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WORLD DEMAND FOR AIRPORT EQUIPMENT AND SERVICES

VOLUME 1

DEPARTMENT OF INDUSTRY
TRADE AND COMMERCE

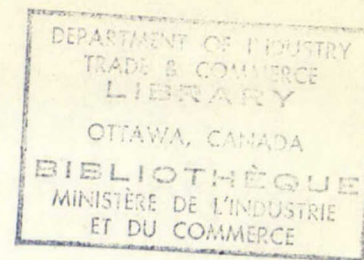


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THE WORLD DEMAND FOR

AIRPORT EQUIPMENT

AND SERVICES



PREPARED FOR
THE DEPARTMENT OF INDUSTRY,
TRADE AND COMMERCE
GOVERNMENT OF CANADA



BY

ACRES INTERTEL LIMITED

OTTAWA, CANADA

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FOREWORD

The following report is the result of a market study carried out on behalf of the Department of Industry, Trade and Commerce by Acres InterTel Limited.

The report provides a forecast of the world's demand for airport equipment and services for the period 1970-1980 with projections to 1990. In the context of the study, airport equipment means those equipment forming part of an airport system, highly specialized, and manufactured only by a small number of countries. In the services are included consulting for technico-economical feasibility studies, engineering design and management of airport construction.

The report consists of two volumes - Volume 1 is primarily a forecast of the world demand, in total and by region. For convenience, I.C.A.O. regional divisions were adopted. For each region, time series indicating the distribution of the forecasted demand is provided. The other main topics covered in Volume 1 are: the Canadian market and procurement history, foreign competition, airport financing, aviation traffic forecasts by region, equipment trends and technological forecasting.

Volume 2 provides specific market information about 86 countries. Vital economic, financial and trade statistics are given to help the reader formulate his own opinion of the market potential in each country. Except for the United States, the countries included in Volume 2 are countries largely dependant on import to satisfy their domestic airport equipment demand.

The estimated total world demand for airport equipment and services amounts to approximately \$9.2 billion. On a per capita basis, the distribution of this demand is very much higher for the industrial countries. Canada, Industrial Europe, U.S.S.R. and the U.S.A., taken together, account for close to \$6.8 billion, representing 74% of the total world demand.

The remaining countries account for the balance of only about \$2.4 billion. Most of these countries rely heavily on the Federal Republic of Germany, France, Holland, Italy, the United Kingdom and the U.S.A. as a source of procurement for the bulk of their sophisticated equipment.

Often, the requirements of many of the developing countries are met by their former colonial powers as a traditional tie, through financial assistance or aids.

Where Canada is concerned, it ranks second in the free world in terms of passenger traffic and domestic demand. Canada is practically self-sufficient in the manufacture of air navigation services equipment.

As a supplier on the world market, Canada does not as yet occupy a major position except for fire and rescue vehicles, baggage handling systems, passenger information displays and aircraft simulators.

It is of interest that the ratio of airport equipment demand in Canada to that in the U.S.A. is the same as that of the population in the countries. This is indicative of the similarity between the two countries in the field of air transport. It arises out of several common factors e.g. the growth of the GNP, geographic distribution of population, vastness of the countries, business activity, air-travel-mindedness of the population, the merit and ease of air travel over other modes of travel.

This similarity of air transport between Canada and the U.S.A. has given rise to many common interests between the two countries. There exists considerable liaison in the military aviation and a good deal of co-ordination in the matter of civil aviation. The recently concluded Memorandum of Understanding dated June 18, 1970, should further extend the scope of liaison and co-ordination in research and development and procurement of air navigation services equipment and in the development of STOL services.

In the U.S., the trend indicates a fast-growing demand for sophisticated radar and operation control equipment and also low cost VOR, ILS and DME. Canada will also experience similar needs. The close relationship proposed by the memorandum should facilitate the participation of Canadian industry in the development and supply of equipment to meet a portion of the anticipated demand for equipment and systems in both countries.

The introduction of the Bø-747 has created a quantum jump in the demand for ramp equipment and this demand will grow during the period covered by this study. Even Industrial Europe is known to be importing some equipment from the U.S.A. Canada should carry out, at an early date, a further "in-depth" study for ramp equipment. This type of equipment does not involve mass production techniques, but rather ingenuity and ability to quickly adapt production to meet each individual requirement. It is believed that Canada has the right "ingredients" to cater to this market.

There is a recognized need for STOL aircraft in the U.S.A. in substantial numbers, only the timing somewhat remains uncertain at present. Other countries like Afghanistan and Norway have adopted STOL aircraft to reach remote and inaccessible areas.

HIGHLIGHTS OF THE STUDY (Cont'd)

The Twin-Otter has already earned a name for the country. Canada is ready to go ahead with the production of the DHC-7. STOL transportation is a developing market. Canada has an enviable opportunity to penetrate this market in industrial countries as well as in the developing countries. Canada can enhance this opportunity considerably by offering a total system comprising the aircraft, air/ground communication and navigation systems, design and construction of STOLports. Here again, it would seem to warrant an in-depth study to evaluate the world demand for STOL systems.

The air traffic (passenger and cargo) does not show any sign of reduction during the 1970-1980 period. A three to fourfold increase in passenger traffic and sixfold increase in cargo traffic is probable. The increase in traffic is accompanied by increased demands for all classes of aviation equipment. The equipment may consist of conventional systems and evolutionary and revolutionary systems.

Manufacturers of conventional types of equipment and systems are too numerous in the world and those ten or twelve countries have for intents and purposes, enjoyed monopoly in the world market.

In the electronic field, the opportunities for Canada lie in penetrating the areas of some of the existing sophisticated systems and in the anticipated future systems, e.g. radar digitizers, ATC automation, microwave ILS, low

cost VOR and DME, inertial navigation systems, airborne satellite communications and navigation systems, approach and landing systems for STOL aircraft.

Early recognition of probable revolutionary events is essential in forecasting new types of demand. A forecast of technological and operational changes leads to an early definition of newer types of equipment to be generated by these changes. An instance in mind is the demand for a new family of ramp equipment that was generated by the Bo-747.

Modern methods of technological forecasting should be generalized. The MOD DELPHI experiment is a step in this direction.

The Department of Industry, Trade and Commerce has instituted a number of programs aimed at increasing export of Canadian equipment. A systematic monitoring of export is essential to measure the effect of these programs. At present it is practically impossible to know the exact volume of Canadian exports in the field of interest. The Dominion Bureau of Statistics do not differentiate airport equipment as such.

Publication of information on long-term development of airports in Canada is also of special importance to Canadian industry for advance forecasting of the domestic market. There does not appear to be any such current publication available.

The demand for airport equipment and services is generated by a number of interdependent factors:

- Air traffic growth.
- Construction of new airports to relieve those reaching saturation or to expand the air transport network.
- Introduction of new generations of aircraft imposing additional requirement on the ground segment of the air transport system.
- Adoption by international agencies of new or additional systems to control traffic and improve flight safety.
- Replacement of older or depreciated equipment.

The following three pages summarize the world demand forecast.

Considering the geographical distribution of the demand over the study period, several points are remarkable:

- The U.S. demand amounts to more than 50% of the world demand.
- The Canadian demand, if compared to the U.S. is in the ratio of the population of the two countries. This correlation is indicative of Canada/U.S. similarity in air transport needs.
- The Canadian demand is of the same order as that of certain regions having from 10 to 20 times larger population (i.e. Caribbean - South America, Africa - Indian Ocean).
- The Canadian domestic market is large and in the free-world second only to that of the U.S.

Considering now the total world demand by main categories of equipment. Over the study period the air navigation services equipment (in major part electronic equipment) represent the largest sector with radar contributing 40% of this sector.

Looking now at the evolution of the distribution of the forecast demand for the world less U.S. (1). On a percentage basis ramp equipment will become a major sector. This trend is in major part due to the introduction of wide body-aircraft and SSTs.

(1) The U.S. was not included in the trend analysis because its overwhelming preponderance would hide the general trend for the rest of the world. The U.S. is analyzed by itself in the relevant section of the chapter on Regional Demand.

1. THE WORLD DEMAND

PROJECTED WORLD REQUIREMENT FOR AIRPORT EQUIPMENT AND SERVICES

1970 - 1990

1. Geographical distribution of the demand

CANADA	
AIRNAV Services Equipment	127
Ramp Equipment	29
Terminal Equipment	12
Runway and Apron Equipment	30
Planned 1970-1980	198
Projected 1980-1990	250
TOTAL	448

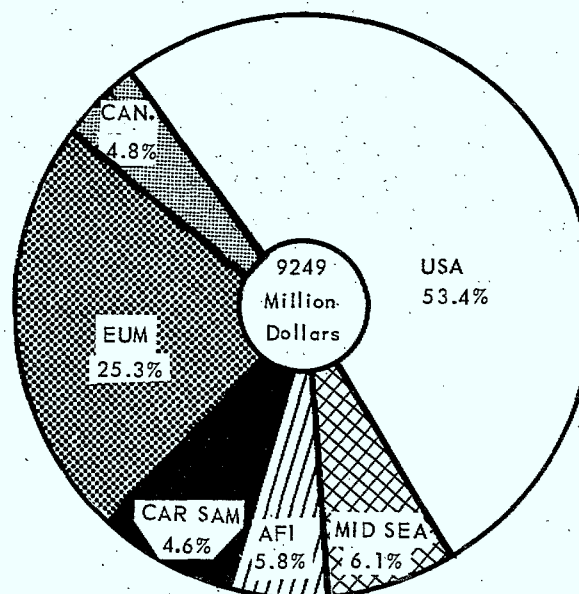
EUROPEAN - MEDITERRANEAN REGION (EUM)	
AIRNAV Services Equipment	982
Ramp Equipment	516
Terminal Equipment	251
Runway and Apron Equipment	363
Consulting Services	227
TOTAL	2339

CARIBBEAN - SOUTH AMERICA REGION (CAR SAM)	
AIRNAV Services Equipment	213
Ramp Equipment	100
Terminal Equipment	38
Runway and Apron Equipment	58
Consulting Services	16
TOTAL	425

AFRICA - INDIAN OCEAN REGION (AFI)	
AIRNAV Services Equipment	198
Ramp Equipment	163
Terminal Equipment	73
Runway and Apron Equipment	75
Consulting Services	32
TOTAL	541

UNITED STATES	
AIRNAV Services Equipment	970
Ramp Equipment	426
Terminal Equipment	226
Runway and Apron Equipment	371
Consulting Services	200
Planned 1970-1980	2,193
Projected 1980-1990	2,741
TOTAL	4,934

MIDDLE EAST - SOUTH EAST ASIA REGION (MID SEA)	
AIRNAV Services Equipment	272
Ramp Equipment	142
Terminal Equipment	56
Runway and Apron Equipment	63
Consulting Services	29
TOTAL	562



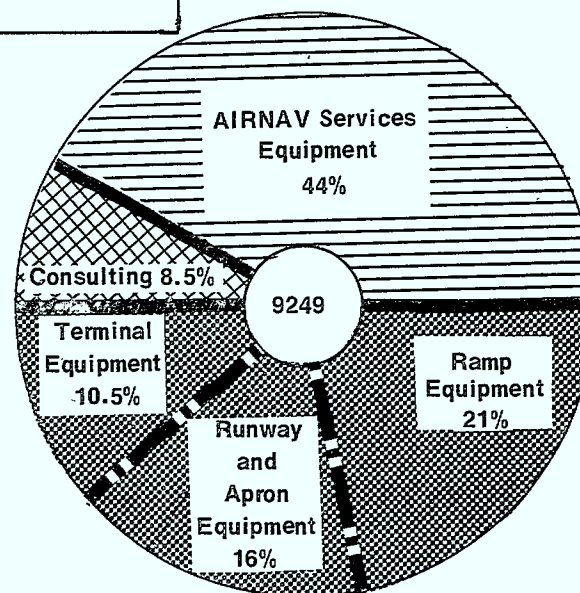
(All values in millions of U.S. dollars unless otherwise indicated)

PROJECTED WORLD REQUIREMENT FOR AIRPORT EQUIPMENT AND SERVICES

1970 - 1990

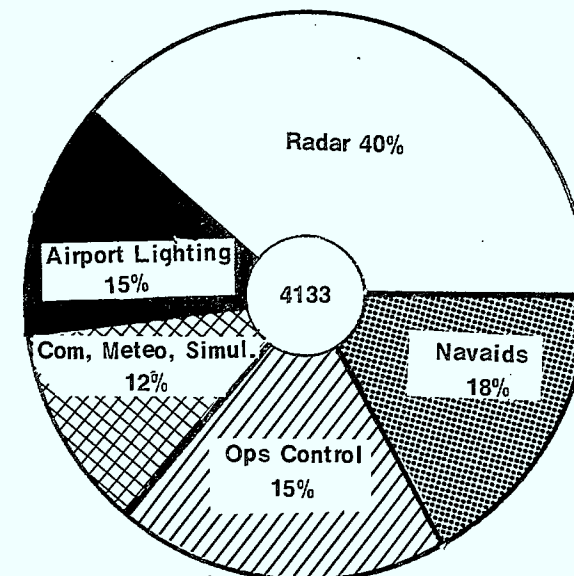
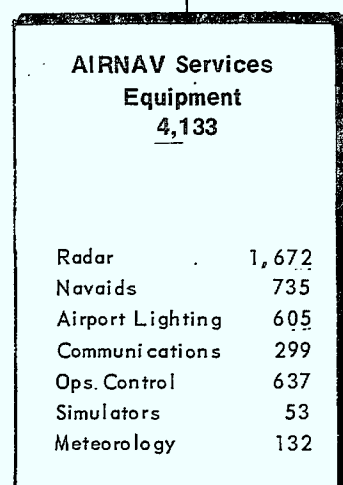
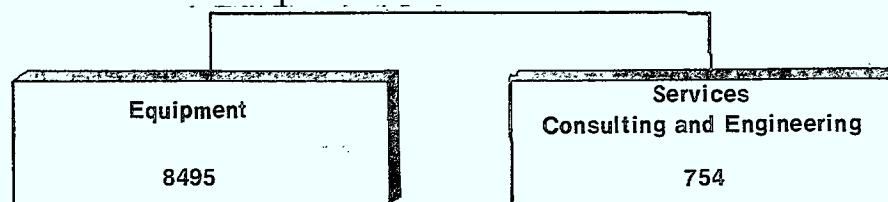
1. THE WORLD DEMAND

2. Distribution by category of equipment

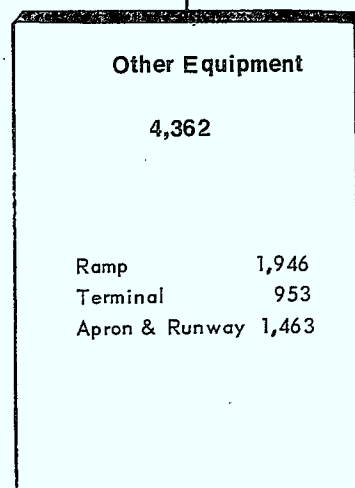


WORLD DEMAND for EQUIPMENT and SERVICES (1970-1990)

WORLD DEMAND for EQUIPMENT and SERVICES (1970-1990)
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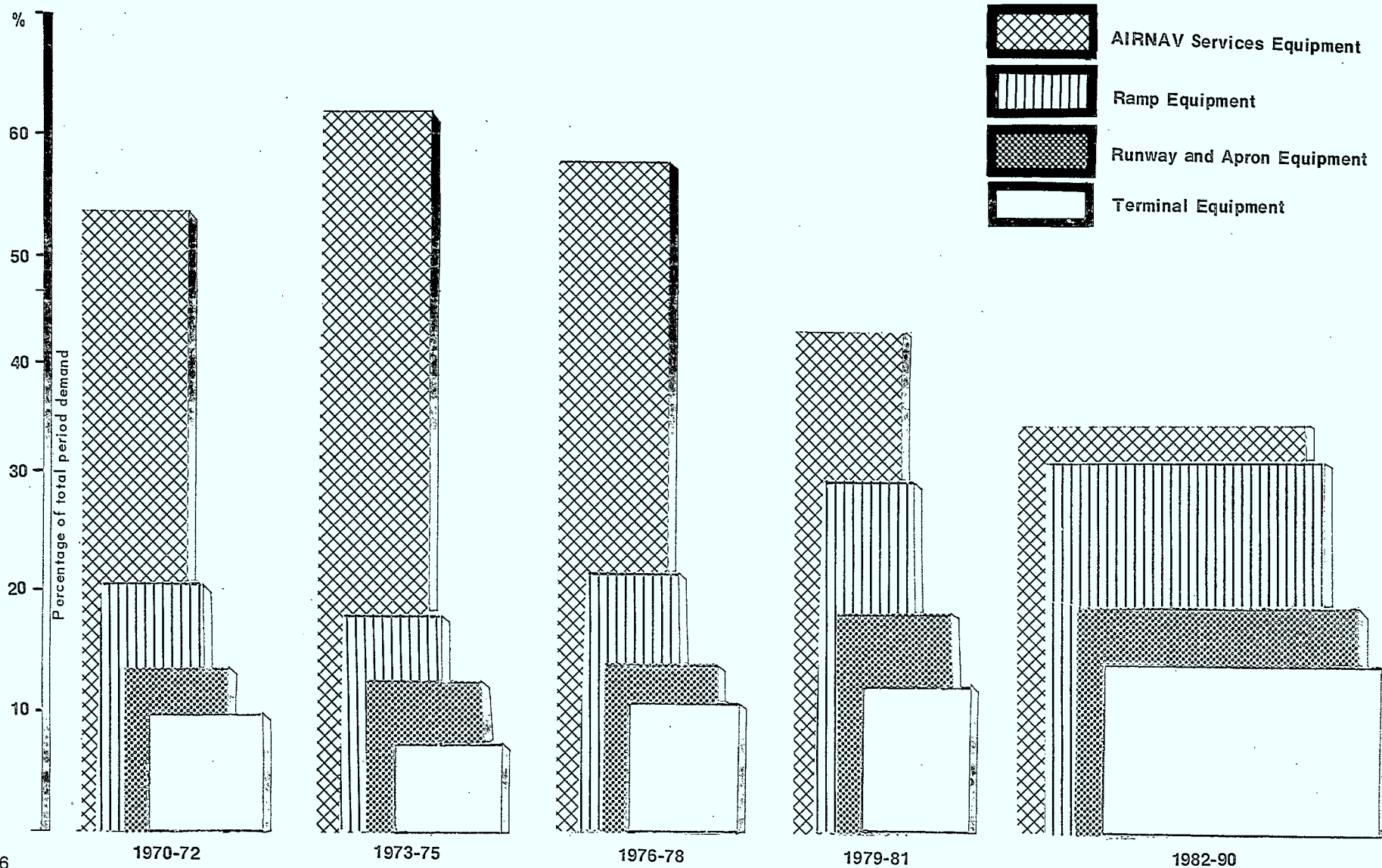
WORLD DEMAND for AIRNAV SERVICES EQUIPMENT (1970-1990)



(All values in million US Dollars)

1. THE WORLD DEMAND

EXPECTED EVOLUTION OF THE WORLD DEMAND FOR EQUIPMENT
(Expressed as a percentage of the total forecast demand for each period)



The following section is a detailed forecast of the demand for equipment and services for the following regions:

- Africa - Indian Ocean
- Caribbean and South America
- Europe and Mediterranean
- Middle East and South East Asia
- The United States

For each region the first page lists all countries included. Canada is the object of a separate treatment.

All cost forecasts are in 1970 U.S. dollars (i.e. the effect of inflation on future cost was not considered).

A table showing the expected change in number of important airports during the forecast period is provided for each region. In this context an important airport is an airport having a significant amount of equipment. For the purpose of the study an airport classification based on volume of traffic was adopted :

Airport Category	Volume of traffic (annual)
A	more than 100,000 air movements
B	between 10,000 and 100,000 air movements
C	less than 10,000 air movements.

2. REGIONAL DEMAND

Africa - Indian Ocean Region

AFRICAN STATES INCLUDED IN THE SURVEY:

	<u>Member States of ASECNA</u>
Algeria	
Congo D.R.	
Ethiopia	Cameroon
Ghana	Central African Republic
Guinea	Chad
Liberia	Congo
Libya	Dahomey
Malawi	Gabon
Morocco	Ivory Coast
Nigeria	Mali
Rhodesia	Mauritania
Rwanda	Malagasy Republic
Sudan	Niger
Tunisia	Senegal
United Arab Republic	Togo
Zambia	Upper Volta

East African Community

Kenya
Tanzania
Uganda

IMPORTANT AIRPORTS - GROWTH TABLE

Airport Category	Existing		Expected Growth				Operational 1990
	1970	1970-72	1973-75	1976-78	1979-81	1982-90	
C	55	4	6	6	7	18	96
B	39	1	2	4	5	10	61
A	0	0	0	0	1	2	3

Africa-Indian Ocean Region.

Essentially, the countries in the African continent comprise this Region.

From the view-point of provisioning of airport equipment, particularly the air navigation services equipment, it would perhaps be logical to group the countries as Francophone, Anglophone and Others in the context of their historical background.

The Francophone countries are virtually those in which ASECNA* operates, and the Anglophone are the countries like Gambia, Kenya, Liberia, Malawi, Nigeria, Tanzania and Zambia.

The equipment in the Francophone countries originated from France and still mostly continues to be so. More or less similar is the case with the Anglophone countries. Although these countries exercise some degree of flexibility, they still have preference for the British equipment. The group Others maintains somewhat of an open mind to the extent it is economically, or politically expedient.

Any leaning toward a particular type or manufacture of equipment stems from the fact that a country prefers to avoid multiplicity in equipment types to facilitate deployment of equipment, provision of spare parts and training of personnel. This tendency, however, is not peculiar only to the countries in Africa.

Inasmuch as all the countries in this area are keen to introduce more modern equipment and systems, several of them are limited by economic reasons, trained personnel and training facilities.

* For a brief description of ASECNA see Vol. II of "The World Demand for Airport Equipment and Services," page 81.

