relay network (was scheduled for completion in 1972); an increase in the number of automatic telephone exchanges to 23; doubling the capacity of the automatic telephone exchanges and their subscriber equipment; installation of an international automatic telex exchange; doubling the

capacity of the domestic telex exchange; construction of a permanent modern telecom training center; and installation of a second satellite ground station antenna oriented toward the Pacific Ocean satellite by January 1974.

Singapore has a small but rapidly expanding telecommunications equipment industry which is composed of two distinct sectors. One produces primarily labor intensive precision components such as diodes, transistors, and integrated circuits. Production materials are imported from leading electronic producing firms in Japan, the United States, and Western Europe; these materials are processed and the finished products are returned to the parent companies abroad. The second sector produces end items such as radio sets, television receivers, and telephone handsets and switching equipment. Although some of these items are exported, radio and television sets are also imported. All complex items, such as radio and television broadcast equipment, are imported, the principal suppliers being Japan, the United States, and Western Europe.

In view of the constantly increasing demand for skilled telecom personnel, Singapore's telecom training facilities are barely adequate and must be augmented. Action has been taken in cooperation with the ITU, United Nations Development Program, and the Colombo Plan nations to establish a modern telecom training center in Singapore. Meanwhile, specialist training for selected engineers and technicians is provided by Australia, New Zealand, and the United Kingdom, and by selected ITU telecom specialists currently assigned to the temporary ITU telecom training center in Singapore.

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