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND
Africa - Indian Ocean Region

COMMUNICATIONS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. HF Transmitter	91	1365	126	1890	49	735	49	735	122	1830	437	6555
2. HF Receiver	291	728	359	898	102	255	138	345	384	960	1274	3186
3. VHF Transmitter/Receiver	105	546	156	811	110	572	79	411	184	957	634	3297
4. Extended Range VHF	18	630	24	840	10	350	8	280	26	910	86	3010
5. UHF Transmitter/Receiver	0	0	0	0	0	0	0	0	0	0	0	0
6. FSK Unit/FS Converter	101	152	80	120	26	39	59	89	153	230	419	630
7. Telegraph Equipment	90	495	376	2068	36	198	0	0	0	0	502	2761
8. Message Switching System	5	600	20	2400	2	240	0	0	0	0	27	3240
9. Automatic Error Correction	4	22	11	61	2	11	0	0	6	33	23	127
10. Selcal System	52	78	14	21	0	0	0	0	66	99	132	198
TOTALS		4615		9109		2400		1860		5016		23004

OPERATIONAL CONTROL

1. Automatic ATC System	0	0	5	1250	6	1500	1	250	1	250	13	3250
2. ATC Console	12	72	19	114	21	126	18	108	1	6	71	426
3. Communications Control Console	4	60	21	315	1	15	0	0	6	90	32	480
4. Transportable Control Tower	3	27	18	162	6	54	14	126	7	63	48	432
5. Recorder	95	855	55	495	34	306	50	450	92	828	326	2934
TOTALS		1014		2336		2001		934		1237		7522

2. REGIONAL DEMAND
Africa - Indian Ocean Region

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

RADAR	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ARSR	1	880	2	1760	9	7920	2	1760	0	0	14	12320
2. Terminal & Approach RADAR	6	3600	9	5400	9	5400	8	4800	17	10200	49	29400
3. SSR	0	0	6	3000	15	7500	0	0	0	0	21	10500
4. PAR	1	450	5	2250	0	0	1	450	2	900	9	4050
5. Bright Display	0	0	17	3060	10	1800	0	0	0	0	27	4860
6. RADAR Digitizer	0	0	6	900	7	1050	0	0	0	0	13	1950
7. ASDE	0	0	0	0	0	0	3	600	2	400	5	1000
8. Weather RADAR (Wx)	0	0	16	3200	11	2200	2	400	4	800	33	6600
TOTALS		4930		19570		25870		8010		12300		70680

NAVAIDS

1. VOR	25	1750	24	1680	24	1680	19	1330	42	2940	134	9380
2. DME	20	1500	4	300	22	1650	9	675	20	1500	75	5625
3. TACAN	0	0	0	0	0	0	0	0	0	0	0	0
4. NDB	11	132	60	720	93	1116	33	396	81	972	278	3336
5. VDF	14	490	27	945	17	595	8	280	35	1225	101	3535
6. ILS	18	3330	8	1480	14	2590	12	2220	30	5550	82	15170
7. VOT	36	288	30	240	0	0	0	0	66	528	132	1056
TOTALS		7490		5365		7631		4901		12715		38102

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND Africa - Indian Ocean Region

SIMULATORS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ATC Simulator	6	240	19	760	7	280	3	120	6	240	41	1640
2. RADAR Simulator	12	840	9	630	6	420	4	280	2	140	33	2310
TOTALS		1080		1390		700		400		380		3950

AIRFIELD LIGHTING

1. Precision Approach	21	1575	17	1275	11	825	3	225	29	2175	81	6075
2. Simple Approach	26	780	28	840	41	1230	25	750	49	1470	169	5070
3. Vasi	40	600	78	1170	53	795	49	735	118	1770	338	5070
4. Runway, Threshold, & End	0	0	19	950	40	2000	59	2950	44	2200	162	8100
5. Centre Line	8	1600	20	4000	1	200	9	1800	12	2400	50	10000
6. Runway Touchdown Zone	8	1200	20	300	1	150	9	1350	12	1800	50	7500
7. Taxiway	3	120	15	600	22	880	42	1680	51	2040	133	5320
8. Beacon	11	110	26	260	23	230	12	120	17	170	89	890
TOTALS		5985		12095		6310		9610		14025		48025

METEOROLOGICAL

1. Automatic Weather Station	14	112	34	272	39	240	20	160	66	528	164	1312
2. Runway Visual Range Computer	9	72	12	96	22	176	8	64	39	312	90	720
3. Ceilometer	36	360	44	440	12	120	4	40	70	700	166	1660
4. Transmissometer	58	580	68	680	20	200	8	80	126	1260	280	2800
TOTALS		1124		1488		736		344		2800		6492

2. REGIONAL DEMAND
Africa - Indian Ocean Region

OTHER EQUIPMENT

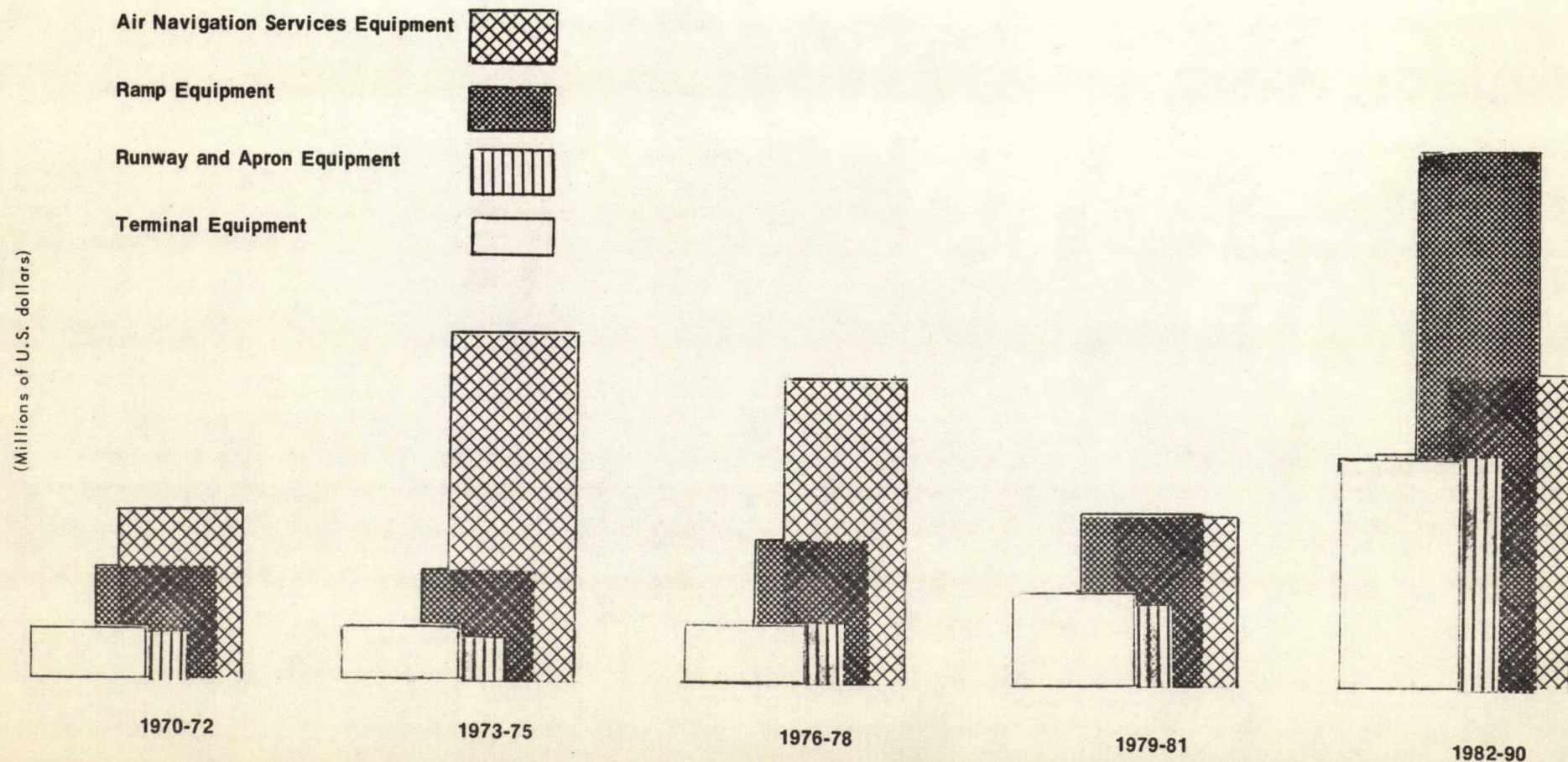
	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
RAMP EQUIPMENT						
1. Passenger Loading - Standard	1216	1311	1491	1824	5728	11571
2. Passenger Loading - Jumbo	360	180	540	750	2430	4260
3. Aircraft Services - Standard	8307	8897	10195	12332	38848	78580
4. Aircraft Services - Jumbo	692	346	1038	1185	3901	7162
5. Towing - Standard	2263	2419	2781	3274	10306	21044
6. Towing - Jumbo	1000	500	1500	1500	5000	9500
7. Baggage and Freight Loading - Std	2436	2437	3077	3701	11729	23381
8. Baggage and Freight Loading - Jumbo	742	583	1012	1191	3836	7365
TOTAL	17016	16673	21636	25758	81778	162863
TERMINAL EQUIPMENT						
1. Passenger Information	568	609	689	874	2784	5524
2. Baggage Handling Systems	980	1050	1190	1980	6220	11420
3. Elevators/Escalators	4310	4650	5255	6460	20365	41040
4. Control Power Supply	1560	1680	1920	2360	7400	14920
TOTAL	7418	7989	9054	11674	36769	72904
RUNWAY and APRON						
1. Fire and Rescue	5920	6405	7085	8400	26850	54660
2. Sweepers	2086	2252	2546	3178	9986	20048
3. Snow Removal	0	0	0	0	0	0
TOTAL	8006	8657	9631	11578	36836	74708

2. REGIONAL DEMAND
Africa - Indian Ocean Region

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	1225	2730	3430	7735	17290	32410

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



2. REGIONAL DEMAND

Caribbean and South American Regions

Argentina	Cuba	Nicaragua
Bahamas	Dominican Republic	Paraguay
Barbados	Ecuador	Trinidad &
Bolivia	El Salvador	Tobago
Brazil	Guatemala	Uruguay
Chile	Jamaica	Venezuela
Colombia	Mexico	Peru

The **Caribbean Region** is composed of a collection of islands, some of which are almost diminutive in size.

In the matter of provisioning of airport equipment, generally speaking, some of the Caribbean countries are British-oriented; some rely on France and some on the Netherlands, depending on their historical or political background. Then, there are countries like Cuba which depend on the U.S.S.R. and other communist sources. Puerto Rico's needs, on the other hand, are met by the U.S.A.

Mexico's main source of import of airport equipment, especially those meant for air navigation services, continues to be the U.S.A.

Regarding the **South American** countries, practically all of them at one time depended on the U.S.A. manufacturers. Much of the existing equipment in this area, in consequence, is of U.S.A. origin. Of late, however, these countries are turning to other countries including Canada to obtain their requirements.

Most of the countries in the Caribbean and South American Regions find it difficult to keep pace with the modernization of airport equipment and systems and some even lag behind in the implementation of plans because of economic reasons, lack of trained personnel and, at times, organizational structures.

IMPORTANT AIRPORTS - GROWTH TABLE

Airport Category	Existing	Expected Growth					Operational 1990
	1970	1970-72	1973-75	1976-78	1979-81	1982-90	
C	74	4	5	5	6	13	107
B	5	2	2	3	2	9	23
A	0	0	0	0	0	0	0

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND Caribbean and South American Regions

COMMUNICATIONS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. HF Transmitter	89	1335	110	1650	43	645	65	975	159	2385	466	6990
2. HF Receiver	246	615	311	777	157	392	162	405	382	955	1258	3144
3. VHF Transmitter/Receiver	116	603	182	946	149	775	215	1118	618	3214	1280	6656
4. Extended Range VHF	28	980	6	210	12	420	12	420	52	1820	110	3850
5. UHF Transmitter/Receiver	0	0	7	406	2	116	3	174	8	464	20	1160
6. FSK Unit/FS Converter	103	154	86	129	26	39	43	64	126	189	384	575
7. Telegraph Equipment	135	742	130	715	160	880	40	220	130	715	595	3272
8. Message Switching System	6	720	7	840	8	960	4	480	12	1440	37	4440
9. Automatic Error Correction	4	22	4	22	6	33	0	0	1	5	15	82
10. Selcal System	48	72	46	69	0	0	0	0	122	183	216	324
TOTALS		5243		5764		4260		3856		11370		30493

OPERATIONAL CONTROL

1. Automatic ATC System	0	0	2	500	12	3000	3	750	4	1000	21	5250
2. ATC Console	7	42	12	72	10	60	11	66	11	66	51	306
3. Communications Control Console	6	90	7	105	8	120	1	15	7	105	29	435
4. Transportable Control Tower	2	8	7	28	3	12	2	8	2	8	16	64
5. Recorder	89	801	137	1233	111	999	50	450	339	3051	726	6534
TOTALS		941		1938		4191		1289		4230		12589

2. REGIONAL DEMAND

Caribbean and South American Regions

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

RADAR	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ARSR	2	1800	7	6300	2	1800	3	2700	1	900	15	13500
2. Terminal & Approach RADAR	12	7200	10	6000	8	4800	3	1800	13	7800	46	27600
3. SSR	1	500	7	3500	10	5000	2	1000	4	2000	24	12000
4. PAR	7	3150	2	900	3	1350	1	450	2	900	15	6750
5. Bright Display	6	1080	8	1440	4	720	4	720	2	360	24	4320
6. RADAR Digitizer	0	0	4	600	10	1500	1	150	4	600	19	2850
7. ASDE	0	0	0	0	0	0	4	800	2	400	6	1200
8. Weather RADAR	3	600	10	200	5	1000	2	400	4	800	24	4800
TOTALS		14330		20740		16170		8020		13760		73020

NAVAIDS

1. VOR	27	1890	47	3290	56	3920	43	3010	107	7490	280	19600
2. DME	12	900	5	375	38	2850	38	2850	24	1800	117	8775
3. TACAN	0	0	0	0	0	0	0	0	0	0	0	0
4. NDB	10	120	40	480	52	624	39	468	89	1068	230	2760
5. VDF	0	0	13	455	0	0	11	385	19	665	43	1505
6. ILS	8	1480	7	1295	19	3515	14	2590	11	2035	59	10915
7. VOT	6	48	40	320	2	16	0	0	46	368	94	752
TOTALS		4438		6215		10925		9303		13426		44307

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND

Caribbean and South American Regions

SIMULATORS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ATC Simulator	3	120	4	160	6	240	1	40	5	200	19	760
2. RADAR Simulator	2	140	4	280	6	420	1	70	3	210	16	1120
		<u>260</u>		<u>440</u>		<u>660</u>		<u>110</u>		<u>410</u>		<u>1880</u>

AIRFIELD LIGHTING

1. Precision Approach	3	225	5	375	8	600	6	450	26	1950	48	3600
2. Simple Approach	11	330	19	570	17	510	12	360	47	1410	106	3180
3. Vasi	14	210	14	210	43	645	47	705	113	1695	274	3465
4. Runway, Threshold, & End	5	250	16	800	27	1350	46	2300	66	3300	160	8000
5. Centre Line	8	1600	6	1200	12	2400	12	2400	20	4000	58	11600
6. Runway Touchdown Zone	8	1200	6	900	12	1800	12	1800	20	300	58	8700
7. Taxiway	6	240	25	1000	30	1200	24	960	71	2840	156	6240
8. Beacon	14	140	16	170	13	130	20	200	52	520	115	1160
TOTALS		<u>4195</u>		<u>5225</u>		<u>8635</u>		<u>9175</u>		<u>18715</u>		<u>45945</u>

METEOROLOGICAL

1. Automatic Weather Broadcast	16	128	17	136	19	152	17	136	51	408	120	960
2. Runway Visual Range Computer	3	24	11	88	8	64	6	48	21	168	49	392
3. Ceilometer	17	170	23	230	31	310	21	210	45	450	137	1370
4. Transmissometer	0	0	36	360	51	510	38	380	84	840	209	2090
TOTALS		<u>322</u>		<u>814</u>		<u>1036</u>		<u>774</u>		<u>1866</u>		<u>4812</u>

2. REGIONAL DEMAND

Caribbean and South American Regions

OTHER EQUIPMENT

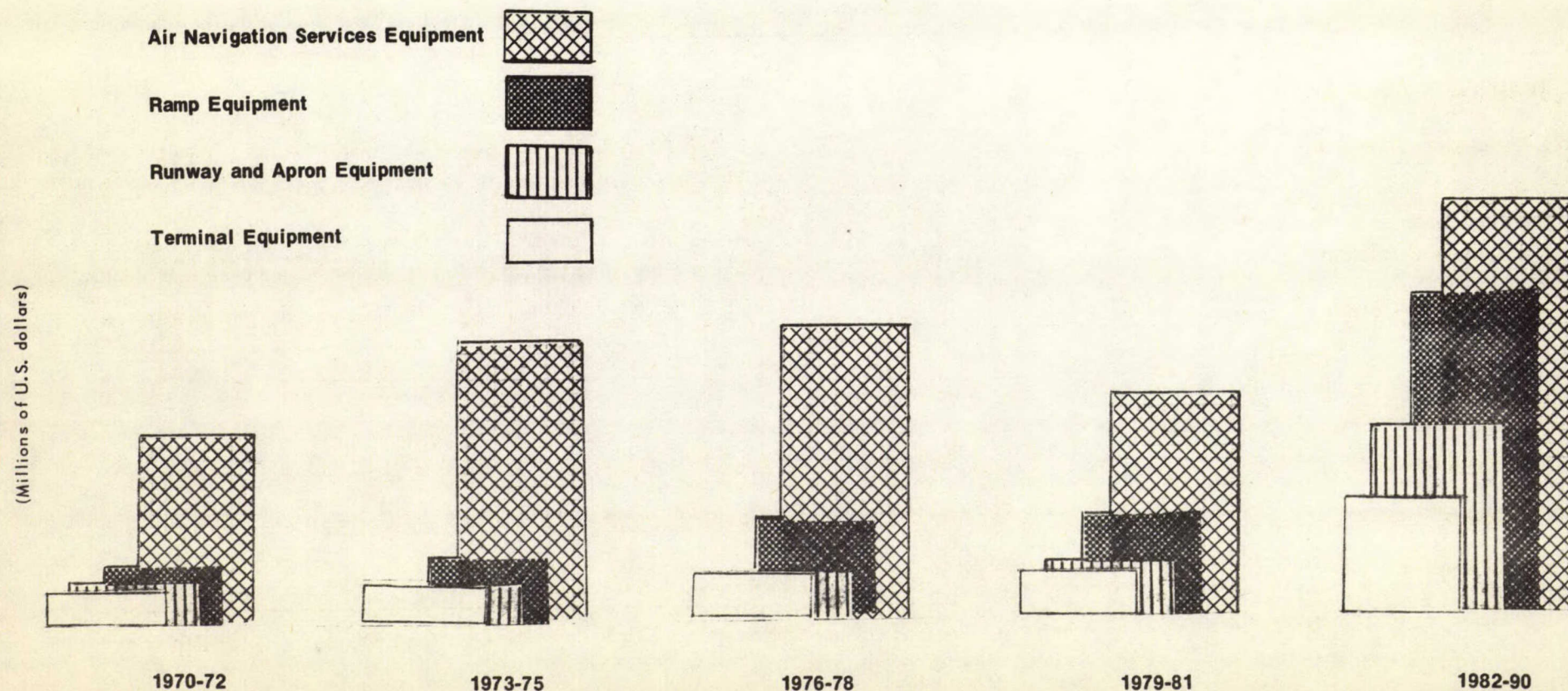
	1970-72 \$,000	1973-75 \$,000	1976-78 \$,000	1979-81 \$,000	1982-90 \$,000	TOTAL \$,000
RAMP EQUIPMENT						
1. Passenger Loading - Standard	750	769	921	988	3344	6773
2. Passenger Loading - Jumbo	180	270	360	570	1440	2820
3. Aircraft Services - Standard	4982	5133	6187	6682	22775	45760
4. Aircraft Services - Jumbo	346	519	692	1060	2768	5385
5. Towing -Standard	1610	1667	1943	2132	7045	14398
6. Towing - Jumbo	500	750	1000	1625	4000	7875
7. Baggage and Freight Loading - Std	1170	1271	1628	1920	6275	12265
8. Baggage and Freight Loading - Jumbo	429	530	668	926	2556	5111
TOTAL	9969	10909	13400	15904	50204	100388
TERMINAL EQUIPMENT						
1. Passenger Information	146	147	227	230	1004	1754
2. Baggage Handling Systems	210	210	350	350	1610	2730
3. Elevators/Escalators	2785	2860	3390	3690	12395	25120
4. Control Power Supply	860	880	1080	1140	3980	7940
TOTAL	4001	4097	5047	5410	18989	37544
RUNWAY and APRON						
1. Fire and Rescue	4790	4935	5615	6050	20000	41390
2. Sweepers	1428	1468	1720	1876	6258	12750
3. Snow Removal	303	583	418	599	2015	3920
TOTAL	6521	6986	7753	8525	28273	58060

2. REGIONAL DEMAND
Caribbean and South American Regions

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	1925	2625	1925	7665	7665	16065

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



2. REGIONAL DEMAND

European - Mediterranean Region

<u>Industrial Europe</u>	<u>Other Europe</u>	
Belgium	Austria	Ireland
Denmark	Bulgaria	Poland
France	Czechoslovakia	Portugal
Germany (West)	Finland	Romania
Italy	Germany (East)	Spain
Luxemburg	Greece	Switzerland
Netherland	Hungary	Yugoslavia
Norway		
Sweden		
United Kingdom	<u>USSR</u>	

IMPORTANT AIRPORTS - GROWTH TABLE

Airport Category	Existing 1970	Expected Growth					Operational 1990
	1970-72	1973-75	1976-78	1979-81	1982-90		
Industrial Europe							
C	76	1	2	2	4	8	93
B	26	1	1	1	1	5	35
A	7	0	1	2	3	9	22
U.S.S.R.							
C	*	10	20	25	25	60	
B	*	5	10	12	13	30	
A	*	0	2	2	2	6	
Other Europe							
C	43	1	2	1	1	4	52
B	15	1	2	3	3	8	32
A	2	0	0	1	1	5	7

European-Mediterranean Region

In dealing with airport equipment this Region can be considered to be composed of Industrial Europe, Other Europe, and U.S.S.R.

The countries in Industrial Europe are highly industrialized, and collectively they possess very high degree of potentiality for the manufacture of aviation equipment not only to meet their own requirements but also to export.

Among the Other European countries, Ireland and Switzerland cater to their needs from indigenous products as well as imports, mostly from Industrial Europe, Greece, Portugal and Spain generally rely on Industrial Europe for their procurements, although Greece has somewhat of a leaning toward the U.S.A. equipment.

The bulk of the remaining countries heavily rely on U.S.S.R. as the source, the exception being East Germany, Czechoslovakia and, to an extent, Yugoslavia. These countries have the capability of manufacturing limited types of airport equipment including radars and fire fighting equipment. All these countries are, however, tending to expose themselves to the western world markets.

U.S.S.R., despite its own capabilities, is known to have imported specialized types of equipment, such as ILS and radars, from the western world.

As an overall review, some countries of even the Industrial Europe are now importing baggage handling equipment and passenger information displays from countries outside Europe.

* Unknown

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND European - Mediterranean Region Industrial Europe

	1970-72 \$,000	1973-75 \$,000	1976-78 \$,000	1979-81 \$,000	1982-90 \$,000	TOTAL \$,000
1. Radars	16809	31550	30019	24329	58999	161706
2. Nav aids	8558	13822	13131	11940	23292	70743
3. Simulators	2769	4520	4250	3370	8259	23218
4. Airfield Lighting	4104	6689	7010	7125	15919	40847
5. Meteorology	2198	3586	3416	2706	6375	18281
6. Communications	1891	3580	3116	3125	6835	18547
7. Ops Control	7960	13416	12556	9883	23878	67693
TOTAL	44289	77213	73498	62478	143557	401035

2. REGIONAL DEMAND

OTHER EQUIPMENT

European - Mediterranean Region

Industrial Europe

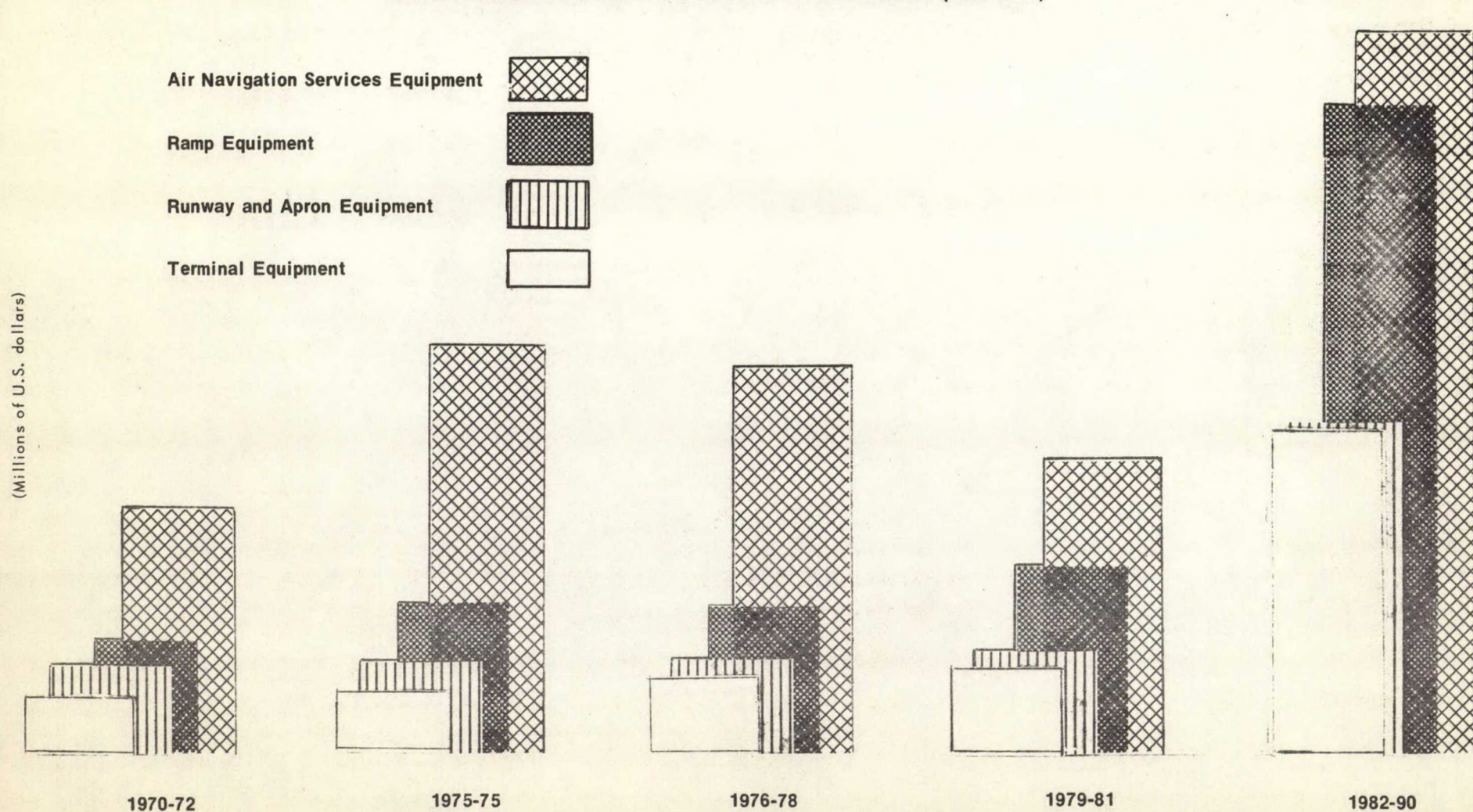
	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
RAMP EQUIPMENT	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
1. Passenger Loading -Standard	1377	1539	1719	2023	6897	13556
2. Passenger Loading - Jumbo	690	1080	1380	1860	7140	12150
3. Aircraft Services - Standard	9051	10083	11203	13122	44840	88301
4. Aircraft Services - Jumbo	660	1153	1473	2073	8078	13437
5. Towing - Standard	2360	2564	2786	3179	10598	21488
6. Towing - Jumbo	500	1000	1250	1750	7000	11500
7. Baggage and Freight Loading - Std	2566	3049	3505	4250	14993	28364
8. Baggage and Freight Loading - Jumbo	819	1135	1362	1761	6471	11549
TOTAL	18024	21604	24679	30020	106018	200346
TERMINAL EQUIPMENT						
1. Passenger Information	583	687	829	939	3724	6762
2. Baggage Handling Systems	1930	2580	3300	3950	16750	28510
3. Elevators/Escalators	4975	5575	6250	7340	25175	49315
4. Control Power Supply	1760	1980	2220	2620	9060	17640
TOTAL	9248	10822	12599	14849	54709	102227
RUNWAY and APRON						
1. Fire and Rescue	6410	6920	7045	8515	27555	56425
2. Sweepers	2572	2912	2960	3874	13030	25348
3. Snow Removal	3134	4239	5210	4949	16135	33669
TOTAL	12116	14051	15215	17338	56720	115442

2. REGIONAL DEMAND
European - Mediterranean Region
Industrial Europe

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	910	5215	9310	13510	42140	71085

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



2. REGIONAL DEMAND
European - Mediterranean Region
U.S.S.R.

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

	1970-72 \$,000	1973-75 \$,000	1976-78 \$,000	1979-81 \$,000	1982-90 \$,000	TOTAL \$,000
1. Radars	6010	22899	25149	23419	57919	135399
2. Nav aids	2550	9699	10659	9920	24539	57369
3. Simulators	240	899	990	920	2289	5339
4. Airfield Lighting	3159	12050	13239	12319	30490	71259
5. Meteorology	430	1630	1789	1659	4119	9629
6. Communications	2270	8649	9500	8840	21869	51129
7. Ops Control	1149	4399	4829	4500	11130	26009
TOTAL	15809	60229	66159	61579	152359	356139

Note: The forecast for U.S.S.R. is based on published new airport construction plans in the period 1970 - 90. Information concerning existing airports was not available, consequently the forecast does not include equipment replacement for the latter.

OTHER EQUIPMENT

2. REGIONAL DEMAND
European - Mediterranean Region
U.S.S.R.

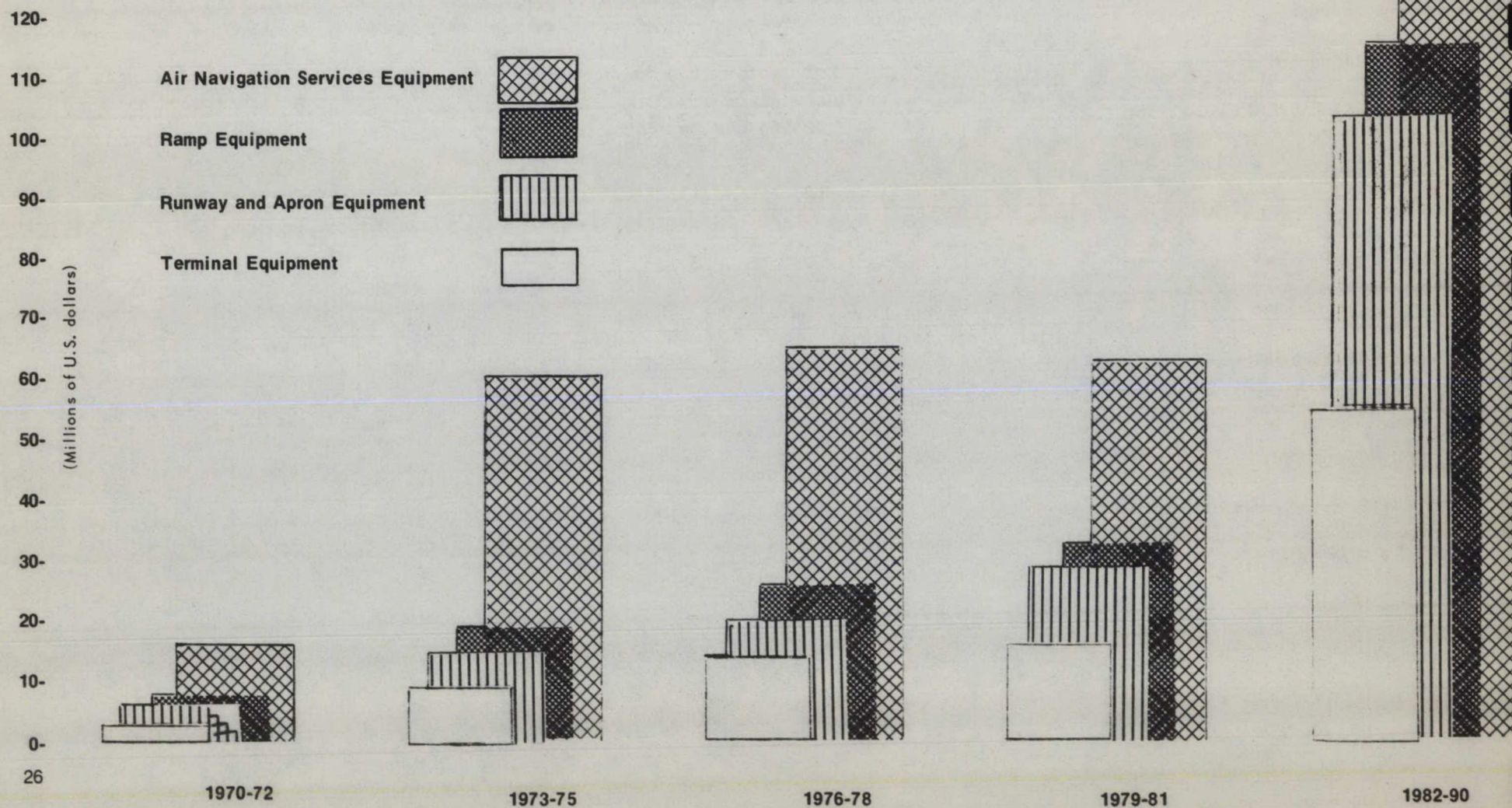
	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
RAMP EQUIPMENT						
1. Passenger Loading - Standard	475	1235	1681	2356	8360	14107
2. Passenger Loading - Jumbo	90	690	720	1170	4500	7170
3. Aircraft Services - Standard	3225	8189	11194	15690	55634	93933
4. Aircraft Services - Jumbo	173	813	835	1479	5570	8870
5. Towing - Standard	901	2087	2929	4070	14346	24333
6. Towing - Jumbo	250	750	875	1500	5500	8875
7. Baggage and Freight Loading - Std	882	2448	3232	4638	16614	27815
8. Baggage and Freight Loading - Jumbo	238	814	997	1514	5548	9111
TOTAL	6234	17026	22464	32418	116072	194215
TERMINAL EQUIPMENT						
1. Passenger Information	205	616	782	1129	4106	6838
2. Baggage Handling System	350	2000	2280	3350	12700	20680
3. Elevators/Escalators	1700	4450	6035	8450	30100	50735
4. Control Power Supply	600	1600	2160	3040	10800	18200
TOTAL	2855	8666	11257	15969	57706	96453
RUNWAY and APRON						
1. Fire and Rescue	2425	5540	7770	10735	38090	64560
2. Sweepers	830	2260	3046	4262	15220	25618
3. Snow Removal	2855	7360	10064	14024	49870	84174
TOTAL	6110	15160	20880	29021	103180	174352

2. REGIONAL DEMAND
European - Mediterranean Region
U.S.S.R.

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	9100	17500	17500	17500	52500	114100

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND European - Mediterranean Region Other Europe

COMMUNICATIONS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. HF Transmitter	16	240	25	375	8	120	2	30	38	570	89	1335
2. HF Receiver	39	98	68	170	28	70	6	15	80	200	221	553
3. VHF Transmitter/Receiver	60	312	89	463	226	1174	287	1491	391	2033	1053	5473
4. Extended Range VHF	0	0	2	70	0	0	0	0	6	210	8	280
5. UHF Transmitter/Receiver	0	0	0	0	0	0	0	0	2	116	2	116
6. FSK Unit/FS Converter	0	0	4	6	4	6	0	0	6	9	14	21
7. Telegraph Equipment	215	1183	420	2310	285	1568	370	2035	640	3520	1930	10616
8. Message Switching System	3	360	12	1440	5	600	8	960	11	1320	39	4680
9. Automatic Error Correction	3	17	5	28	2	11	3	17	12	66	25	139
10. Selcal System	24	36	51	77	55	83	34	51	158	237	322	484
TOTALS		2246		4939		3632		4599		8281		23697

OPERATIONAL CONTROL

1. Automatic ATC System	3	750	8	2000	4	1000	3	750	18	4500	36	9000
2. ATC Console	8	48	12	72	11	66	16	96	35	210	82	492
3. Communications Control Console	12	180	11	165	3	45	11	165	28	420	65	975
4. Transportable Control Tower	9	81	11	99	2	18	6	54	12	108	40	360
5. Recorder	81	729	150	1350	46	414	43	387	354	3186	674	6066
TOTALS		1788		3686		1543		1452		8424		16893

2. REGIONAL DEMAND
European - Mediterranean Region
Other Europe

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

RADAR	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ARSR	3	2700	3	2700	1	900	0	0	6	5400	13	11700
2. Terminal & Approach RADAR	4	2400	3	1800	6	3600	9	5400	17	10200	39	23400
3. SSR	2	1000	7	3500	3	1500	1	500	6	3000	19	9500
4. PAR	1	450	3	1350	9	4050	5	2250	8	3600	26	11700
5. Bright Display	9	1620	4	720	1	180	2	360	14	2520	30	5400
6. RADAR Digitizer	0	0	7	1050	2	300	1	150	8	1200	18	2700
7. ASDE	0	0	0	0	1	200	1	200	4	800	6	1200
8. Weather RADAR	2	400	7	1400	6	1200	2	400	23	4600	40	8000
TOTALS		8570		12520		11930		9260		31320		73600

NAVAIDS

1. VOR	16	1120	25	1750	21	1470	30	2100	114	7980	206	14420
2. DME	18	1350	20	1500	11	825	12	900	55	4125	116	8700
3. TACAN	0	0	0	0	0	0	0	0	0	0	0	0
4. NDB	11	132	49	588	53	636	3	36	33	396	149	1788
5. VDF	18	630	17	595	14	490	12	420	41	1435	102	3570
6. ILS	22	4070	22	4070	35	6475	23	4255	57	10545	159	29415
7. VOT	22	176	8	64	4	32	0	0	22	176	56	448
TOTALS		7478		8567		9928		7711		24657		58341

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND European - Mediterranean Region Other Europe

SIMULATORS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ATC Simulator	8	320	5	200	9	360	4	160	20	800	46	1840
2. RADAR Simulator	4	280	6	420	4	280	4	280	13	910	31	2170
TOTALS		600		620		640		440		1710		4010

AIRFIELD LIGHTING

1. Precision Approach	8	600	4	300	21	1575	53	3975	40	3000	126	9450
2. Simple Approach	3	90	1	30	9	270	8	240	28	840	49	1470
3. Vasi	16	240	12	180	27	405	38	570	78	1170	171	2565
4. Runway, Threshold, & End	2	100	10	500	9	450	21	1050	52	2600	94	4700
5. Centre Line	5	1000	4	800	10	2000	12	2400	17	3400	48	9600
6. Runway Touchdown Zone	12	1800	8	1200	16	2400	16	2400	24	3600	76	11400
7. Taxiway	2	80	1	40	18	720	25	1000	55	2200	101	4040
8. Beacon	10	100	6	60	11	110	19	190	45	450	91	910
TOTALS		4010		3110		7930		11825		17260		44135

METEOROLOGICAL

1. Automatic Weather Station	18	144	30	240	16	128	26	208	74	592	164	1312
2. Runway Visual Range Computer	5	40	7	56	10	80	4	32	21	168	47	376
3. Ceilometer	17	170	38	380	16	160	32	320	55	550	158	1580
4. Transmissometer	14	140	19	190	22	220	19	190	58	580	132	1320
TOTALS		494		866		588		750		1890		4588

2. REGIONAL DEMAND
European - Mediterranean Region
Other Europe

OTHER EQUIPMENT

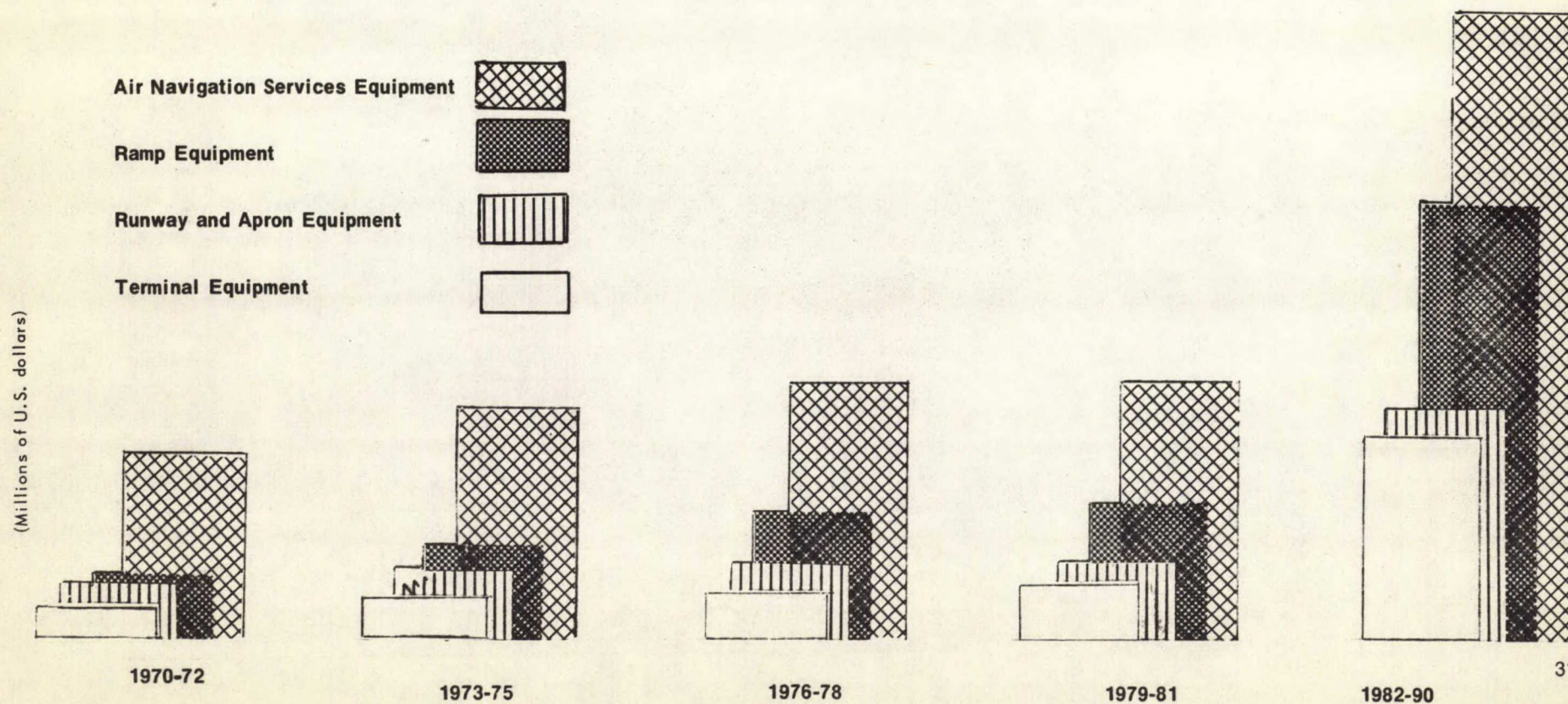
	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
RAMP EQUIPMENT						
1. Passenger Loading - Standard	722	798	1016	1092	4094	7723
2. Passenger Loading - Jumbo	270	360	810	990	4050	6480
3. Aircraft Services - Standard	4779	5318	6764	7329	27287	51478
4. Aircraft Services - Jumbo	322	495	1052	1398	5475	8742
5. Towing - Standard	1291	1434	1699	1854	6647	12926
6. Towing - Jumbo	375	625	1250	1750	6000	10000
7. Baggage and Freight Loading - Std	1322	1541	2218	2516	9508	17107
8. Baggage and Freight Loading - Jumbo	418	534	912	1122	4198	7185
TOTAL	9499	11106	15723	18052	67260	121642
TERMINAL EQUIPMENT						
1. Passenger Information	249	289	434	474	2227	3673
2. Baggage Handling Systems	420	490	1210	1280	8090	11490
3. Elevators/Escalators	2565	2830	3620	3885	14705	27605
4. Control Power Supply	900	1000	1320	1420	5400	10040
TOTAL	4134	4609	6584	7059	30422	52808
RUNWAY and APRON						
1. Fire and Rescue	3495	3835	4375	4715	16885	33305
2. Sweepers	1306	1432	1856	1982	7532	14108
3. Snow Removal	2848	2848	4082	4233	12683	26694
30 TOTAL	7649	8115	10313	10930	37100	74107

2. REGIONAL DEMAND
European - Mediterranean Region
Other Europe

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	1505	1610	5705	5705	27720	42245

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



2. REGIONAL DEMAND

Middle East and South East Asia Regions

Afghanistan	Lebanon
Australia	Malaysia
Burma	Nepal
Ceylon	New Zealand
India	Pakistan
Indonesia	Philippines
Iran	Saudi-Arabia
Iraq	Singapore
Israel	South Korea
Japan	Syria
Jordan	Thailand
Kuwait	Turkey

In the Middle East Region, because of the historical background at least the air navigation services equipment in Bahrain, Cyprus, Jordan, Kuwait, Muscat and Oman, Saudi Arabia, South Yemen, Trucial States, Turkey, Yemen and Qatar are mostly of the United Kingdom origin. These countries in recent years have begun to import airport equipment and consultancy services from other sources as well, such as Canada, France, Italy, West Germany, U.S.A. Some of them are now also open to communist sources. Most of the air navigation services equipment in Iran, Israel and Lebanon are imported from the U.S.A.; some from France. Iraq and Syria appear to have rather an open-door policy with a slant toward the U.S.S.R.

The South East Asia Region meets its requirements either from indigenous manufacturers or from imports. The countries in this area have more or less an open market for the Ramp, Terminal, and Runway and Apron equipment except those which are under economic or political influence of one country or other.

For example, Australia imports only the sophisticated types of navigation equipment and communication systems -- mainly from France and the U.K. India meets its requirement of communication equipment virtually from its own resources. The rest is imported from countries like Italy, Netherlands, West Germany, U.K., U.S.A; also Japan and communist countries, in the case of fire crash tenders. The equipment in South Korea, Thailand and Vietnam would be exclusively of U.S.A. origin. Those in Malaysia and Singapore are mostly procured from the U.K. The main source of procurement by Afghanistan and Nepal is the U.S.A; the U.S.S.R. is another source of limited import.

IMPORTANT AIRPORTS - GROWTH TABLE

Airport Category	Existing		Expected Growth				Operational 1990
	1970	1970-72	1973-75	1976-78	1979-81	1982-90	
C	44	3	3	5	5	11	71
B	28	1	2	3	2	5	41
A	0	0	0	1	1	2	4

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND

Middle East and South East Asia Regions

COMMUNICATIONS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. HF Transmitter	70	1050	99	1485	102	1530	73	1095	151	2265	495	7425
2. HF Receiver	218	545	266	665	348	870	231	578	441	1103	1504	3761
3. VHF Transmitter/Receiver	155	806	233	1210	182	936	296	1539	642	3938	1506	7829
4. Extended Range VHF	14	490	4	140	28	980	20	700	45	1890	120	4200
5. UHF Transmitter/Receiver	4	232	0	0	0	0	5	290	8	464	17	986
6. FSK Unit/FS Convertor	50	75	63	95	66	99	112	168	129	194	420	631
7. Telegraph Equipment	120	660	425	2337	185	1018	65	358	285	1568	1080	5941
8. Message Switching System	7	840	19	2280	10	1200	3	360	11	1320	50	6000
9. Automatic Error Correction	4	22	15	83	6	33	2	11	12	66	39	215
10. Seical System	45	68	28	42	4	6	13	20	64	96	155	232
TOTALS		4788		8337		6672		5119		12304		37220

OPERATIONAL CONTROL

1. Automatic ATC System	8	2000	9	2250	3	750	3	750	10	2500	33	8250
2. ATC Console	10	60	6	36	10	60	0	0	0	0	26	156
3. Communications Control Console	5	75	14	210	3	45	1	15	0	0	23	345
4. Transportable Control Tower	12	108	16	144	1	1	2	18	2	18	33	297
5. Recorder	292	2628	84	756	39	357	36	324	585	3205	1036	9324
TOTALS		4871		3396		1215		1107		7783		18372

2. REGIONAL DEMAND

Middle East and South East Asia Regions

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

RADAR	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ARSR	0	0	17	15200	3	2700	1	900	9	8100	30	27000
2. Terminal & Approach RADAR	7	4200	13	7800	7	4200	6	3600	17	10200	50	30000
3. SSR	3	1500	12	6000	11	5 00	1	500	17	8500	44	22000
4. PAR	3	1350	5	2250	3	1350	3	1350	6	270	20	9000
5. Bright Display	3	540	18	3240	4	720	0	0	9	1620	34	6120
6. RADAR Digitizer	5	750	10	1500	8	1200	1	150	8	1200	32	4800
7. ASDE	0	0	0	0	1	200	3	600	1	200	5	1000
8. Weather RADAR	5	1000	14	3800	7	1400	7	1400	10	2000	43	8600
TOTALS		9340		38890		17270		8500		34520		108520

NAVAIDS

1. VOR	16	1120	44	3080	75	5250	42	2940	62	4340	239	16730
2. DME	3	225	7	525	41	3075	41	3075	20	1500	112	8400
3. TACAN	0	0	0	0	0	0	0	0	0	0	0	0
4. NDB	13	156	59	708	61	732	23	276	63	756	219	2628
5. VDF	1	35	16	560	8	280	8	280	20	700	53	1855
6. ILS	8	1480	17	3145	17	3145	19	3515	25	4625	86	15910
7. VOT	16	128	56	448	0	0	0	0	72	576	144	1152
TOTALS		3144		8466		12482		10086		12497		46675

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND

Middle East and South East Asia Regions

SIMULATORS	1970-72		1973-75		1976-78		1979-81		1982-90		TOTAL	
	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000	Units	\$,000
1. ATC Simulator	10	400	12	480	7	280	4	160	20	800	53	2120
2. RADAR Simulator	7	490	7	490	6	420	0	0	0	490	490	1890
TOTALS		890		970		700		160		1290		4010

AIRFIELD LIGHTING

1. Precision Approach	12	975	19	1425	12	975	5	375	44	3300	94	7050
2. Simple Approach	16	480	17	510	26	780	19	570	65	1950	143	4290
3. Vasi	16	240	42	630	22	330	31	465	84	1260	195	2925
4. Runway, Threshold, & End	11	550	26	1300	25	1250	44	2200	62	3100	168	8400
5. Centre Line	19	3800	6	1200	8	1600	8	1600	20	4000	61	12200
6. Runway Touchdown Zone	19	2850	12	1800	8	1200	6	900	20	3000	65	9750
7. Taxiway	23	920	16	640	20	800	34	1360	53	2120	146	5840
8. Beacon	11	110	19	190	5	50	12	120	42	420	89	890
TOTALS		9925		7695		6985		7590		9150		51345

METEOROLOGICAL

1. Automatic Weather Station	47	376	14	112	4	32	22	176	61	488	148	1184
2. Runway Visual Range Computer	15	120	19	152	8	64	13	104	39	312	94	752
3. Ceilometer	1	570	23	230	20	200	5	50	91	910	190	1900
4. Transmissometer	78	780	36	360	31	310	8	80	144	1440	297	2970
TOTALS		1786		854		606		410		3150		6806

2. REGIONAL DEMAND
Middle East and South East Asia Regions

OTHER EQUIPMENT

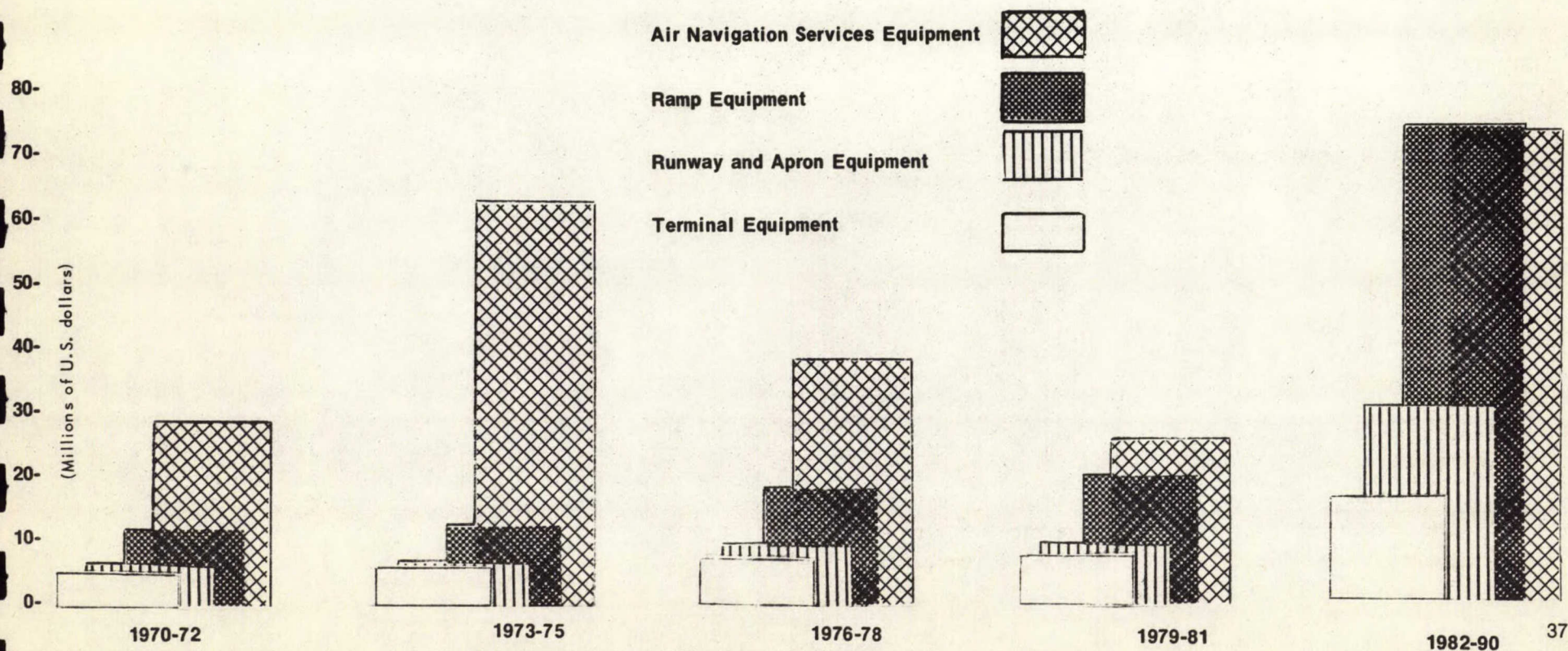
	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
RAMP EQUIPMENT						
1. Passenger Loading - Standard	921	978	1273	1301	4256	8730
2. Passenger Loading - Jumbo	270	360	780	870	3900	6180
3. Aircraft Services - Standard	6221	6635	8584	8778	29137	59357
4. Aircraft Services - Jumbo	519	692	1207	1380	6470	10268
5. Towing - Standard	1702	1800	2261	2343	7719	15826
6. Towing - Jumbo	750	1000	1625	1875	8500	13750
7. Baggage and Freight Loading - Std	1810	2007	2757	2872	10257	19704
8. Baggage and Freight Loading - Jumbo	559	669	1073	1176	4794	8273
TOTAL	12754	14143	19561	20597	75034	142089
TERMINAL EQUIPMENT						
1. Passenger Information	407	446	592	594	2082	4121
2. Baggage Handling Systems	700	770	1490	1490	5470	9920
3. Elevators/Escalators	3250	3440	4495	4645	15215	31045
4. Control Power Supply	1160	1240	1640	1660	5500	11200
TOTAL	5517	5896	8217	8389	28267	56286
RUNWAY and APRON						
1. Fire and Rescue	4415	4610	5730	6020	19670	40445
2. Sweepers	1584	1670	2224	2298	7566	15342
3. Snow Removal	624	904	1049	1034	3706	7318
TOTAL	6623	7184	9003	9352	30942	63125

2. REGIONAL DEMAND
Middle East and South East Asia Regions

CONSULTING SERVICES

	1970-72	1973-75	1976-78	1979-81	1982-90	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	1820	1820	6020	6020	13055	28735

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1990)



2. REGIONAL DEMAND

United States

There exists considerable traditional co-operation and interchange of information between the U.S.A. and Canada in the fields of aircraft development and air navigation services. The U.S.A. is also an important market of Canada for military types of aircraft and avionics equipment.

The Memorandum of Understanding dated June 18, 1970, recently concluded between the Department of Transport of Canada and the Department of Transportation of the U.S.A. would further extend the existing co-operation and would, most conceivably, widen the export area to include airport equipment for civil air transport.

The Memorandum, apart from other points, seeks collaboration in investigating problems connected with **STOL** service, and in the field of **air traffic control and airways navigations aids**. It agrees to develop a joint research project for the furtherance of co-operation in the development and supply of air traffic control and airways navigation aids equipment.

The U.S.A. is experiencing a staggering volume of air traffic, with the associated airspace utilization problems and terminal congestions. It is faced with the situation of these problems becoming more accentuated in the coming years.

With the view of meeting these problems effectively the Department of Transportation/Federal Aviation Administration have, since 1969, embarked on **Ten-Year National Aviation System Plans**.

The fulfilment of these plans would require all the effort and resources of the country to be brought to bear. Despite so, because of the magnitude of these plans and in view of the Memorandum of Understanding, it would stand to reason that the U.S.A. would explore external markets for the import of several types of aviation equipment and systems.

IMPORTANT AIRPORTS - GROWTH TABLE

Airport Category	Existing 1970	Expected Growth						Operational 1980
		1971	1972	1973	1974	1975	1976-1980	
C	509	-4	-5	-6	-7	-8	-27	452
B	157	3	4	5	7	8	28	213
A	36	3	3	4	5	5	15	71

The following forecast is based on the **equipment** content of the **ten-year plan**. Since the U.S. publish an updated plan yearly it was felt unnecessary to produce a detailed twenty year forecast.

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND United States

RADAR	1971		1972		1973		1974		1975		1976- 1980		TOTAL	
	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000
1. ARSR	8	8000	13	13000	13	13000	12	12000	13	13000	50	50000	109	109000
2. Terminal & Approach RADAR	0	0	38	22800	18	10800	20	12000	22	13200	105	63000	203	121800
3. SSR	0	0	10	5000	15	7500	17	8500	17	8500	80	40000	139	69500
4. Bright Display	16	2880	28	5040	19	3420	21	3780	10	1800	70	12600	164	29520
5. Video Recording	0	0	24	720	102	3060	31	930	30	900	33	990	220	6600
6. RADAR Digitizer	23	6900	49	14700	16	4800	16	4800	6	1800	30	9000	140	42000
7. RADAR Performance Monitor	0	0	0	0	198	3960	198	3960	82	1640	82	1640	560	11200
8. ASDE	0	0	0	0	5	1000	5	1000	5	1000	40	8000	55	11000
9. Weather RADAR	0	0	0	0	5	1000	5	1000	6	1200	20	4000	36	7200
10. Weather RADAR Display	0	0	0	0	26	650	26	650	26	650	89	225	167	4175
TOTAL		17780		61260		49190		48620		43620		191455		411995

NAVAIDS

1. VOR	0	0	14	980	22	1540	45	3150	36	2520	121	8470	238	16660
2. DME	0	0	3	90	101	3030	168	5040	130	3900	291	8730	693	20790
3. NDB	1	12	1	12	1	12	1	12	1	12	5	60	60	120
4. VHF Marker Beacon	13	130	8	80	13	130	18	180	23	230	128	1280	203	2030
5. VDF	0	0	15	525	10	350	10	350	10	350	35	1225	80	2800
6. ILS	0	0	38	7030	54	9990	42	7770	41	7585	428	79180	603	111555
TOTAL		142		8717		15052		16502		14597		98945		153955

2. REGIONAL DEMAND

United States

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

COMMUNICATIONS	1971		1972		1973		1974		1975		1976-1980		TOTAL	
	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000
1. HF Transmitter	0	0	2	60	2	60	2	60	4	120	10	300	20	600
2. HF Receiver	0	0	8	80	8	80	8	80	16	160	40	400	80	800
3. VHF Transmitter/Receiver	0	0	130	2600	69	1380	61	1220	56	1120	208	4160	524	10480
4. Extended Range VHF	0	0	2	140	2	140	2	140	2	140	6	420	14	980
5. UHF Transmitter/Receiver	0	0	78	780	46	460	38	380	38	380	114	1140	314	3140
6. Microwave Link	0	0	5	250	33	1650	33	1650	33	1650	62	3100	166	8300
7. Automatic Error Correction	0	0	48	264	16	88	16	88	16	88	80	440	176	968
8. Telegraph Equipment	0	0	158	869	185	1018	163	897	110	605	400	2200	917	5589
9. Message Switching System	1	120	0	0	1	120	0	0	1	120	1	120	4	480
10. Data Communication System	0	0	0	0	0	0	0	0	10	1500	55	8250	65	9750
11. Electronic Voice Switching	0	0	1	4	5	20	8	32	7	28	15	60	36	144
TOTAL		120		5047		5016		4547		5911		20590		41231

OPERATIONAL CONTROL

1. Automatic ATC System	13	72800	7	39200	2	11200	1	5600	1	5600	10	56000	34	190400
2. ATC Console	52	900	65	1125	17	294	19	329	21	363	140	2422	314	5433
3. Transportable Control Tower	0	0	0	0	0	0	5	45	5	45	15	135	25	225
4. Recorder (150-Channel)	0	0	0	0	22	3146	32	4576	17	2431	66	9438	137	19591
TOTAL		73700		40325		14640		10550		8439		67995		215649

AIR NAVIGATION SERVICES - ELECTRONIC AND VISUAL SYSTEMS

2. REGIONAL DEMAND

United States

	1971		1972		1973		1974		1975		1976- 1980		TOTAL	
SIMULATORS	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000	Qty.	\$,000
1. ATC Simulator	1	<u>235</u>	0	<u>0</u>	2	<u>470</u>	3	<u>705</u>	8	<u>1880</u>	0	<u>0</u>	14	<u>3290</u>
TOTAL		235		0		470		705		1880		0	14	3290

AIRFIELD LIGHTING

1. Precision Approach	0	0	38	3420	50	4500	35	3150	30	2700	330	3470	483	17240
2. Simple Approach	0	0	0	0	15	450	15	450	25	750	57	1710	112	3360
3. VASI	0	0	33	495	50	750	50	750	50	750	100	1500	283	4245
4. Runway, Threshold & End	12	600	8	400	13	650	17	850	23	1150	137	6850	210	10500
5. Centre Line	12	2400	7	1400	12	2400	15	3000	20	4000	123	24600	189	37800
6. Runway Touchdown Zone	12	1800	7	1050	12	1800	15	2250	20	3000	123	18450	189	28350
7. Taxiway	12	<u>480</u>	7	<u>280</u>	12	<u>480</u>	15	<u>600</u>	20	<u>800</u>	123	<u>4920</u>	189	<u>7560</u>
TOTAL		5280		7045		11030		11050		13150		61500		109055

METEOROLOGICAL

1. Automatic Weather Broadcast	0	0	143	529	58	215	63	233	31	105	35	130	330	1212
2. Runway Visual Range Computer	12	180	7	105	12	180	15	225	20	300	123	1845	189	2835
3. Ceilometer	0	0	0	0	25	450	20	360	20	360	70	1260	135	2430
4. Hygrothermometer	0	0	0	0	25	150	20	120	20	120	70	420	135	810
5. Transmissometer	0	0	0	0	63	945	50	750	50	750	175	2625	338	5070
6. Automatic Wx Sensing & Transmission	0	0	0	0	0	0	10	500	20	1000	100	5000	130	6500
7. Digital Weather Display	0	<u>0</u>	0	<u>0</u>	32	<u>1024</u>	33	<u>1056</u>	65	<u>2080</u>	357	<u>11424</u>	487	<u>15584</u>
TOTAL		180		634		2964		3244		4715		22704		34441

2. REGIONAL DEMAND

United States

OTHER EQUIPMENT

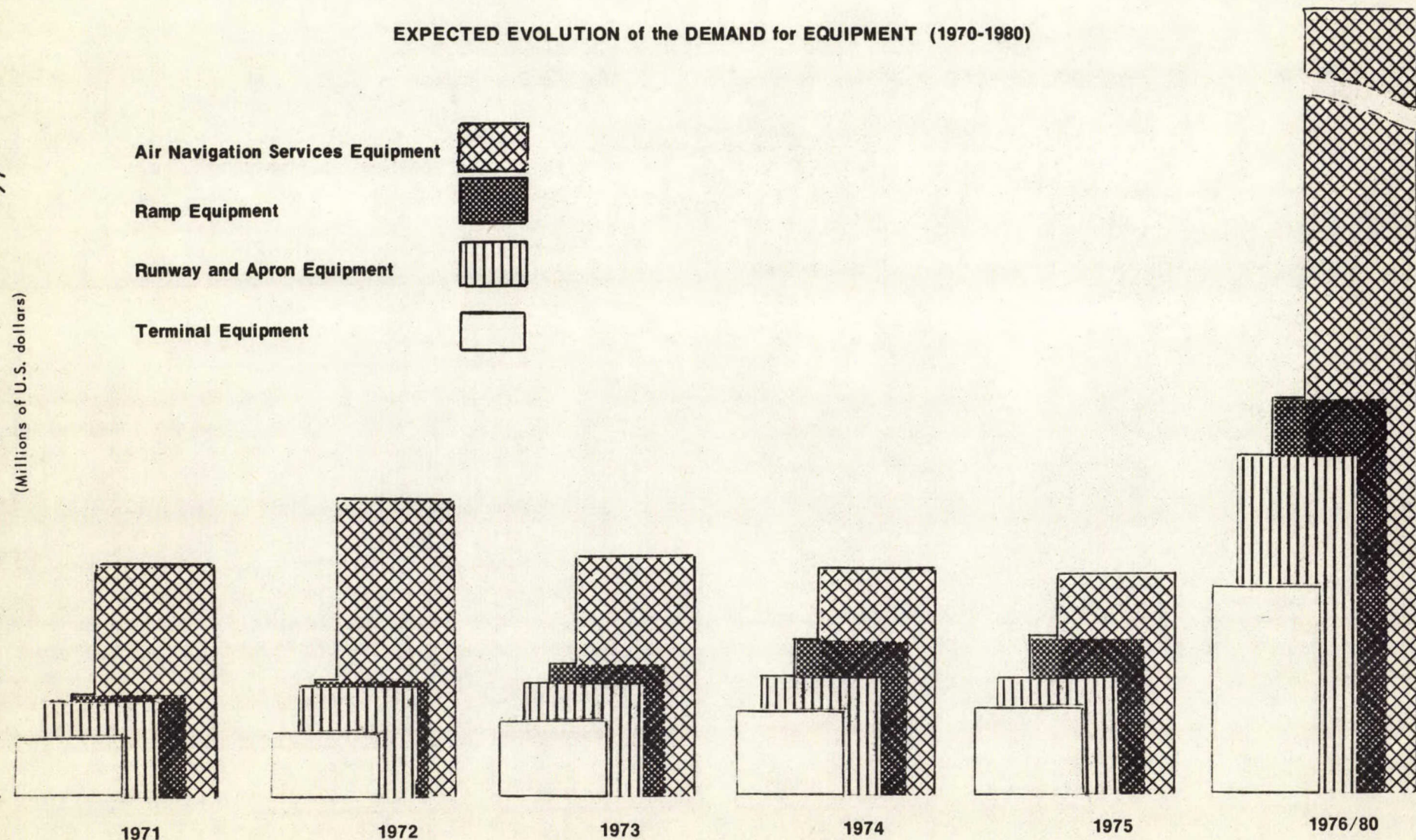
	1971	1972	1973	1974	1975	1976-80	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
RAMP EQUIPMENT							
1. Passenger Loading - Standard	3486	3524	3705	3942	3980	12122	30761
2. Passenger Loading - Jumbo	2250	2250	2550	2850	2850	8550	21300
3. Aircraft Services - Standard	22829	23092	24238	25772	26036	79422	201390
4. Aircraft Services - Jumbo	2389	2389	2709	3029	3029	9109	22654
5. Towing - Standard	5758	5799	5989	6265	6307	19219	49338
6. Towing - Jumbo	1875	1875	2125	2375	2375	7125	17750
7. Baggage and Freight Loading - Std	6777	6873	7351	7946	8042	24584	61574
8. Baggage and Freight Loading - Jumbo	2363	2373	2598	2840	2850	8594	21620
TOTAL	47728	48176	51265	55021	55470	168726	426388
TERMINAL EQUIPMENT							
1. Passenger Information	1642	1680	1821	2001	2039	6405	15588
2. Baggage Handling Systems	6090	6160	6880	7670	7740	24220	58760
3. Elevators/Escalators	12695	12810	13450	14280	14395	43755	111385
4. Control Power Supply	4500	4560	4820	5160	5220	15920	40180
TOTAL	24927	25210	26971	29111	29394	90300	225913
RUNWAY and APRON							
1. Fire and Rescue	15555	15605	16000	16590	16640	50405	130795
2. Sweepers	6552	6598	6944	7376	7422	22556	57448
3. Snow Removal	22107	22203	22944	23966	24062	72961	188243
TOTAL	43224	43454	45155	47416	47647	144579	371476

CONSULTING SERVICES

	1971	1972	1973	1974	1975	1976-80	TOTAL
	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000
Feasibility Studies, Planning, Design and Project Management	15750	16500	21750	27000	27750	90750	199500

2. REGIONAL DEMAND United States

EXPECTED EVOLUTION of the DEMAND for EQUIPMENT (1970-1980)



3. CANADA

Introduction

According to ICAO traffic statistics for 1969 Canada is the second most active nation of the free world as far as civil aviation traffic (air movements and total tonne kilometres performed).

The demand for airport equipment and services in Canada is generated by civil and military aviation activities.

In the following paragraphs dealing exclusively with Canada the following topics are covered:

- **The domestic demand (1970-1980).**
- **Procurement:** The trends in DND and DOT equipment procurement.
- **R & D:** A survey of current Canadian R & D activities in areas related to the study.
- **Exports:** A review of Canadian industry performance on the export market.

The Domestic Demand (Civilian)

The civilian traffic is accommodated by a network consisting of 345 licensed aerodromes, 90 operated by the ministry of transport, 129 by municipalities and 126 by private operators. The most significant part of the demand for civil aviation airport equipment is generated by twenty five airports (International trunk and feeder airports). Civil aviation is controlled and regulated under the Aeronautics Act which defines the responsibilities of the Minister of Transport and the Air Transport Committee with respect to the safety, development and reliability of aviation. The minister of transport air services program description is the following:

Airports and other Ground Services -- Construction, operation and maintenance of civil airports and seaplane docking facilities owned or controlled by the department, excluding Montreal and Toronto International Air-

Air Traffic Control -- Provides for operational safety control of private and commercial aircraft operating in Canada; operation of air traffic control systems for Canada and in that International Airspace for which Canada has accepted responsibility through the International Civil Aviation Organization.

Civil Aviation -- Provides through the application of the Aeronautics Act: appropriate regulations for the control of private and commercial aircraft operations; the development of safety standards; the inspection and licensing of aviation personnel, facilities and equipment and the investigation of aircraft accidents.

Flight Operations -- The purchase, operation and maintenance of departmental aircraft for VIP transportation, airways calibration of navigational aids, airways and Air Regulations inspection, Helicopter Services to the Marine Program.

Montreal and Toronto International Airports (Revolving Fund) -- Construction, operation and maintenance of Montreal and Toronto International Airports. Support facilities for these Airports such as Radio Aids to Navigation, Meteorological Services and Air Traffic Control are provided in the respective activities.

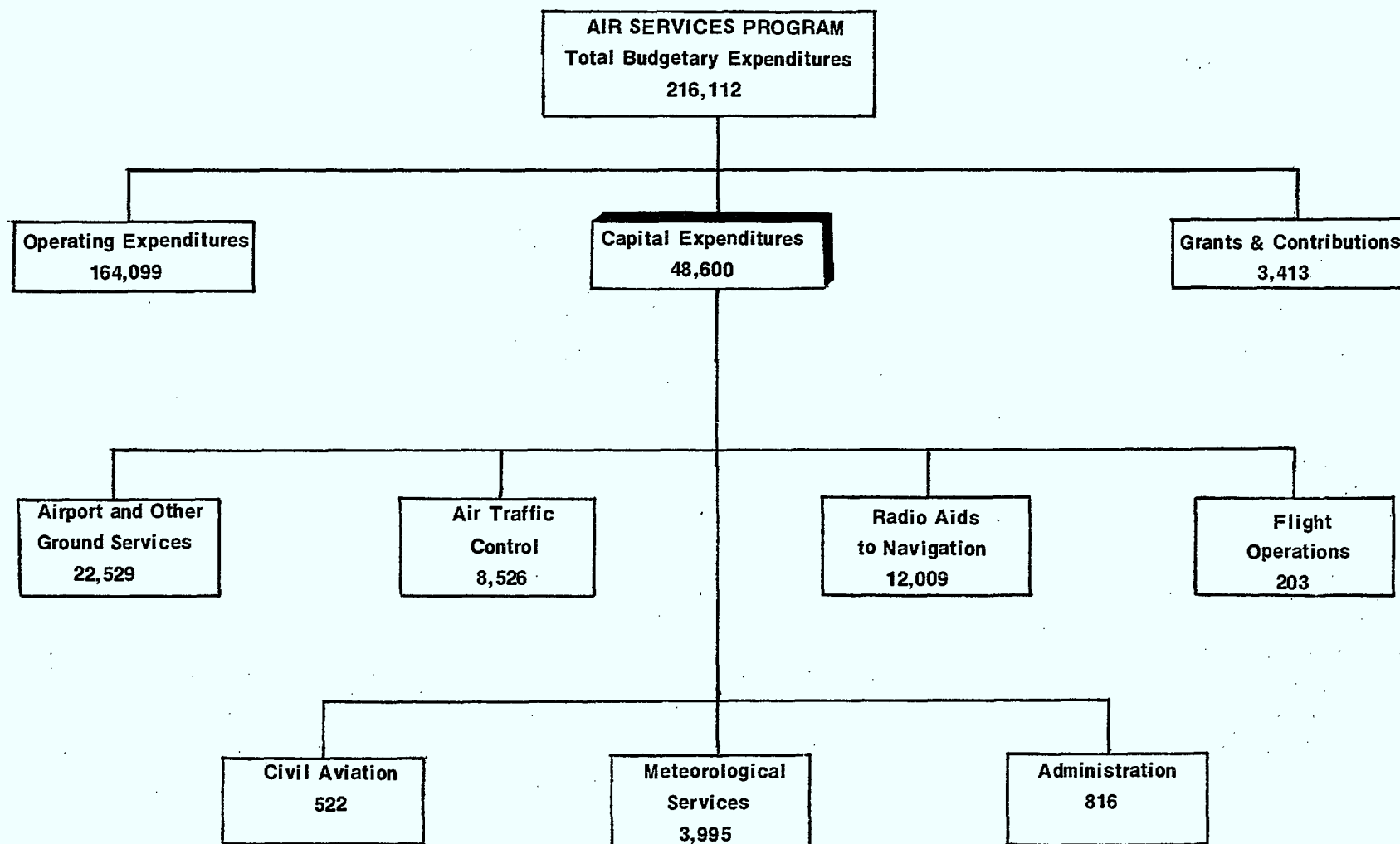
Meteorological Services -- Provides for all phases of meteorological service for civil and military purposes in Canada, for shipping in adjacent ocean areas and on the Great Lakes, and within prescribed areas of responsibility agreed to internationally for aviation over the Atlantic and Pacific oceans.

Radio Aids to Navigation -- Construction, installation, operation and maintenance of telecommunications and electronic facilities to serve aviation, marine and meteorological operations.

Administration -- Central and regional administration including personnel, financial, construction and planning services.

The proposed budgetary expenditures to carry out that part of the program planned for the fiscal year 1970-71 is shown on the opposite table.

DEPARTMENT OF TRANSPORT - AIR SERVICES PROGRAM
(Breakdown of Proposed Expenditures for Fiscal Year 1970-71)



(All figures in thousands of Canadian Dollars)

The Domestic Demand (Civil Aviation) Cont'd

The demand for Air Navigation services equipment for civilian airports and airways originates almost entirely from the Ministry of Transport. At the ministry, long range planning for airports is made on the basis of 10-Year and 20-Year projections (Master Plan). These projections are annually appraised to determine whether objectives are still valid. The Branches involved in supplying the equipment or services necessary to implement the Plan prepare five-year budgetary estimates with additional five-year projections. The opposite table shows the forecast expenditures for Air Navigation services equipment for Civil Aviation for the period 1970-80. It is in the major part based on the budgetary estimates and the ICAO Report of the Fifth North Atlantic Regional Air Navigation Meeting (April 1970).

The demand for "Other Equipment" originates from several sources; Airlines, Private Enterprises and Ministry of Transport. Runway and Apron equipment is almost exclusively procured by the Ministry. The Ramp equipment is procured mainly by Airlines and Private Enterprises. For example for the current operation of the Bo-747 at Montreal International Airport most of the Ramp equipment is owned by a private firm who lease it to the Airlines. Our forecast of the demand for "Other Equipment" is based on the current and expected airports that will be operating over the 1970-80 period and takes into account the impact of wide-body aircraft and SSTs. (see methodology).

In 1962 the Department of Transport published "Canada in the Jet Age the report of a study of Department of Transport Air Services Needs for the period 1962-1970". This publication presented in a concise form a wealth of information helpful to the Canadian suppliers of equipment

and services. The intention of the Department was to periodically update this document. As far as we could find, no updating report has been published.

In the United States the necessity for insuring orderly development of an adequate system of airports and airways facilities brought about the publication, for the first time in 1969, of the 10-Year National Aviation System Plan which was subsequently revised in 1970. The implementation of this plan is contingent upon approval of the fiscal budgets and it is understood that revision will be made as dictated by changing conditions and new requirements. Publication of the plan provides an incentive for other government agencies and private industry to further their interest and better co-ordinate their activities in the field of aviation.

The Domestic Demand (Military)

The Department of National Defence operates 57 military airfields, 15 of which generate the bulk of DND's demand for airport equipment. In 1968 the operational objectives for the Air Division of the Canadian Forces were defined. In terms of equipment demand it is very likely that during the period 1970-80 thirteen air bases will be provided with new equipment, including radars, landing systems, communication control consoles, A.T.C. simulators, air ground air digital communications. It is not believed that these systems have yet been firmly defined. As indicated in the section on Air Traffic the military traffic is not expected to grow except of course if a large scale war were to break out. As time goes it is expected that more and more services will be shared by the military and civilian traffic and also that DND will use aerodrome equipment similar to those designed for civil aviation.

AIR NAVIGATION SERVICES EQUIPMENT

The Domestic Demand

3. CANADA

	1970-71 \$, 000	1971-72 \$, 000	1972-73 \$, 000	1973-74 \$, 000	1974-75 \$, 000	1975-80 \$, 000	TOTAL \$, 000
Radars	4765	6900	8000	9480	6450	19000	54595
Nav aids	7080	6329	2404	2329	2339	12040	32521
Simulators	120	125	95	105	105	700	1250
Airfield Lighting	2380	2565	1910	2140	2110	14765	25870
Meteorology	431	210	210	210	210	210	1481
Communications	1615	1635	1535	975	905	3060	9725
Ops Control	425	325	125	105	105	400	1485
TOTAL	16816	18089	14279	15344	12224	50176	126927

3. CANADA

OTHER EQUIPMENT
The Domestic Demand

	1971 \$,000	1972 \$,000	1973 \$,000	1974 \$,000	1975 \$,000	1976-1980 \$,000	TOTAL \$,000
RAMP EQUIPMENT							
1. Passenger Loading - Standard	123	180	180	180	323	807	1795
2. Passenger Loading - Jumbo	150	150	150	150	450	690	1740
3. Aircraft Services - Standard	808	1197	1197	1197	2079	5361	11839
4. Aircraft Services - Jumbo	193	193	193	193	513	857	2142
5. Towing - Standard	194	281	281	281	429	1222	2691
6. Towing - Jumbo	250	250	250	250	500	875	2375
7. Baggage and Freight Loading - Std	311	428	428	428	810	1862	4269
8. Baggage and Freight Loading - Jumbo	175	191	191	191	407	729	1886
TOTAL	2205	2871	2871	2871	5512	12405	28739
TERMINAL EQUIPMENT							
1. Passenger Information	40	79	79	79	182	420	879
2. Baggage Handling Systems	70	140	140	140	790	1210	2490
3. Elevators/Escalators	415	605	605	605	1130	2795	6155
4. Control Power Supply	160	240	240	240	440	1100	2420
TOTAL	685	1064	1064	1064	2542	5525	11944
RUNWAY and APRON							
1. Fire and Rescue	485	1025	1025	1025	1025	4305	8890
2. Sweepers	208	594	594	594	594	2618	5202
3. Snow Removal	695	1800	1800	1800	1800	7749	15644
TOTAL	1388	3419	3419	3419	3419	14672	29736

Procurement (DOT)

The history of DOT's equipment procurement is outlined by the accompanying table.

The earlier communications equipment used by DOT prior to 1950 were procured by the military during the war. From 1950 onward 94% of the communications equipment was built in Canada to DOT specifications. The main gap in Canadian-built communications equipment was in the field of multi-track tape recorders that were obtained from the U.S. and Germany.

The Department started an extensive Radar programme around 1956. During the 1956-59 period the ARSRs procured were imported from the U.S. and the displays manufactured in Canada. Between 1960 and 1969, 25 SSRs and 17 Bright Displays were purchased and manufactured in Canada. Around 1964, 7 PARs manufactured in the U.K. and assembled in Canada were procured. After 1965 seven ASR systems were imported from U.S. and 40 Video Mappers procured in Canada. The Canadian content of the Radars and related systems purchased by DOT during the 1957-68 period was approximately 66%. A contract has been recently awarded to a Canadian firm for the manufacture of four long-range radars.

Under the Nav aids heading the main equipment included are NDB, VOR, ILS, DME and VHF D/F.

The DOT demand for NDB since 1955 was of the order of 600 units. All were manufactured in Canada. There are 275 NDBs currently in use and the replacement rate is around 20 units per year.

During the period 1953-1960, 74 VOR transmitters were purchased from Canadian manufacturers. All the goniometers were obtained from U.S. suppliers. A domestic firm is now engaged in the manufacture of complete VOR systems (Standard and Doppler).

The first DMEs installed by DOT were of Italian origin. A Canadian firm is now producing DMEs.

There are now 55 ILS systems operated by DOT. The first fourteen systems installed were obtained from the U.S. Subsequently all ILS systems were obtained in Canada.

To summarize the Nav aids situation, the domestic industry can virtually take care of all Canadian requirements in so far as classical ICAO approved type of Radio Navigation aids are concerned.

Procurement (DND - Air)

DND is operating 14 control towers and associated equipment in Canada and two towers or Canadian airfields in Europe. This is a significant reduction from the 22 control towers equipped aerodromes that were active in 1954.

Over the 1957-1968 period approximately 83% of the communication equipment procured were of Canadian origin. Over the same period practically all ground Radars or large Nav aids systems were imported from U.S. This consisted mainly of: G.C.A. radars (CPN-4 and MPN-11) and TRN-17 and GRN-502 Tacans. Recently to cope with urgent requirements DND bought 2 ASR from the U.K.

		1957- 1959		1960- 1962		1963- 1965		1966- 1968		SUMMARY 1957 - 1968		
		Total	Foreign	Total	Foreign	Total	Foreign	Total	Foreign	Total	Foreign	Canadian
		\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	\$,000	Percentage
COMMUNICATIONS	DOT	1260	60	1505	105	1860	105	1955	105	6580	375	94
	DND	6000	1200	9720	1800	7720	1200	1500	-	24940	4200	83
	TOTAL	7260	1260	11225	1905	9580	1305	3455	105	31520	4575	85
RADAR	DOT	3825	2550	2510	-	4973	809	5895	2427	17203	5786	66
	DND	5951	5951	1700	1700	506	506	1600	1600	9757	9757	0
	TOTAL	9776	8501	4210	1700	5479	1315	7495	4027	26960	15543	44.5
NAVAIDS	DOT	850	189	2530	126	2565	126	615	126	6560	567	91.5
	DND	-	-	1900	1900	5700	5700	1900	1900	9500	9500	0
	TOTAL	850	189	4430	2026	8265	5826	2515	2026	16060	10067	37

Research and Development

Research and Development in Canada is carried out by governments, universities and industry. In "Aeronautics Highway to the Future" a study of aeronautical R & D in Canada carried out by Dr. J.J. Green, the R & D performance of the three sectors is analyzed and shows the leading part played by industry in avionics and aerospace research and development. To foster R & D in industry a number of government incentive and assistance programs have been created (see opposite table).

The total air transportation system can be divided in two main segments, the air and ground segments. The air segment includes the aircraft and all the avionics it carries. The ground segment includes the runways, terminals and all ground based equipment necessary for the safe control and guidance of aeroplanes in the air and on the ground but it also includes all the systems necessary to interface the air transportation system with the ground transportation system. Reviewing the current R & D programs in Canada it is apparent that the ground segment is not included in the R & D programs of universities and large government research establishments. All government R & D in this sector is performed by the Department of Transport.

In the study previously mentioned, Dr. J.J. Green recognizes that "Future aeronautical R & D activities in this country may be related more to civil aviation than to the need of the defence sector" and also indicates "that the most challenging avenue open to Canadian manufacturers....appears to be based on their ability to design and develop STOL aircraft systems".

If a national STOL R & D program is to take place the ground segment must be part of it; for example visual and radio nav aids should be included. The total system must be considered.

The main areas of R & D carried out by the Department of Transport are the following:

- Radar digitizing,
- Digital displays for air traffic control,
- A.T.C. Automation,
- ILS improvement,

University of Waterloo is carrying out for the Department of Transport man-machine relationship studies in the areas of digital displays.

The total cost of R & D at the Department of Transport is approximately \$1.5 million per year.

CANADIAN GOVERNMENT RESEARCH AND DEVELOPMENT ASSISTANCE PROGRAMS

Program	Budget 1970-71	Administered by	Terms
Industrial Research and Development Incentives Act (IRDIA)	\$30 million	Department of Industry, Trade and Commerce	Retroactive grants or income tax credits of up to 25% of capital spending on R&D in one year, and 25% of current spending in excess of the average current spending over the five preceding years. Grants are exempt from federal income tax and do not reduce capital costs for tax purposes.
Program for the Advancement of Industrial Technology (PAIT)	\$15.5 million	Department of Industry, Trade and Commerce	Non-repayable grants of up to 50% of the cost of development and innovation of new and improved products or processes involving new technology, with good market prospects. Allowable costs include non-recurring pre-production activities. Grants may cover more than 50% of the total cost in exceptional cases, but the excess amount is repayable if the project is successful.
Defence Industry Productivity Program (DIP)	\$42.3 million	Department of Industry, Trade and Commerce	Support of selected development programs; grants of up to half the cost of new equipment for plant modernization; support for the establishment of production capacity and qualified sources for production of component parts and materials on terms approved by Treasury Board. Designed to enhance technical competence of the defence industry in areas with both civil and defence sales potential.
Defence Industrial Research Program (DIR)	\$4.5 million	Defence Research Board	Non-repayable grants for specific research projects of broad defence interest: up to 50% of the total cost, or more when considered justified. Company contributions are eligible for IRDIA benefits. Results of the research must normally be exploited in Canada. Research data, patents and equipment remain with the company but the Crown has royalty-free use of licenses and the Defence Research Board must authorize foreign licenses.
Industrial Research Assistance Program (IRAP)	\$7.43 million	National Research Council	Shares the cost of specific research projects by paying wages and salaries of scientists and technicians engaged, while material and overhead costs are borne by the company. IRAP's share is normally about half the total cost. Preference given to relatively long-term applied research in science and engineering. Title to results retained by the industrial firm.

Introduction

In order to explore the extent of foreign competition Canada is likely to face in the export market an analysis was made to determine the potentiality of nearly one hundred countries in the field of manufacture of airport equipment and supply of consultancy services. The basis of this analysis was the number of representative firms that are engaged in this area.

It was observed that France, Italy, United Kingdom, U.S.A. and West Germany were the five countries in which the number of manufacturing and consulting firms exceeded that of Canada, as the **Foreign Competition Chart** indicates. This chart is supported by a set of **Tables** listing a number of firms in these six countries and the area of their activities. The lists of firms are intended to be only representative in character and are by no means exhaustive.

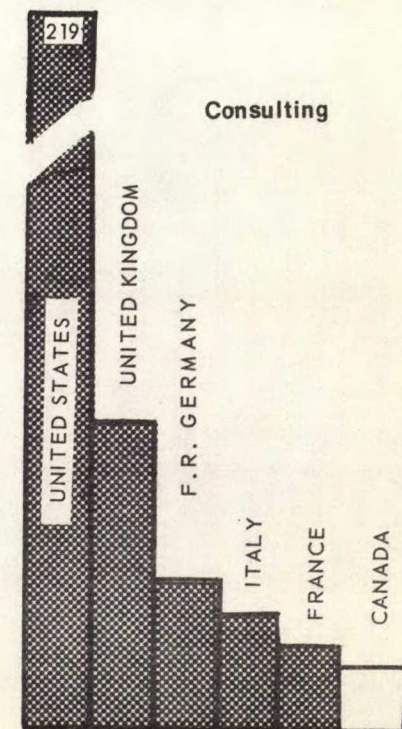
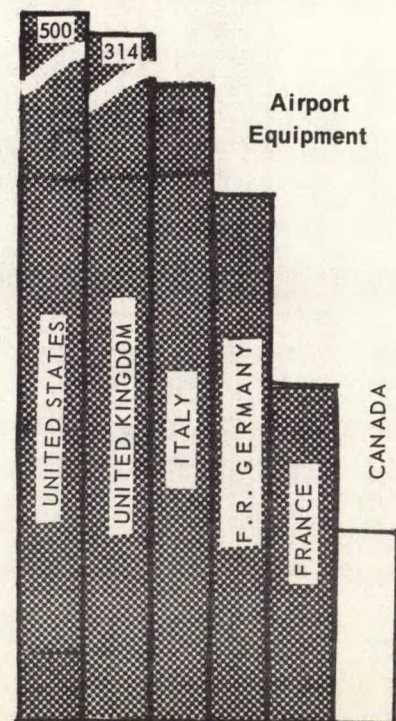
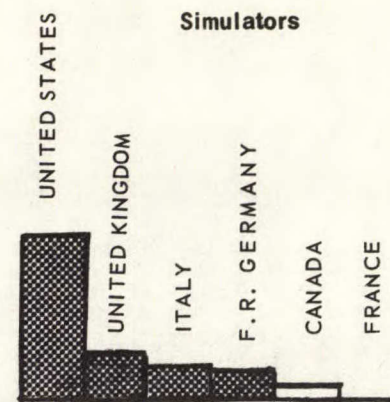
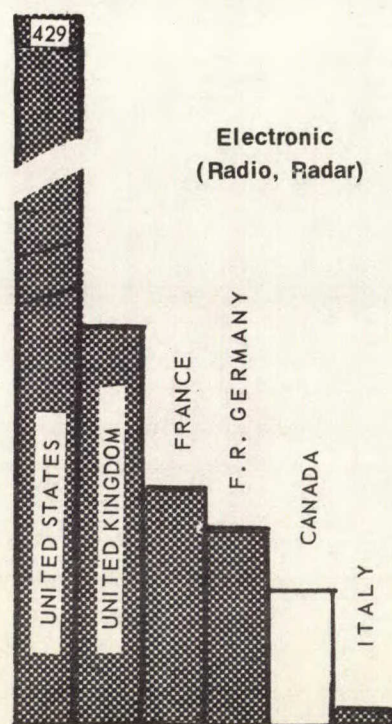
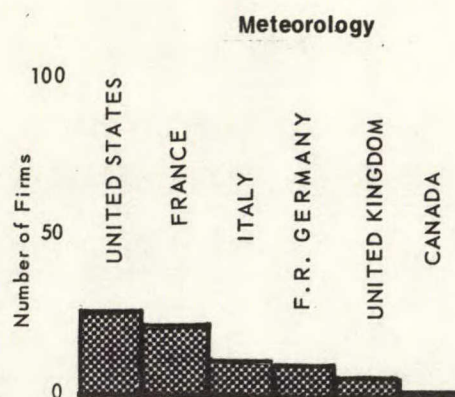
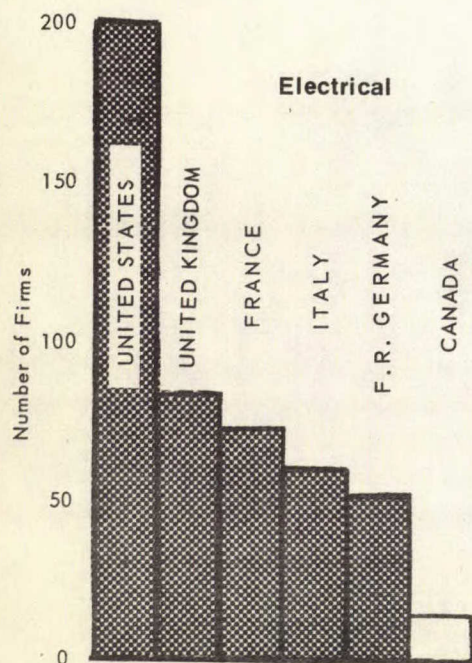
The analysis had an unavoidable limitation in that it could not take

into consideration the volume of commodities a country produces and the extent of consultancy services it renders. This was either because the relevant information was unavailable, or it was inadequate for the purpose. Otherwise, it is not unlikely that a few other countries, such as the Netherlands, might have figured among probable competitors.

Competition

Despite its limitation, it is believed, the analysis leads to the conclusion that Canada at present occupies either the fourth or the fifth position in the manufacture of various classes of aviation equipment, and in the consulting services. What is more relevant, it is an indirect measure of the extent of foreign competition by the western countries in the aviation world market. A review of "**Current and Planned Projects**", dealt with in Vol. 2 of this Report, would, to a great extent, substantiate the point.

4. FOREIGN COMPETITION



4. FOREIGN COMPETITION

FRANCE

FRANCE	TERMINAL	GROUND EQUIPMENT	PASSENGER HANDLING	METEOROLOGY SERVICES	SERVICES
	LIGHTING POWER PLANTS VENTILATION HEATING AIR CONDITIONING	STARTERS/CHARGING UNITS RUNWAY DE-ICING SWEEPERS SNOW BLOWERS CRASH TENDERS FUEL TENDERS	BAGGAGE/CARGO HANDLING RESERVATIONS TICKETING DISPLAY SYSTEMS JETWAYS WALKWAYS ELEVATORS/ESCALATORS	WIND DIRECT/SPEED IND. TRANSMISOMETER CEILOMETER RADIOSONDE RUNWAY VISUAL RANGE COMP. AUTOMATIC WX STATIONS	CONSULTANTS ARCHITECTS
BERTIN-CIE					
LES REALISATIONS METALLIQUES					
SOVARREL					
FERRANTI					
AIRPORT CONS ENG ASSC					
CAREL FOUCHE LANGUEPIN					
AUTOMOBILES BERLIET					
RAPISTAN LANDE SA					
COMPAGNE des COMPUTEURS					
GRACE S.A.R.L.					
THOMSON-CSF					
AERAZUR					
S.A. LEBON & CO					
SATAM					
SODETEG					
ETS. M. GUINAULT & CIE					
COMPAGNIE GENERALE d'AUTOMATISME CG					
ETS. GABRIEL et CIE					
ASCINTER OTIS					
C.I.T.E.C					
A.C.O. MAT					
A.C.E.C.					
SAINT GOBAIN					
PHILIPS					
TUNZINI					

4. FOREIGN COMPETITION

FRANCE

	RADAR										NAVAIDS					LIGHTING					COMMUNICATIONS					OPERATIONAL CONTROL																		
	ARSR	ASR	SSR	PAR	ASDE	BRIGHT DISPLAY	RADAR DIGITIZER	WEATHER RADAR	VOR	DME	TACAN	NDB	VDF	ILS	VOT	NDB MONITORING	PRECISION APPROACH	SIMPLE APPROACH	VASI	RUNWAY, THRESHOLD END	CENTRE LINE	RUNWAY, TOUCH-DOWN	TAXIWAY	BEACONS	OBSTRUCTION	HF	VHF	EXTENDED RANGE VHF	UHF	FQCY SHIFT KEYS	FQCY SHIFT CONVERTOR	TELEGRAPH EQUIPMENT	MESSAGE SWITCHING SYSTEM	SELCAL	ATC SYSTEM	ATC CONSOLE	COMMUNICATIONS CONSOLE	TRANSPORTABLE CONTROL	TWR RECORDERS	ATC SIMULATOR	RADAR SIMULATOR			
S.O.D.E.T.G.																																												
THOMSON-C.S.F.																																												
HOLOPHONE																																												
BARBIER, BENARD & TURENNE																																												
COMP. CENTRAL (C.O.C.E.I.)																																												
GROUPE C.I.T.E.C.																																												
COMPAGNIE INT'L POUR INFO																																												
ROHDE & SCHWARTZ FRANCE																																												
SECRE SA																																												
GICAM PARIS																																												
L'ENTREPRISE TELEPHONIQUE																																												
ABD-AIR EQUIPMENT																																												

4. FOREIGN COMPETITION

FEDERAL REPUBLIC OF GERMANY

	TERMINAL					GROUND EQUIPMENT					PASSENGER HANDLING					METEOROLOGY SERVICES					SERVICES				
	LIGHTING	POWER PLANTS	VENTILATION	HEATING	AIR CONDITIONING	STARTERS/CHARGING UNITS	RUNWAY DE-ICING	SWEEPERS	SNOW BLOWERS	CRASH TENDERS	FUEL TENDERS	BAGGAGE/CARGO HANDLING	RESERVATIONS	TICKETING	DISPLAY SYSTEMS	JETWAYS	WALKWAYS	ELEVATORS/ESCALATORS	TRANSMISOMETER	CEILOMETER	RUNWAY VISUAL RANGE COMP.	AUTOMATIC WX STATIONS	CONSULTANTS	ARCHITECTS	
ROLBA-UNIMOG						○		○																	
ALFRED SCHMIDT								○	○																
MARTIN BEICHACK							○	○																	
DAHMS & CO												○					○								
VFW (AIRGATE)												○													
FAUN-WERKE									○																
DAIMLER-BENZ							○	○	○	○		○													
RHEINSTAHL HENSCHEL AG															○										
AD STRUVER KG										○															
SCHORLING (SCHOLING)						○	○	○																	
STORR												○													
ORENSTEIN & KOPPEL																	○								
STOEHR FORDERANLAGEN SALZER UND CO												○													
IMPULS PHYSIK																			○	○					
RHEINISCHE STAHLWERKE						○	○	○	○	○	○	○				○	○								
SIEMENS						○																			
VEREINIGTE FLUGTECHNISCHE WERKE												○					○								
PHILIPS TELECOMMUNICATIE IND												○													

4. FOREIGN COMPETITION
FEDERAL REPUBLIC OF GERMANY

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ARSR										ASR										SSR										PAR										ASDE										BRIGHT DISPLAY										WEATHER RADAR										VOR										DME										TACAN										NDB										VDF										ILS										VOT										NDB MONITORING										PRECISION APPROACH										SIMPLE APPROACH										VASI										RUNWAY, THRESHOLD END										CENTRE LINE										RUNWAY, TOUCH-DOWN ZONE										TAXIWAY										BEACONS										OBSTRUCTION										HF										VHF										EXTENDED RANGE VHF										UHF										FQCY SHIFT KEYS										FQCY SHIFT KEYS										TELEGRAPH CONVERTOR										MESSAGE SWITCHING EQUIPMENT										SELCAL										ATC SYSTEM										ATC CONSOLE										COMMUNICATIONS CONSOLE										TRANSPORTABLE CONSOLE										RECORDERS										ATC SIMULATOR										RADAR 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4. FOREIGN COMPETITION
ITALY

	TERMINAL	GROUND EQUIPMENT	PASSENGER HANDLING	METEOROLOGY SERVICES	SERVICES																			
	LIGHTING	POWER PLANTS	VENTILATION	HEATING	AIR CONDITIONING	STARTERS/CHARGING UNITS	RUNWAY DE-ICING	SWEEPERS	SNOW BLOWERS	CRASH TENDERS	FUEL TENDERS	BAGGAGE/CARGO HANDLING	RESERVATIONS	TICKETING	DISPLAY SYSTEMS	JETWAYS	WALKWAYS	ELEVATORS/ESCALATORS	TRANSMISOMETER	CEILOMETER	RUNWAY VISUAL RANGE COMP.	AUTOMATIC WX STATIONS	CONSULTANTS	ARCHITECTS
SOLARI & CO														●										
LANCIA & CO									●															
INDART S.P.N.									●															
ATAER-ATTREZZATURE												●												
OFFICINE MECCANICHE M. CARELLO												●					●							
CISA												●												
WALTER STOCKLIN ITALIA												●												
BUINI & GRANDI	●		●																					
COGEPI	●	●	●	●	●																			
ISOTTA FRASCHINI E MOTORI BREDA		●																						
SAUTI S.P.N.																						●		
ITALCONSULT																						●		
MAGNETI MARELLI						●																		
SCHLINDER S.P.N.																●	●							
OFFICINE VIBERTI TORINO									●															
TRANSTECNICA											●													
SELINIA														●										

4. FOREIGN COMPETITION

ITALY

[illegible]

4. FOREIGN COMPETITION
UNITED KINGDOM

FOREIGN COMPETITION																										
UNITED KINGDOM																										
	TERMINAL	GROUND EQUIPMENT	PASSENGER HANDLING	METEOROLOGY SERVICES	SERVICES																					
	LIGHTING	POWER PLANTS	VENTILATION	HEATING	AIR CONDITIONING	STARTERS/CHARGING UNITS	RUNWAY DE-ICING	SWEEPERS	SNOW BLOWERS	CRASH TENDERS	FUEL TENDERS	BAGGAGE/CARGO HANDLING	RESERVATIONS	TICKETING	DISPLAY SYSTEMS	JETWAYS	WALKWAYS	ELEVATORS/ESCALATORS	TRANSMISOMETER	CEILOMETER	RUNWAY VISUAL RANGE COMP.	AUTOMATIC WX STATIONS	CONSULTANTS	ARCHITECTS		
SOVEX LIMITED												●														
(RAPISTAN) MFG EQUIP CO LTD												●														
LEYLAND								●		●																
LINER/CROKER								●																		
SMITH & WELLSTOOD								●																		
PYRENE-CO LTD									●																	
GEC-ELLIOTT												●														
FERRANTI														●												
BABCOCK-MOXEY LTD															●	●										
PLESSEY														●												
CARMICHAEL & SONS LTD									●																	
HCB ANGUS LTD									●																	
HALL LIFTS & ESCALATORS LTD																●										
PETBOW LTD					●																					
CAMMEL LAIRD (ANGLESEY) LTD																●	●									
AEC LTD									●	●																
ROOTES MOTORS						●			●	●	●	●														
HEDLEY S CRABTREE																						●				
ATKINSON VEHICLES							●	●	●	●																
WILLIAM BUNCE & SON							●	●																		
HWEDGEHILL EQUIP LTD												●			●	●										
MERCURY AIRFIELD EQUIP LTD								●		●		●														
ROLBA LIMITED							●	●																		
JOHN THOMPSON TRANSPORTER									●																	
STC (ITT)													●													

4. FOREIGN COMPETITION
UNITED KINGDOM

	RADAR										NAVAIDS					LIGHTING					COMMUNICATIONS					OPERATIONAL CONTROL																		
	ARSR	ASR	SSR	PAR	ASDE	BRIGHT DISPLAY	RADAR DIGITIZER	WEATHER RADAR	VOR	DME	TACAN	NDB	VDF	ILS	VOT	NDB MONITORING	PRECISION APPROACH	SIMPLE APPROACH	VASI	RUNWAY, THRESHOLD END	CENTRE LINE	RUNWAY, TOUCH-DOWN ZONE	TAXIWAY	BEACONS	OBSTRUCTION	HF	VHF	EXTENDED RANGE VHF	UHF	FQCY SHIFT KEYS	FQCY SHIFT CONVERTOR	TELEGRAPH EQUIPMENT	MESSAGE SWITCHING SYSTEM	SELCAL	ATC SYSTEM	ATC CONSOLE	COMMUNICATIONS CONSOLE	TRANSPORTABLE CONTROL	TWR	RECORDERS	ATC SIMULATOR	RADAR SIMULATOR		
PYE TELECOMMUNICATIONS MTD																																												
MARCONI																																												
REDIFON																																												
RACAL																																												
STC (ITT)																																												
BURNDIPT ELECTRONICS																																												
PLESSEY																																												
EKCO ELECTRONICS																																												
RESEARCH ENGINEERS LIMITED																																												
THORN BENDIX																																												
RCA (GB)																																												
COSSOR (RAYTHEON)																																												
FERRANTI																																												
EMI ELECTRONICS LIMITED																																												
INTERNATIONAL AERADIO																																												
GEC-AEI LIMITED																																												
SOLARTRON ELECTRONICS GROUP																																												
THORN ATLAS AIRFIELD LIGHTING																																												
CHRISTIE BROS LIMITED																																												
DECCA RADAR LTD (PLESSEY)																																												
CREED & CO																																												
ELLIOT BROS																																												
BUTLERS LIMITED																																												
BRITISH COMMUNICATION CORP																																												

4. FOREIGN COMPETITION
UNITED STATES

4. FOREIGN COMPETITION UNITED STATES	TERMINAL	GROUND EQUIPMENT					PASSENGER HANDLING					METEOROLOGY SERVICES				SERVICES								
	LIGHTING	POWER PLANTS	VENTILATION	HEATING	AIR CONDITIONING	STARTERS/CHARGING UNITS	RUNWAY DE-ICING	SWEEPERS	SNOW BLOWERS	CRASH TENDERS	FUEL TENDERS	BAGGAGE/CARGO HANDLING	RESERVATIONS	TICKETING	DISPLAY SYSTEMS	JETWAYS	WALKWAYS	ELEVATORS/ESCALATORS	TRANSMISOMETER	CEILOMETER	RUNWAY VISUAL RANGE COMP.	AUTOMATIC WX STATIONS	CONSULTANTS	ARCHITECTS
BARKLEY & DEXTER LABS																				⊙	⊙			
KAHL SCIENTIFIC INSTRUMENT CORP																				⊙	⊙			
JOHN GILLEN CO																⊙	⊙							
LAMBERT INC								⊙	⊙															
LITTLE GIANT PRODUCTS INC								⊙	⊙															
MARMON HETHERINGTON CO INC								⊙	⊙															
MEYER PRODUCTS INC								⊙	⊙	⊙														
NESBITT ENVIRONMENTAL (ITT)		⊙	⊙	⊙																				
RCA												⊙		⊙										
SICARD INDUSTRIES INC								⊙	⊙															
MCGRAW EDISON INSTRUMENT DIV	⊙													⊙										
WAYNE MFG CO								⊙																
AEROJET GENERAL CORP												⊙												
RAPISTAN INC												⊙												
MATTHEWS CONVEYER (CHAINBELT)												⊙												
HOBART BROS					⊙																			
KOLLSMAN INSTRUMENT													⊙											
WOLLARD AIRCRAFT EQUIPMENT														⊙	⊙	⊙								
PEAT MARWICK LIVINGSTONE & CO																						⊙		
AIRWAYS ENGINEERING CO																						⊙		
R. DIXON SPEAS ASSC																						⊙		
YANKEE WALTER CORP								⊙	⊙	⊙	⊙													
NORDSKOG CO INC													⊙											
FRINK SNO-OWS INC								⊙	⊙	⊙														
AMERICAN LA FRANCE									⊙															
JETWAY EQUIPMENT CORP												⊙			⊙									
STANRAY AVIATION EQUIPMENT												⊙		⊙	⊙									
VICTOR CONTROLS LIMITED					⊙																			

4. FOREIGN COMPETITION UNITED STATES

	RADAR					NAVAIDS					LIGHTING					COMMUNICATIONS					OPERATIONAL CONTROL																								
	ARSR	ASR	SSR	PAR	ASDE	BRIGHT DISPLAY	RADAR DIGITIZER	WEATHER RADAR	VOR	DME	TACAN	NDB	VDF	ILS	VOT	NDB MONITORING	PRECISION APPROACH	SIMPLE APPROACH	VASI	RUNWAY, THRESHOLD END	CENTRE LINE	RUNWAY, TOUCH-DOWN ZONE	TAXIWAY	BEACONS	OBSTRUCTION	HF	VHF	EXTENDED RANGE VHF	UHF	FQCY SHIFT KEYS	FQCY SHIFT CONVERTOR	TELEGRAPH EQUIPMENT	MESSAGE SWITCHING SYSTEM	SELCAL	ATC SYSTEM	ATC CONSOLE	COMMUNICATIONS CONSOLE	TRANSPORTABLE CONTROL TWR	RECORDERS	ATC SIMULATOR	RADAR SIMULATOR				
RCA	•	•	•	•	•	•	•	•	•	•	•	•	•	•											•	•	•	•	•	•															
CUTLER HAMMER NY																																													
CUBIC INDUSTRIAL CORP																																													
BUTLER NATIONAL CORP																																													
UNIVAC (SPERRY RAND)	•	•		•																																									
COLLINS RADIO																																													
IBM FEDERAL SYSTEM																																													
STANCIL HOFFMAN CORP																																													
LEACH CORP CALIF																																													
ELECTRONIC LIGHTS INC																																													
BURROUGHS																																													
TELESIGNAL CORP																																													
TEXAS INSTRUMENT CO	•	•	•	•																																									
RAYTHEON CORP																																													
GRANGER ASSOCIATES																																													
AMERACE ESNA CORP																																													
INT'L TECHNICAL PRODUCTS																																													
AIRBORNE INST LABS																																													
MOTOROLA																																													
WILCOX INT'L ELECTRIC																																													
AIR TRAFFIC CONTROL SYSTEMS																																													
HUGHEY & PHILLIPS																																													
ITT																																													
GENERAL ELECTRIC																																													
CRAIG SYSTEMS INC																																													
CROUSE HINDS CO																																													

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5. METHODOLOGY

Introduction

For the purpose of forecasting of requirements, the equipment is grouped in the following **categories**:

- **Air Navigation Services Equipment**
- **Runway and Apron Equipment**
- **Terminal Equipment**
- **Ramp Equipment**

Air Navigation Services Equipment includes radars, radionavigation aids, lighting, communications, operational control systems, simulators and meteorological services. The **Runway and Apron Equipment** comprises of fire fighting equipment, rescue vehicles, sweeping and snow clearance implements. Those in the category of **Terminal Equipment** consist of flight information displays, baggage handling equipment, elevators, escalators and central emergency power generators. The **Ramp Equipment** takes into account passenger loading, baggage and freight loading, towing and the aircraft services equipments.

The forecast is aided by numerous types of publications; information provided by the Canadian Trade Commissions; visits to a number of countries in Africa, the Caribbean area, South America, Europe, and South East Asia; discussions with officials of IATA and ICAO as well as those of some of the national governments. In the study of African countries, discussions with the Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar (ASECNA) at Dakar have been of great benefit. Plans and reports received from some countries, and discussions with manufacturers and suppliers of equipment have also contributed to the forecast.

The forecast takes into consideration not only the facilities already planned, but also the probable future requirements arising out of Bo-747

and SST operations; growth of air traffic, passenger and cargo movements and the anticipated development of additional airports. The requirement due to general aviation and the V/STOL aircraft is kept in view.

In predicting the future requirements, the replacement of the existing equipment and the recurring replacement of those to be installed during the forecast period are taken into account. The average life-expectancy of electronic, electro-mechanical and mechanical equipment is taken as the measure for the rate of replacement of equipments. Consideration is given to the possibility of certain types of equipment or systems becoming obsolescent due to technological developments.

The forecast takes note of possible augmentation of facilities at existing airports and requirements due to development of new airports because of increased and diverse types of air traffic, introduction of aircraft of advanced characteristics.

The development of new airports is estimated on the strength of known data, to the extent these were available; otherwise, from computerised extrapolated data related to air traffic activities. The growth rate of new airports is based on a computerized model. The airports have been classified as **Class A**, **Class B**, and **Class C** for countries other than the U.S., according to aircraft movements. The U.S. airports are categorized as **High**, **Medium** and **Low Density** as in the Department of Transportation/Federal Aviation Administration (DOT/FAA) National Aviation System (NAS) Plan.

The **methodology** for the forecast of Air Navigation Services Equipment has fundamentally differed from that of other three categories of equipments. Then again, even within the category of Air Navigation Services Equipment itself the basis of study has not been the same for the U.S.A., U.S.S.R., and the rest of the world.

Air Navigation Services Equipment

In the case of the U.S.A. the requirement of Air Navigation Services Equipment is mainly based on the DOT/FAA NAS Plan (1971-1980) and its companion document the National Aviation System Policy Summary. Other available sources are also taken into account, e.g. Airport World, Aviation Week and Space Technology, Space Aeronautics, Aviation Daily.

The U.S.A. forecast was made in two steps. As a realistic approach, the first step was to forecast for the period 1971-1980 on the strength of the NAS Plan, and because of the DOT/FAA policy to convene an Annual Planning Conference in order to update the existing 10-year plan, and to advance the plan successively by one year. The requirement for the period 1981-1990 was then projected from this forecast on the assumption that the rate of requirements would continue to be the same as in 1971-1980.

The DOD/FAA NAS Plan is self-contained. It includes the current and the future requirements as well as replacements and augmentations during the plan period 1971-1980. It indicates estimates of expenditures, and in most cases also the quantity of equipment or systems required. Wherever quantification would be unrealistic, only the expenditure is given. Estimates of expenditures are categorized as Facility and Equipment (F&E) and Research and Development (R&D).

The equipment/systems are grouped according to the type of service these are intended to provide. Accordingly, the same or a similar equipment often appears under two or more sections. To mention a few examples: Radars come under En Route Control and Services as well as Terminal Area Control and Services; DME as En Route

Navigation Aids as also Landing Aids; the Voice Recorder is shown under En Route Control and Services, Terminal Area Control and Services, and Flight Services.

The F&E estimates in the NAS Plan are inclusive of cost of equipment, siting, installation and ancillary services. In some cases, these include buildings and structures and support aircraft.

In consequence, the NAS Plan was analysed to consolidate the equipments/systems of the same or similar class, and to estimate cost of the equipment content. The equipment cost was estimated from the F&E cost on the analogy of all-inclusive expenditures on some of the known typical installations vis-a-vis the cost of the equipment. Wherever the Plan is not specific, the quantity was estimated as a percentage of the F&E cost, keeping in view the general market price of the equipment in question.

Augmentation of current plans, or replacement of existing equipment and systems could not be included in the forecast on the U.S.S.R. It had to be limited to the probable requirement of new equipments and the recurring replacements which are likely to arise out of future development of airports and aviation growth. This was because of lack of sufficient information on the existing airports and aviation services of the country.

Next, the replacement of equipment was forecast. This was based on the number of years a facility has been, or likely to have been, in operation, the average life-span of the equipment used, and the possibility of an equipment becoming obsolete.

In the case of those equipment and systems where data were scanty or unavailable for forecasting approach was somewhat different.

5. METHODOLOGY

Air Navigation Services Equipment (Cont'd)

To forecast the requirement of telegraph equipment, error correction systems, message switching systems, and communications control consoles the number of existing and predicted en route air-ground channels and point-to-point circuits (other than the voice circuits) terminating at an airport, were listed. This was next co-related to expected message traffic and the responsibility of the communication center for relaying and dissemination of messages. The co-relation was established in reference to present and anticipated volume of air traffic, Bo-747 and SST operations, and whether the airport serves as a Flight Information Center (FIC), Area Control Center (ACC) or a Relay point.

Likewise, in the instance of ATC consoles, Selcal systems, and automatic ATC systems, the requirement was forecast in relevance to volume of air traffic, the number of air-ground and point-to-point voice channels, Bo-747 and SST operations and the type of air traffic control services provided at an airport.

In the treatment of simulators, additional consideration was whether there exists any centralized ICAO or national training center in the region.

Constituents of meteorological service were estimated on the basis of volume of air traffic, Bo-747 and SST operations, keeping in view the prevalent practices and the ICAO recommendations.

In regard to countries other than the U.S.A. and the U.S.S.R. the ICAO Air Navigation Plans (ANP) were based as main documents. These were supplemented by the U.S.A.F. Flight Information Publications, facility charts as published by government and private agencies and Interavia. Extensive use was made of the data and information obtained from other sources, mentioned in the Introduction.

The ICAO ANPs deal only with those airports which form part of international civil aviation, and provide facility-wise data on radionavigation

aids, lighting, and communication channels/circuits. These indicate whether a facility is in existence or planned. The ANPs do not contain any such data on radars, message switching systems, operational control systems, simulators and Selcal devices. Nor do these go into the system-description for the meteorological service.

The U.S.A.F. Flight Information Publications, other facility charts and Interavia, on the other hand, provide factual information on practically all the airports in a country, irrespective of whether an airport is a grass/gravel strip or a full-fledged one. These also deal with radars to a limited extent.

Considerable in-depth study and step by step country-wise analyses were made in forecasting the Air Navigation Services Equipment.

The methodology applied is briefly outlined as follows. As a first step, the available data on radars, radionavigation aids, lighting and communication channels/circuits were tabulated for the related airports. The predicted future requirements of these facilities due to increased demands on the existing airports and on the new airports likely to be developed were then added to the tabulation. This facility-chart was then converted to an equipment-oriented table.

Next, the equipment required for those facilities already planned were forecast for the period 1970-72. In certain cases of critical types of equipment -- such as the VOR, ILS and the radar -- the forecast was extended up to 1973-75 on a proportional basis to take into account such problems as land acquisition, siting, power supply and personnel, according to the country or the region dealt with.

The probable future requirements were, thereafter, provided for the periods ranging from 1973-75 through 1990 according to the anticipated increase in activities at the existing airports and the forecast of development of new airports.



Other Equipment

Except for the flight information display and the electric generator, these are entirely mechanical equipment comprising the **Runway and Apron Equipment**, the **Terminal Equipment** and the **Ramp Equipment**.

Although the task of forecasting was limited to the electronic equipment only, the scope of the forecast has been intentionally enlarged to include these categories of equipment as well. This is because it became apparent during the study that these equipment could offer a sizeable market.

A study was accordingly carried out, and it is revealing that the estimated dollar value of Other Equipment is almost equal to those in the category of Air Navigation Services Equipment.

This part of forecasting was not as detailed or analytical as in the area of Air Navigation Services Equipment. Nonetheless, this fact, it is considered, would not detract from the overall estimate. Because of the large market potential for these equipment it would be greatly worthwhile to undertake a detailed forecast of requirements for these categories of equipment.

Runway and Apron Equipment

The fire fighting equipment and the rescue vehicles were forecast in reference to the ICAO recommended scale, depending on the type and capacity of aircraft currently operating and expected to operate at an airport.

The sweeping equipment and the snow clearance equipment were

estimated in the light of aircraft movements and aircraft types as well as the climatological condition.

In both cases the scale of these categories of equipments generally provided at some of the typical airports were taken into consideration.

The forecast for this category of equipment was carried out on a regional basis.

Terminal Equipment

Flight information displays and the baggage handling equipment were predicted on the basis of peak-hour passenger movements, types of aircraft operations and aircraft movement.

The practice generally followed in providing such facilities in airport terminals served as a guide-line in the forecasting of elevators and escalators.

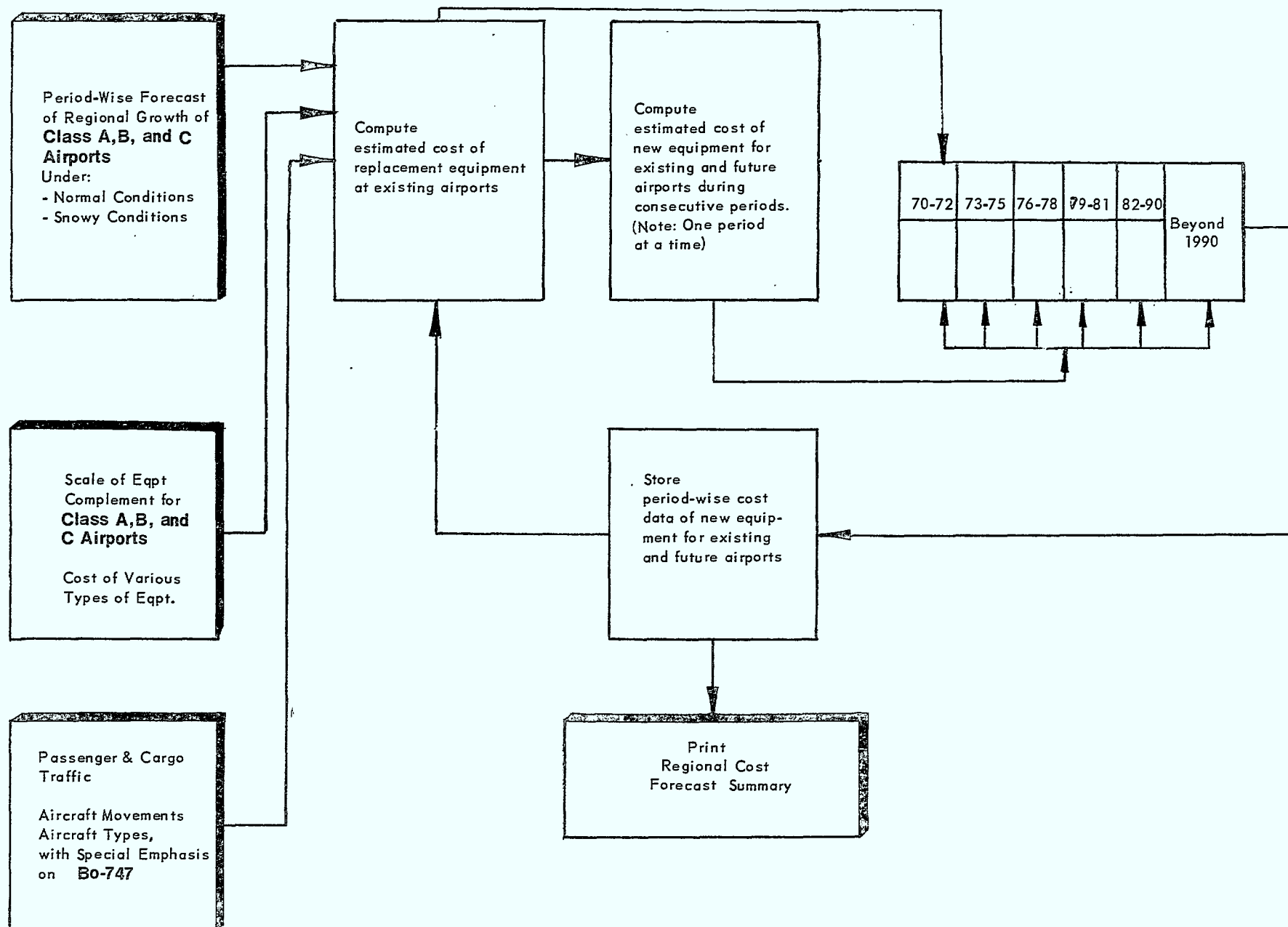
The requirement of central power supply generators was limited to redundancy arrangements to maintain and operate essential air navigation facilities and airport services in the event of failure of the main source.

Here also, the requirement was studied on a regional basis.

Ramp Equipment

The extent of requirement of this category of equipment is related to types of aircraft, the peak-hour movements of aircraft, turn-around time, and the type of air traffic at an airport.

In estimating these equipments, several publications were referred to, expert opinions sought, manufacturers and suppliers consulted in order to forecast the regional requirements.



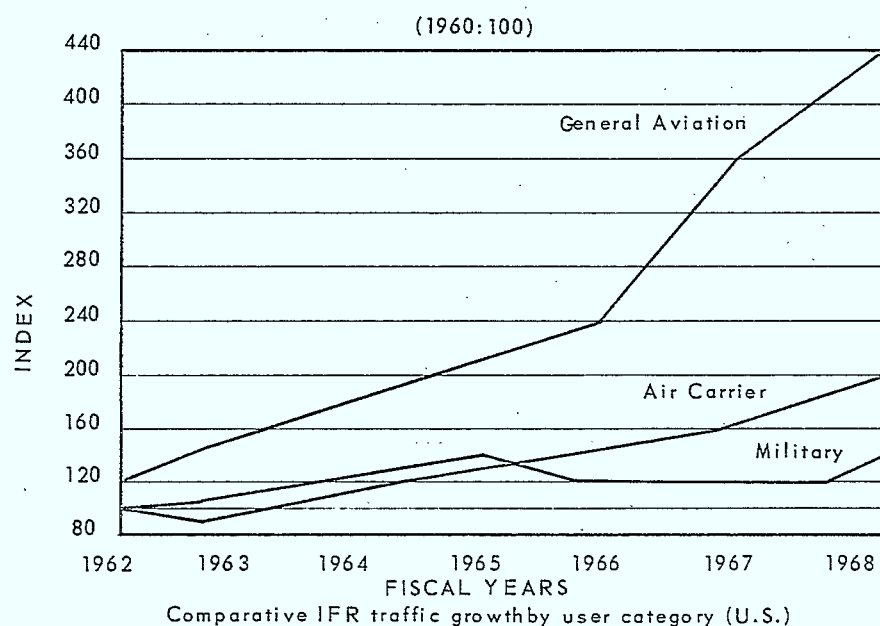
6. AIR TRAFFIC

Reporting on the growth of scheduled traffic between 1968 and 1969, ICAO indicates a 10% increase in "passengers carried" and 13% for "passenger kilometres performed". Both figures are perfectly correct but could lead to serious misunderstanding if used indiscriminately to express the increase in "passenger traffic".

"Passenger kilometres" is a measure of the work done by the air-carriers. It includes in one figure both "passengers carried" and "kilometres flown per passenger" and is most useful to airlines for revenue computation, route analysis or other. From an airport planner point of view the "passenger kilometres performed" is of second order importance, consequently in this study, when speaking about growth, we are using almost exclusively units unrelated to distance flown such as "air movements", "passengers carried" and "tonnes carried".

Air Carriers, Military and General Aviation Traffic

We can consider air traffic in the various parts of the world under the divisions of Air Carriers, Military and General Aviation. The relative growth of these three categories is shown on the accompanying graph of IFR traffic. The graph displays U.S. statistics but, in practice, because of the overwhelming preponderance of U.S. traffic, is adequate to show the relative importance of the three types of traffic.



Military Aviation Traffic

It is generally agreed that military air traffic will not increase. First, more and more reliance is being placed on various types of missiles for offence and defence and less military aviation activity is the result. Secondly, the cost of new military aircraft is rising very rapidly and this will in itself limit the numbers of military aircraft that a country can afford. And third, the increased use of military aircraft simulators is reducing the actual amount of flying time required for basic instruction and instrument flying training. In short, it is more likely that military aircraft movements will decrease rather than the opposite. Many military airbases in North America and Europe have been closed and some of them have been converted for use by general aviation. It therefore appears that military aviation is not likely to present a large market, especially when contrasted with the steady growth in civil aviation and the spectacular growth in general aviation. Of course, this picture could change very rapidly if any large scale war should break out, but we have assumed that this will not happen.

General Aviation - Traffic

In the United States, general aviation is growing at a tremendous rate. The FAA estimates that by 1980, 87% of the combined activity at the 22 largest metropolitan airports will be from general aviation aircraft. The number of these aircraft in the USA is expected to grow from 130,000 in 1970 to as many as 225,000 by 1980. These statistics appear credible when we consider that 63% of the 10,000 airports in the USA are privately owned and are used solely for general aviation and that the FAA plans to spend \$176 million on existing G.A. airports and \$268 million on new G.A. airports by 1980.

Although figures on the relative amounts of civil vs. general aviation are rather sparse for other areas, the growth of G.A. that has been experienced in the United States may be anticipated to occur elsewhere in the world and will be an important component of the air transportation system.

In terms of aircraft, the 160,000 G.A. aircraft outnumber the world's airline fleet 33 to 1. If G.A. pilots continue to increase their instrument-flying capability (present rate is 25% increase per year), then by 1975, G.A. will be by far the largest user of the IFR facilities at the airports and in the airways.

Air Carriers Traffic

In terms of air movements, Air Carrier traffic is second to General Aviation traffic but its effect on capital expenditure for the ground segment of the air transportation system is by far the greatest. The current distribution of "scheduled Air Carrier traffic" is shown on the accompanying table by region and by type of traffic. From 1946 onward world traffic expressed in "passengers carried" has maintained a steady average growth rate of about 13 per cent. While the 1969 and 1970 growth rates were 10 and 7 per cent respectively, the 1971 rate is expected to increase to 10 per cent again.

When we individually consider the seven ICAO regions, the wide variation between the growth rates in the different parts of the world is apparent. In 1969, while air passenger traffic in the Far East is soaring upwards at a rate of 16.0% per year, in South America, the growth rate is a modest 1.9 per cent.

To obtain a somewhat more complete picture of Air Carriers activities, we can consider the distribution of total scheduled air traffic in the various ICAO Regions by type of traffic,

One cannot fail to notice the extraordinarily high rate of growth of "Freight Tonnes carried". For the period 1965- 1969 the average growth rate for the world was 16 per cent.

Non-scheduled vs. Scheduled Air Carriers Traffic

Our forecasts of air traffic (see Traffic Forecasting), have been produced from the statistics of the regularly scheduled aerservices. However, it must be realized that non-scheduled traffic is by no means insignificant. In 1969, it is estimated that world non-scheduled capacity amounted to at least 10% of scheduled capacity. On the North Atlantic, the actual non-scheduled passenger traffic was 19% of the scheduled traffic. And, although non-scheduled flights comprise only a relatively small percentage of the total, the non-skeds inclusive-tour traffic is growing twice as fast as the scheduled traffic. In addition, the load factor of the non-skeds is almost twice as great. In fact, by 1975, at this rate of increase, the non-scheduled traffic will equal the scheduled traffic. It is realized that manufacturers of airport equipment are not concerned with whether a flight is scheduled or not. These points are mentioned here to show how the future traffic may be split up.

DEVELOPMENT OF AIR CARRIERS TRANSPORT (Scheduled Services)

REGION	AIRCRAFT MOVEMENTS			PASSENGERS CARRIED			FREIGHT TONNES CARRIED		
	Millions	Annual % increase		Millions	Annual % increase		Thousands	Annual % increase	
	1968-69	1968-69	1965-69	1968-69	1968-69	1965-69	1968-69	1968-69	1966-69
North America	11.84	1.0	6.5	175.6	7.2	13.7	2,328.	17.	16.
Europe	3.26	5.9	5.0	61.0	17.9	11.9.	1,067.	19.	12.8
Far East	1.38	16.0	11.5	24.5	20.3	25.9	207.	20.	28.3
South America	.94	-4.1	-1.6	10.1	1.9	5.5.	192.	-15	
Oceania	.64	1.0	-1.9	7.8	7.0	7.0	176.	12.6	4.0
Africa	.58	5.6	4.9	6.0	15.1	10.7	90.0	11.8	6.0
Middle East	.26	5.9	7.5	3.8	.6	12.8	51.0	11.4	36.0
World	18.9	2.2	5.8	288.8	10.0	13.0	4,112.0	15.0	16.0

7. TRAFFIC FORECASTING

Many studies of aviation growth have been made. Previous forecasts of aviation traffic which were made between 1950 and the present have ranged widely, but they all **under-estimated the actual amount of growth which occurred.** At the present time, about the only point on which all of the forecasters will agree, is that there will be a growth and that this growth will be substantial. The large differences between the forecasts can be partly accounted for by the various assumptions which each forecaster had to make at the outset. These assumptions are basic to the business of making any forecast. Aviation traffic forecasting can be approached in two fundamental ways. The first is the **projection of historical trends;** this approach pre-supposes the availability of historical data covering a period long enough to discriminate seasonal or short term fluctuations from long term trends. A second type of approach is **correlation and regression techniques;** the expected traffic trend is related to basic parameters whose long term behaviour is predictable and well understood. The choice of the parameters depends on the type of traffic one is trying to forecast.

Some Factors Affecting the Growth of Air Traffic

The volume of air traffic that is generated depends on a number of factors, many of which are inter-related. For example, in the case of passengers, some typical factors which will tend to increase air traffic are:

1. Increase in population. This is not always a sure indicator for aviation growth, particularly in under-developed countries, because the large population increases usually occur in a social level which can neither afford to fly nor wish to fly.
2. Increase in disposable income.
3. Improvement in quality of air services.

Typical factors which may tend to reduce the growth of the same traffic are:

1. Travel delays due to airport congestion. This may cause so much resentment that traffic will be diverted to other modes of surface transportation.
2. Growth of general aviation traffic which may absorb the remaining

capacity of the air traffic control and ground handling facilities.

3. The availability of improved ground transportation (Hovercraft, Air-trains, Turbotrains, etc.)
4. The availability of improved forms of communications.

Aviation Traffic Forecast

For the purpose of this study traffic forecasts were produced by analyzing ICAO historical data. On the opposite page our forecasts by region and type of traffic are represented graphically.

In part 2 of this report, traffic forecasts are given for each of the countries included in the survey. All forecasts are computer derived using a standard exponential growth program and allowing for unrestrained demand.

We have assumed that things will go on much as at present. For example:

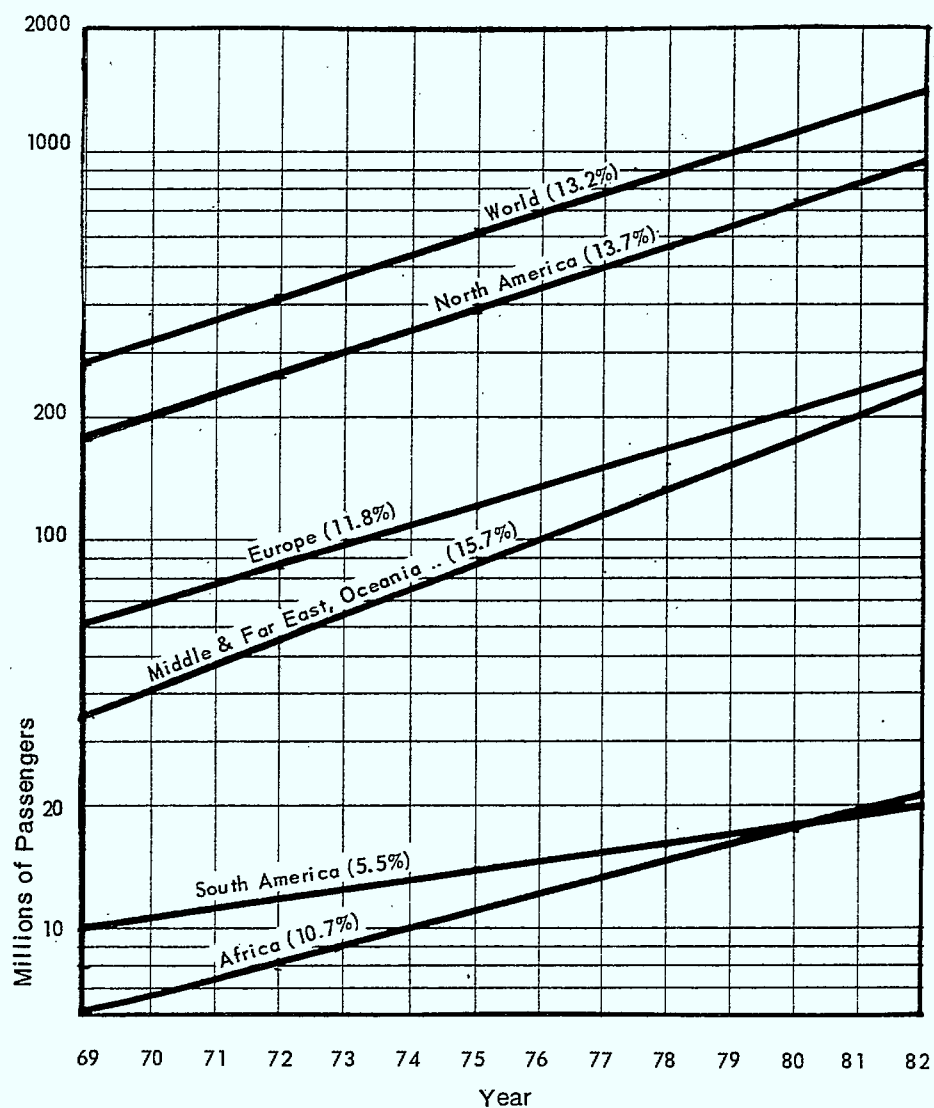
1. There will be neither a serious depression nor unrestrained inflation.
2. No serious sociological revolution will occur in the western world, i.e.: the present mix of capitalistic and socialistic societies will continue.
3. The world will continue in a quasi-peaceful state with only small "brush-fire" wars occurring on a more-or-less continuous basis.
4. The incentives which presently exist to make people invest in airlines, etc. will continue.
5. There will continue to be a reliance on a free economy and free market systems to generate economic activity.
6. Government policies similar to those of the last 20 years will continue.

According to the current annual rates of growth the number of passengers that will be carried by the world airlines will double every five to six years while the number of tonnes of freight will double every four to five years.

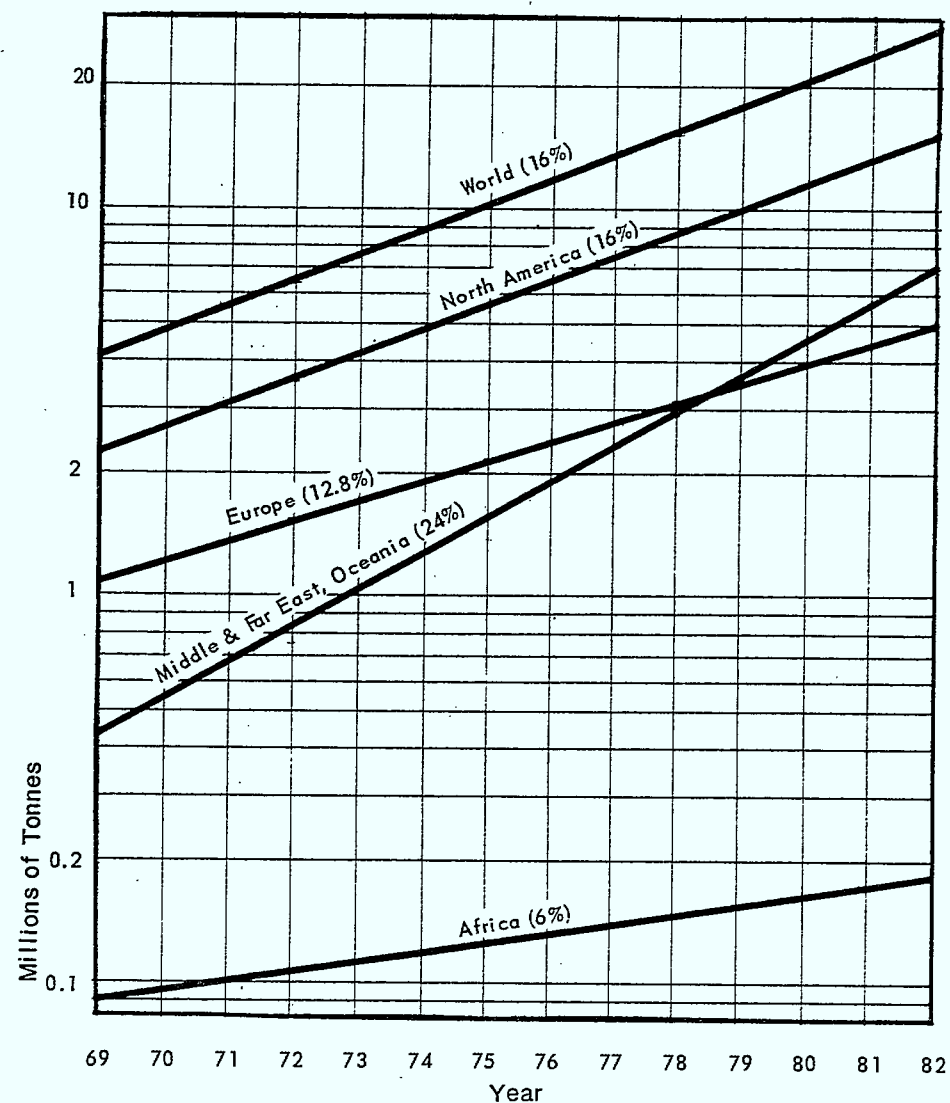
It is particularly important to notice the spectacular growth in the Middle and Far East where the total traffic may equal European traffic by the beginning of the eighties.

FREE WORLD COMMERCIAL AIR TRAFFIC PROJECTIONS BY REGIONS (1969 - 1982)

Expected Passengers to be Carried on Scheduled Flights



Expected Freight to be Carried on Scheduled Flights



8. AIRCRAFT OF THE SEVENTIES

The growth in commercial traffic expected for the next twenty years will be paralleled by a growth in the size and speed of the aircraft. Almost simultaneously two new categories of aircraft have emerged: the large capacity subsonic transport and the supersonic transport, more frequently referred as **Jumbos** and **SSTs** respectively. The trend toward faster and bigger aircraft is matched by an increase in airport size and location of new airports at increasing distances from the cities.

The result of these trends is a spectacular reduction in the duration of city to city travel time for **Intercontinental travel** but at the same time for trips 300 miles or less in 1975, the total passenger trip time will be twice what it was in 1950. The STOL, VTOL and V/STOL aircraft are the likely answer to reduce the duration of short trips.

Large Capacity Subsonic Jet Transport Jumbos.

1970 was the year of the Jumbo. Figures released when the BO 747 ended one year in airline service on January 21, 1971, showed that the 747's carried 7 million passengers 15,500 million passenger miles. Many airlines now fly a total in excess of 100 of these aircraft and it will soon be followed by the Lockheed L-1011 (if the Rolls-Royce engine procurement difficulties can be resolved) and L500 and the Douglas DC-10 in 1971. In the short range, large capacity aircraft the European Airbus A-300B, the BAC 311 and DASSAULT MERCURE are all at various stages of development.

The large capacity subsonic jet transport has a particularly strong impact on the terminal area of the airport system. "The fundamental impact revolves around aircraft/facility compatibility for the resolution of time/distance/space activities involving passengers, baggage and cargo...." (D.R. Hemming, Director, Planning and Research, Air, DOT. 7th session of Commonwealth Air Transport Council).

By 1973 Bo 747 will operate in 111 airports in 67 countries. To provide the necessary equipment to manoeuvre the aircraft, load and unload passengers and baggages, carry out minor repairs, refuel and supply all basic necessities, equipment investments of the order of half million dollars per airport will be required. The largest share of these investments falls within the category of ground support equipment.

Supersonic Transport

Two supersonic transports are flying the British-French "Concorde" and the Russian TU-144. Both are Mach 2, 1200 miles an hour, 100% faster than current subsonic jet used by the airlines. Both are undergoing intensive tests and it is believed that commercial flying will start in 1972.

In the United States, the prototype of a Mach 3 aircraft is being built. It will fly 50% faster than either the Concorde or the TU-144. The necessity for an SST is strongly challenged in the U.S. and the opponents of the project insist that the noise and air pollution that will be created by these aircraft will be excessive. The Airport Operators Council International has urged the Administration to give "unequivocal assurance" that the SST will not proceed beyond the prototype stage unless it meets noise standards for future aircraft, which has already been set by FAA. It is believed that the S.S.T. program will continue, and that the effect of the pressures exercised by its opponents will be the production of an aircraft less detrimental to the environment.

Arriving slightly after the Jumbo, the S.S.T. will have little impact on the airport and terminal facilities. Runways suitable for DC8s and 707s will be adequate for SSTs. The height and length of the known SSTs will make them compatible, with very minimal modification with the facilities provided for the Jumbos.

The Report of ICAO Fifth North Atlantic Regional Air Navigation meeting identifies some of the areas where the introduction of SSTs would have major effects. At the beginning, the only requirement will be for MET, COM and AIS services to be geared to the greater speed involved, and in the transition areas where SST would penetrate subsonic levels, to insure that adequate surveillance is provided by radars or other means. Oceanic clearance is likely to require computer assistance to ensure effective minimal longitudinal spacing. Toward the end of the decade when lateral and longitudinal separation will need to be reduced to allow the expected traffic flow, various new solutions will be needed such as: satellite surveillance, enhanced navigational capabilities, airborne separation monitors.

PLANNED BOEING 747 OPERATIONS
at
111 AIRPORTS
in
67 DIFFERENT COUNTRIES AND TERRITORIES

8. AIRCRAFT OF THE SEVENTIES

AMERICAN SAMOA
Pago/Pago — 1973

ANGOLA
Luanda — 1972

ARGENTINA
Buenos Aires — 1972

AUSTRALIA
Brisbane — 1972
Darwin — 1971
Melbourne — 1971
Perth — 1971
Sydney — 1970

AUSTRIA
Vienna — 1971

BAHAMAS
Freeport — 1971
Nassau — 1970

BAHRAIN
Bahrain — 1971

BELGIUM
Brussels — 1971

BERMUDA
Kindley Field — 1970

BRAZIL
Brasilia — 1973
Rio de Janeiro — 1972
São Paulo — 1973

CAMBODIA
Siem Reap — 1972

CANADA
Montreal — 1970
Toronto — 1971
Vancouver — 1971

CEYLON
Colombo — 1971

CHINA
Taipei — 1971

CZECHOSLOVAKIA
Prague — 1971

DENMARK
Copenhagen — 1971

FIJI
Nandi — 1970

FRANCE
Paris — 1970

FRENCH ANTILLES
Fort-de-France — 1970
Pointe-à-Pitre — 1970

FRENCH GUYANA
Cayenne — 1970

FRENCH POLYNESIA
Tahiti — 1973

**FRENCH TERRITORY OF
AFARS AND ISSAS**
Djibouti — 1973

**GERMANY, FEDERAL
REPUBLIC OF**
Düsseldorf — 1973
Frankfurt — 1970

Hamburg — 1970
Köln-Bonn — 1972
München — 1970
Stuttgart — 1972

GREECE
Athina — 1971

HONG KONG
Hong Kong — 1970

INDIA
Bombay — 1971
Calcutta — 1971
Delhi — 1970

IRAN
Tehran — 1970

IRELAND
Dublin — 1971
Shannon — 1971

ISRAEL
Tel Aviv — 1971

ITALY
Milan — 1970
Rome — 1970

JAMAICA
Kingston — 1970
Montego Bay — 1970

JAPAN
Osaka — 1972
Tokyo — 1970

KENYA
Nairobi — 1971

KOREA
Seoul — 1972

KUWAIT
Kuwait — 1971

LEBANON
Beirut — 1970

MALAGASY
Tananarive — 1973

MALAYSIA
Kuala Lumpur — 1971

MEXICO
Mexico City — 1972

NETHERLANDS
Amsterdam — 1971

NETHERLANDS ANTILLES
Aruba — 1971
Curaçao — 1971

NEW ZEALAND
Auckland — 1973
Christchurch — 1973

NORWAY
Bergen — 1972
Oslo — 1972

PAKISTAN
Karachi — 1970

PHILIPPINES
Manila — 1972

PORTUGAL
Lisbon — 1970

PUERTO RICO
San Juan — 1970

REUNION
St. Denis — 1973

RHODESIA
Salisbury — 1972

SAUDI ARABIA
Dhahran — 1973

SENEGAL
Dakar — 1972

SINGAPORE
Singapore — 1971

SOUTH AFRICA
Johannesburg — 1971

SPAIN
Barcelona — 1970
Madrid — 1970

SURINAM
Paramaribo — 1973

SWEDEN
Stockholm — 1972

SWITZERLAND
Geneva — 1970
Zurich — 1970

THAILAND
Bangkok — 1970

TURKEY
Ankara — 1971
Istanbul — 1970

UNITED ARAB REPUBLIC
Cairo — 1971

UNITED KINGDOM
London — 1970
Prestwick — 1973

UNITED STATES
Anchorage — 1971
Boston — 1970
Chicago — 1970
Dallas — 1972
Detroit — 1971
Fairbanks — 1971
Honolulu — 1970
Houston — 1972
Los Angeles — 1970
Miami — 1970
Newark — 1971
New York, J.F.K. Intl — 1970
Philadelphia — 1971
Portland — 1971
San Francisco — 1970
Seattle — 1971
Washington/Dulles Intl — 1970

U.S.S.R.
Moscow — 1973

URUGUAY
Montevideo — 1973

VENEZUELA
Caracas — 1971

VIET-NAME
Saigon — 1972

WAKE ISLAND
Wake Island — 1970

8. AIRCRAFT OF THE SEVENTIES

V/STOL

The increasing congestion of air space around the major American airports and the resulting delays in air travel have caused the Administration to undertake studies to find solutions. The advent of Area Navigation will help establish multiple lane airways. However, all these lanes converging at the Jetport runway will not suffice to resolve the congestion problem; congestion is on the airport.

In 1967 the Civil Aeronautics Board investigated the need for and feasibility of VTOL, STOL or V/STOL services among the nine major cities in the Northeast corridor. CAB examiner E. Robert Seaver concluded that such service is not only necessary but is technically and economically feasible for seven of those cities. Subsequently Eastern, American, and McDonnell Douglas tested the French-built Breguet 941 in connection with this investigation. More recently in early 1971, Pan American and Sikorsky Aircraft have asked the U.S. DOT to aid them in operating a new "demonstration air service" in the corridor using 3 Sikorsky S-65-40 helicopters capable of carrying 42 passengers, for a one year demonstration period beginning June 1, 1971.

Similarly, in Britain, British Air Services are researching intensively the feasibility of an entirely new network of commuter airline services connecting STOL-ports at four or five provincial hubs with another proposed STOL-port located in the dockland of decaying inner London.

The Japanese are proposing a commuter "metroflight" airline linking the new Tokyo International Airport at Narita with a new STOL-port in the city's heart, possible on reclaimed land along the waterfront.

In the helicopter field, New York Airways, which the industry is watching and which earlier experimented with fixed-wing STOL, now is operating three Sikorsky S-61 Mark II turbine powered helicopters carrying 30 passengers. Its new "30-30" service offering 30 seats each 30 minutes at each of New York's three airports has been extremely successful.

The trend toward suburban and inner-city STOL terminals will become a major movement throughout the seventies. The FAA has defined STOL operations criteria (see table).

Flying and handling STOL aircraft in densely built areas will bring a number of air navigation problems and new electronic and visual aids will need to be designed.

Because V/STOL should land with a steep direct approach, a conventional ILS localizer cannot be used. NASA is experimenting with an onboard inertial landing system up-dated by radar fixes.

With the de Havilland DHC-7, Canada is in a good position in the STOL aircraft market and R & D efforts in designing navigational aids to promote the total STOL system concept should be mutually beneficial to the aircraft and electronic industries. However, the larger airlines want a STOL carrying 150 passengers or more.

FAA criteria for STOL operations

Both the FAA and American aircraft industry circles have for some time been studying the question of defining more closely the field length required for STOL operations and simultaneously fixing the related runway size, so that one can speak of a STOL runway. In this connection, the following first universally accepted definition of a STOL shorthaul airliner was evolved:

- A civil STOL transport must be integrated into the existing terminal ATC procedures, especially at the large central airports, in such a way that conventional takeoff and landing operations are in no way hampered. To this end, STOL aircraft should approach their special runways at an angle of 7.5-9° (compared with the 2.5-3° of conventional transports). Additionally, STOL transports should be substantially more manoeuvrable, during the approach and climb-out phases, than conventional aircraft.

- Approach and climb-out procedures for STOL transports should be so selected that unproductive flight time be cut to a minimum; this presupposes high manoeuvrability with a small turning radius at low speeds. The desired targets are turning radii of 500 feet on the approach and 1,000 feet on climb-out.

The aforementioned criteria automatically lead to the parameter which is of crucial importance in STOL operations, namely the minimum flying speed (V_{mc}) at which the aircraft remains largely controllable after a critical engine failure. Various industry studies in the USA have shown that a minimum speed of about 65 knots is necessary if STOL aircraft are to operate from urban STOL ports with runway lengths of only 1,500 feet and at approach angles of more than 7.5 degrees, so that a turning radius of 500 feet remains attainable with the guarantee of required performance and lift reserves.

This minimum speed requirement, which is unusually severe by today's standards, will remain the decisive criterion for any future STOL transports provided that the FAA and local authorities in the USA are agreed that the minimum runway length for STOL operations should be 1,500 feet. Shorter runway lengths for these operations seem fairly unlikely, because the costs of terminal buildings, maintenance facilities and car parking space exceed the land procurement costs by such a wide margin that economies in land purchase are not worthwhile. The minimum speed requirement thus promises to become a basic STOL criterion and, in conjunction with the maximum lift coefficient of a given configuration, determines the wing loading and also, for a given runway length, the total thrust/weight ratio for safe take-off.

Interavia 1/1970

AIRCRAFT OF THE SEVENTIES - PRINCIPAL STATISTICS

Type	Powerplant	Overall dimensions Span Length Height Wing area Wing sweep	Accommodation Max seating (N°, pitch, abreast) Hold vol (cu ft)/ N° compartments Press diff (lb/sq in)	Weight (lb) Ramp Take-off Landing Zero fuel Op wt empty	FAR Field lengths (gross wt)		Cruise performance True speed (kt) Altitude (ft) Fuel consumption (lb/hr)			Payload-range (ISA, still air, no reserves)	
					Take-off	Landing	Max cruise	Cost economical	Long range	Max payload (lb/n.m. (Cost econ cruise))	Full tanks (lb/n.m.) (long-range cruise)
Long Range Aircraft	SSTs										
	BAC/Sud Concorde (production aircraft)	4 x 38,300lb (with reheat) R-R Bristol/Snecma Olympus 593 two spool turbojets 63° (leading edge)	83ft 10in 204ft 40ft 3,856 sq ft	128/34/4 713/2 10.7	389,000 385,000 240,000 200,000 170,000	9,850 11,600 11,460 11,530	7,950 7,950 9,385 9,385	1,176	1,176 50,000—62,000 41,000lb/hr	28,000 4,550	15,500 5,080
	Boeing SST (production aircraft)	4 x 67,000lb (with reheat) General Electric GE4 single spool turbojets	143ft 5in 298ft 53ft 2in 7,700 sq ft	298/34/6 1684/2 11.9	750,000 745,000 460,000 390,000 327,700	10,800 n.a. n.a. n.a.	8,250 n.a. n.a. n.a.	1,566	1,566 60,000—73,000 n.a.	62,000± 4,400	48,500± 5,000
	Tupolev Tu-144	4 x 38,580lb (with reheat) Kuznetsov NK-144 turbofan (1:1 by-pass)	50° 5' (leading edge) 81ft 180ft n.a. n.a.	126/34/4-5 700/2 n.a.	n.a. 330,000 n.a. n.a. n.a.	6,235* n.a. n.a. n.a.	4,920 n.a. n.a. n.a.	1,345 65,000 n.a.	1,345 5,000 n.a.	24,000 3,500	n.a. n.a.
	LARGE CAPACITY Subsonic Jet Transports										
	Boeing 747	4 x 43,500lb Pratt & Whitney JT9D-3 two-spool turbofans	195ft 8in 231ft 4in 63ft 5in 5,500 sq ft 37.5° (±-chord)	490/32/10 6,190/3 8.9	713,000 710,000 564,000 526,000 353,398	9,000 n.a. n.a. n.a.	5,800 n.a. n.a. n.a.	529 30,000 n.a.	518 30,000 n.a.	466 30,000 n.a.	123,000 4,000 6,150
	Lockheed-California L-1011 TriStar Intercontinental	3 x 52,500lb Rolls-Royce RB.211-56 three-spool turbofans	170ft 182ft 8in 59ft 5in 4,180 sq ft	345/32/9 4,573±/3 8.44	n.a. 575,000 422,000 377,000 271,236	10,000 10,450 n.a. n.a.	6,120 n.a. n.a. n.a.	498 31,000 n.a.	n.a. n.a. n.a.	482 35,000	105,764 4,000 5,090
	Lockheed-Georgia L-500	4 x 52,500lb Rolls-Royce RB.211-56 three-spool turbofans	222ft 8in 245ft 11in 66ft 5in 6,200 sq ft 25° (±-chord)	— 58,250/3 8.2	861,500 858,500 699,000 652,714 333,264	9,500 10,950 11,800 12,000	7,700 7,700 8,600 8,600	467 31,000 31,250	457 31,000 27,750	446 31,000 26,300	319,450 3,210 5,780
	McDonnell Douglas DC-10-20 Intercontinental	3 x 49,800lb Pratt & Whitney JT9D-17 two-spool turbofans	155ft 4in 180ft 58ft 1in 3,550 sq ft 35° (±-chord)	330/34/9 3,040/3 8.6	533,000 530,000 376,000 346,000 250,395	10,000 12,780 8,750 10,000	5,675 n.a. 6,640 n.a.	518 31,000 23,900	499 31,000 19,250	481 31,000 17,950	95,500 4,557 6,278
	LARGE CAPACITY										
	Airbus Industrie A-300B	2 x 49,000lb GE CF6-50A or 2 x 51,000lb R-R RB. 211-52 turbofans	147ft 165 ft 1in 53ft 6in 2,803 sq ft 28° (±-chord)	295/30/8 4,005/2 8.25	n.a. 291,000 264,550 240,300 177,000	6,450 7,400 8,950 9,300	6,150 6,150 6,950 6,950	515 25,000 17,650	505 30,000 15,400	460 35,000 11,300	63,300 1,851 2,915
	BAC Three-Eleven	2 x 43,000lb Rolls-Royce RB.211-41 turbofans	147ft 175ft 3in 42ft 8in 2,700 sq ft 25° (±-chord)	294/30/9 2,538/2 8.25	286,500 285,000 261,000 235,000 172,500	7,600 8,800 9,200 10,000	5,300 5,300 6,900 6,900	485 30,000 13,800	485 30,000 13,800	441 30,000 10,700	62,500 1,655 3,635
	Boeing 727-200	3 x 14,000lb Pratt & Whitney JT8D-7 turbofans	108ft 153ft 2in 34ft 1,560 sq ft 32° (±-chord)	178/32/6 1,450/2 8.6	170,000 169,000 148,000 136,000 95,000	8,660 n.a. n.a. n.a.	5,480 n.a. n.a.	514 25,000	n.a. n.a.	450 30,000	39,340 1,680 2,550±
Medium Range Aircraft	JETS										
	Yakovlev Yak-40	3 x 3,300lb Ivchenko AI-25 turbofans	82ft 66ft 9in 21ft 4in 753 sq ft Nil	31/31/3 n.a. n.a.	30,200 30,200 29,210 24,200 18,750	1,475 n.a. n.a. n.a.	n.a. n.a. n.a.	297 n.a. n.a.	270 n.a. n.a.	n.a. n.a. n.a.	6,100 530 1,000
	TURBOPROPS										
	Breguet 941C	4 x 1,480 e.s.h.p. Turbomeca Turmo III D3 free turbines	76ft 10in 79ft 11in 31ft 8in 900 sq ft Nil	57/29/4 2,754/1 Unpressurised	55,150 54,000 54,000 52,250 33,800	1,460 1,790 2,020 2,820	1,030 1,310 1,410 1,530	224 10,000 2,580	220 10,000 2,500	200 15,000 1,980	11,400 925 1,695
	de Havilland Canada DHC-7	4 x 1,035 e.s.h.p. Pratt & Whitney PT6A-50 turboprops	85 ft 70 ft 23ft 5in 650 sq ft Nil	48/32/4 290/2 pressurised n.a.	38,500 36,500 34,600 23,800 18,970	1,900 2,000 n.a. n.a.	1,900 1,900 n.a. n.a.	240 10,000 n.a.	n.a. n.a. n.a.	n.a. n.a. n.a.	8,000 400 1,250
	General Aircraft Corporation GAC-100	4 x 894 e.s.h.p. Pratt & Whitney PT6A-40 turboprops	70 ft 67 ft 24ft 5in 460 sq ft 1.5° (±-chord)	36/33/4 240/1 6.5	25,500 25,500 25,000 23,500 17,638	1,710 2,210 2,200 2,770	2,330 2,330 2,605 2,605	293 15,000 1,320	286 25,000 980	235 25,000 700	7,380 750 2,092
STOL Short Range Aircraft											

9. THE SYSTEM AND EQUIPMENT TREND

Introduction

The key note of the Convention on International Civil Aviation is the safe, regular, efficient and economic operation of civil air transport engaged in international air services. This is equally true for domestic air services, and is as relevant in the airport terminal area as it is during the en route phase of a flight.

In air transport, the ground organization is as much concerned with the safety, regularity and efficiency of a flight as the pilot in the aircraft. The air navigation services and all other ground services are provided solely as means to discharge the responsibilities of the ground organization.

The system and equipment comprising the air navigation services are determined basically by the activity in the airspace. The activity measurement includes such factors as volume of air traffic, types of aircraft, and the overall requirements in the area under consideration.

Accordingly, in the matter of provision of air navigation services facilities, consideration is to be given to all types of aircraft currently operating and planned to be introduced, the air route segments, the present and expected air traffic density, the controlled and uncontrolled flights, the IFR and VFR operations, runways, and the jurisdiction of airspace (e.g. FIR, UIR, CTA, CTR) for which air traffic control services units are responsible. It has also to take into account the meteorological conditions and the topography of the area.

Similarly, the activity at an airport is essentially the measure in providing ground services consisting of ramp equipment, terminal equip-

ment, runway and apron equipment. Such parameters as the type of aircraft operated, the volume of air traffic, passenger and cargo movements determine the airport activity.

During the post World War II period there has been a considerable change in the type of aircraft and operations, and a phenomenal increase in the aircraft, passenger and cargo movements. The general aviation has risen from insignificance to prominence. The world commercial aircraft movement has increased annually by nearly 6% during the years 1965 to 1969. The number of passengers carried has been doubling itself every 5 to 6 years, and the cargo-tonne every 4 to 5 years. The air carrier fleet has seen a transition from two-engined piston aircraft to jet aircraft of Bo 747 family.

Associated with this prolific growth, there came about problems connected with airspace utilization and terminal area capacity. To meet the problems created not only the existing terminal and airfield areas had to be extended and new constructions undertaken, but also the air navigation services considerably strengthened and ground services improved.

The terminal area capacity and the en route system capacity are interlinked from the view-point of air navigation services. Higher the en-route traffic, greater is the need for terminal area capacity. There must also be appropriate relationship between the air traffic control system and the related traffic demands.

The air traffic control (ATC) system, the navigation and com-

9. THE SYSTEM AND EQUIPMENT TREND

munication facilities, as also the meteorological service have in consequence seen some evolutionary and revolutionary changes since the wake of World War II.

Of the L/MF navigation aids, there now remains only the NDB. The VOR, the ILS and the radar have come to be widely used since about 1946. During the last decade the X-band DME, and the Secondary Surveillance Radar (SSR) have added to the list of precision aids.

Automation in the ATC system is no longer a novelty. Wireless Telegraphy has given way to Radiotelephone (RTF) for air/ground communication and to RTF and Teletypewriter system for point-to-point communication. There has been progressively greater use of VHF/UHF for air/ground communication.

In the **ground services** area, the orthodox hand and cart methods are no longer sufficient. Passengers-baggage are now handled by means of conveyor belts and carousels. Standardized containers are used for lifting baggage and cargo. Expensive and sophisticated systems are required for the loading and handling of aircraft.

System and Equipment

As regards the time of introduction of the anticipated changes, in the air navigation services, it would be a reasonable prognostication that the inertial navigation system will be the first to be recognized by the ICAO, by about 1973. This would be followed by microwave ILS around 1974-1975. Satellite is expected to be the next candidate for communication and navigation, about 1978. The reliability of satellite system should by

then be firmly established and its capabilities considerably expanded; and so should the controversy over the use of VHF band or the L-band be resolved.

Nonetheless, it would be incorrect to assume that the new systems and techniques will dispense with the existing ones as they appear.

Considerable study and deliberations are made by international bodies such as the ICAO, the ITU and the IATA in adopting a new system for world-wide application. Economic consideration is another major factor. It does not make it feasible for administrations or airlines to adopt a new system or technique as soon as they receive international recognition. It not only involves purchase of new equipment, but also maintenance and training of personnel. In consequence, an existing system and a new system have to live side by side for several years before a new system/technique can completely replace the one existing.

Typical examples are the introduction of Single Side Band (SSB) for international air-ground communication, and the ILS of superior system performance. Despite the strong advocacy by the ITU since about 1950 the SSB has gained acceptance only in recent years and notably in April 1970 at the Fifth North Atlantic Air Navigation Meeting. When more stringent technical specifications for ILS were developed by the ICAO in 1962 for Category II and Category III operations, the ICAO had to specify a protection date of January 1, 1970 to the then ILS. The ILS developed since 1962, and now widely used, enjoys a protection date of January 1, 1975, as do the VOR and the DME. The Fifth North Atlantic Air Navigation meeting in April

9. THE SYSTEM AND EQUIPMENT TREND

1970 has, in fact, recommended extension of this protection date for ILS, VOR and DME to "facilitate planning for a period of time extending well beyond the 1975 date".

Then again, the member countries of ICAO are not obligated in any legal sense to comply with ICAO standards or protection dates as soon as these are specified. The countries not too infrequently file "differences" with ICAO because of practical difficulties and take time to implement them.

Further, ICAO standards and recommendations have no force where domestic operations are concerned. Administrations or national air carriers have no obligation in this respect. An equipment or a system, in consequence, continue to be provided for domestic operations even if it is outmoded for international air services.

Accordingly, as a realistic approach, it can be foreseen that there will be continuing need of basically the present day radar, navigation aids, airport lighting system, HF and VHF equipment almost to the end of the present century in most part of the world. Technological advancements, automation and computerisation will however enter as time goes on. Doppler VOR, microwave ILS and the satellite communication and navigation would also find their way gradually from 1976 or so.

Countries with high degree of manufacturing and economic potentialities and with high aviation activities would start to adopt more and more automation and computerisation as also sophisticated systems and equipment much earlier. Even so, the existing basic equipment and systems can be estimated to survive till at least about 1985.

A good pointer in this direction is the Fifth North Atlantic Air Navigation Meeting. In dealing with long term systems planning for about the next ten years, the meeting had no recommendation to make for the withdrawal of any of the existing systems. On the contrary, its recommendations include further improvement and expansion of several of the existing systems. Another oblique indication is the concerted effort, for example, in the U.S.A. and in industrial Europe to develop low cost ILS, VOR, DME and airport lighting systems, to mention a few.

Trend

In the next two decades changes in the field of air navigation services will be of evolutionary as well as revolutionary nature. Changes will be basically influenced by four primary considerations, namely, reduction of cockpit workload, reduction of air traffic controllers' workload, more efficient utilization of airspace, and conservation of radio frequencies.

These, in turn, would induce accelerated improvements in system characteristics and technical specifications of some of the existing equipment and would also bring about new techniques and systems. There is room for still more improvement in the navigational accuracy and capability of VOR, DME, VORTAC and TACAN. The ILS requires particular attention in this regard. The existing VHF/UHF ILS imposes a number of siting problems and its installation requires large areas to be sterilized from construction of buildings and hangars. Its navigational accuracy often suffers as one aircraft lands and another approaches to

land about the same time. The capability of the air route surveillance radar, and the terminal and approach radar is to be further enhanced and that of the SSR further explored. There will be more development in the technical characteristics of scan-converted bright displays, digitization and telemetering of radar information; and ATC and communication automation. With development these will find greater and greater use.

Air navigation based on point-source types of aids, such as VOR, NDB, will become less expedient giving rise to area-coverage aids derived from VOR/DME combination, and/or a hyperbolic system. Satellites will play a significant role in this context.

The use of HF for communication will gradually shrink. The Extended Range VHF and the conventional VHF with less and less channel-spacing will gain much wider use for air-ground communication. Microwave links, landlines, submarine cables will enter more and more for point-to-point communication.

In keeping with these developments there will also be evolutionary changes in the air traffic control procedures; and greater standardization of phraseologies and formats of messages exchanged on air traffic control and communication.

There will take place an all round improvement in the approach lighting system, especially to cater for category III operations and for heliports and STOLports. The VASI will be another area for improvement.

Air-ground Data links, and computer systems will come to be extensively used. In fact, the computer will become one of the vital ingredients of air navigation services and ground services. Be it air traffic control,

communication, radar, navigation, meteorological service, flight information display, the computer will inevitably play its part. The computer lends itself to solving, at least reducing, many of the present and anticipated problems associated with airspace utilization, collision avoidance, and terminal congestions.

Dealing specifically with revolutionary type of changes, such changes can be envisaged only to a limited extent. The progress of science and technology is a continuous process and so are the research and development. Industries, in most part, function in competitive spirits. Many of the solutions now being advocated are easier to hypothesize than to achieve.

All the same, it remains certain that inertial navigation will come to be internationally recognized for en route and terminal navigation. Satellites will offer one of the basic means of communication, and navigation; monitoring of flight progress and aircraft separations; and meteorological forecasts. The ILS will be based on the scanning beam microwave technique, enabling the aircraft to make curved approaches to land and eliminating several of the siting problems encountered with the current VHF/UHF ILS.

Ground services facilities will include highly advanced and sophisticated systems. Passengers' baggage will be handled and dispensed by computerized systems. Plastic tags attached to baggages will automatically channelize them to specified flights; and carry out sorting and dispensing. There will be computerized passenger ticketing and processing. Airline reservations and air cargo will be processed automatically by computers.

10. TECHNOLOGICAL FORECASTING

The MOD DELPHI Experiment

The growth in capital investments and in responsibilities for aviation systems planners is closely matching the exponential growth of air traffic. Major decisions taken today have far reaching consequences. New airports are planned to meet the next twenty years demand not knowing what the future can be; but still, one can not wait for certainties.

If in 1970 one was trying to enumerate the possible achievements in the field of transportation that could take place before year 2000, the list would be limited only by one's imagination. Thinking only about some of the concepts of significant importance to the aviation community that have already been brought forward by the scientific world or have now reached the stage of experimentation, we believe that the occurrence of these events is almost entirely conditioned by the wishes of the people forming the aviation community. The state of the technology is not the most accelerating or limiting factor.

The MOD DELPHI Experiment

Looking at the future on the basis of those premises it was felt important to interrogate the aviation world by analyzing the responsiveness of a representative group of experts singly confronted with the problem of forecasting the happening of a series of probable future technological events.

Our MOD DELPHI 7051 questionnaire - an adaptation of the DELPHI Technique - was sent to three hundred aviation experts located in fifty two countries representing at the same time all the main geographical regions of the world including the communist countries and the principal elements of the aviation community: governments, airlines, industry, pilots associations, world and regional organizations.

- All people contacted, are involved, at various levels, in the decision

making process that shapes the world air transportation system.

The questionnaire proposed sixteen events covering the fields of flying vehicles, navigation, landing systems, environment and communications. For each question the forecaster could express himself in one of four ways by:

- a) Defining the time frame when in his opinion the event will take place.
- b) Placing the event in the far future (still accepting its occurrence).
- c) Declining to give an opinion (no opinion).
- d) Rejecting the proposition (The event will "never" take place).

The opposite table shows the results of the statistical analysis of the answers. The apex of each triangular shaped shaded area indicates the mode of the frequency distribution of the answers for the particular proposition.

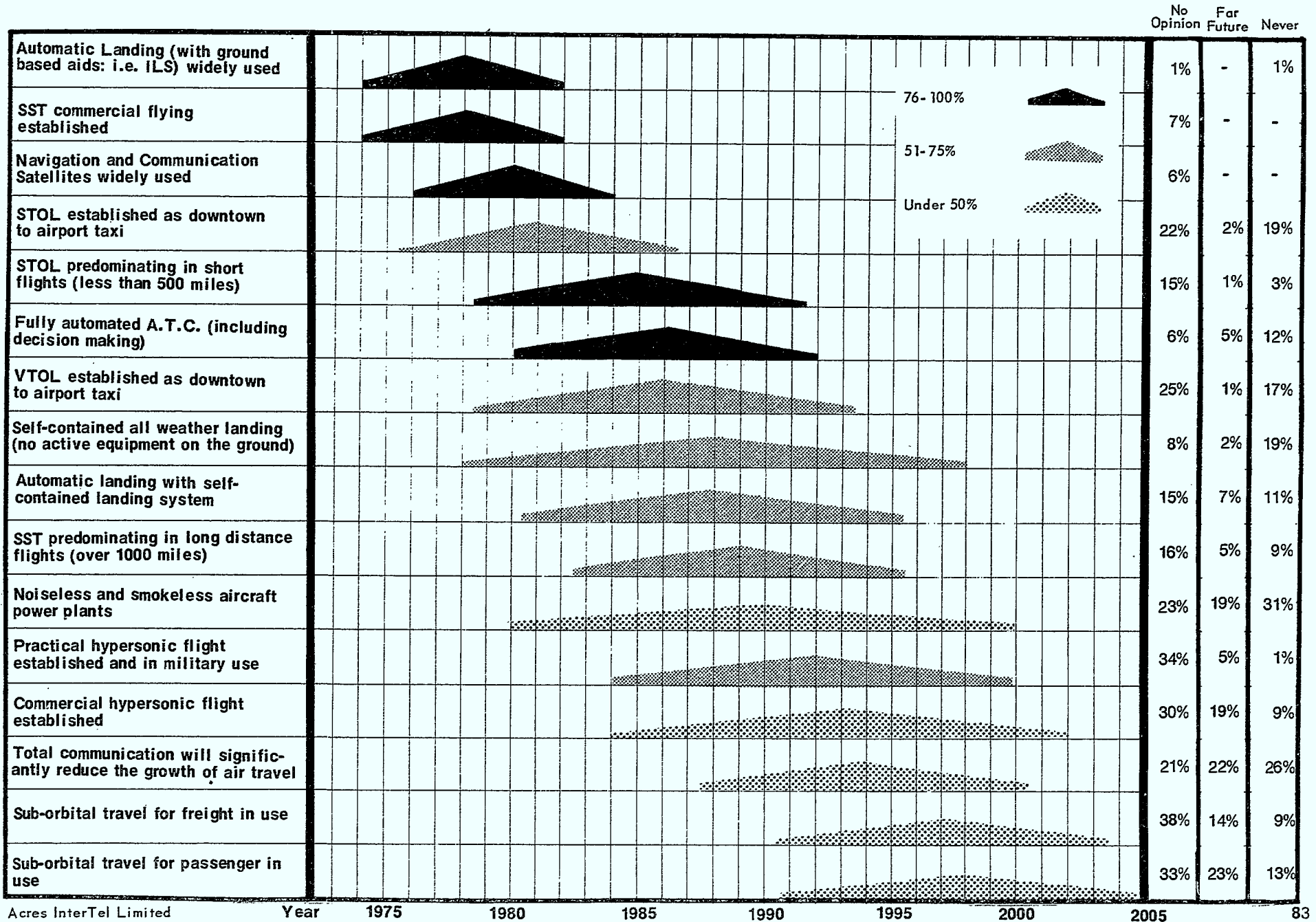
The base dimension is a measure of the dispersion and is equal to twice the value of the standard deviation.

The degree of shading indicates broadly the percentage of forecasters having indicated a time period. The three columns, Far Future, No Opinion and Never, further complete the percentage distribution of the answers.

The quasi-consensus is not truly a forecast but it is highly significative in the sense that it represents the pooled opinions of a large group of influential people.

- MOD DELPHI 7051 was carried as an experiment in futurology. It is a powerful method for probing the future, and probing the future is the basis for long range planning.

10. TECHNOLOGICAL FORECASTING
The MOD DELPHI Experiment



11. CONSTITUENTS OF AN AVIATION SYSTEM

Aviation System

Typical constituents of an Aviation System are:

- Air Traffic
- Airport, Runways, Taxiways, Lighting, etc.
- Tower Control Service
- Approach Control Service
- Area/Airways Control Service
- Communication Center
- Flight Information Center
- Search and Rescue Services
- Meteorological Service and Pilot Briefing
- Safety Services
- Airport Information Services
- Airline Offices and Counters

These constituents are by no means fixed, either in terminology or in number. There are airports where functions of some of the constituents are merged in one, while there are others with larger numbers of elements. Irrespective of the arrangement that may be obtaining at an airport, it remains that the objective of governments is to provide the best practicable facilities and services for safe, regular and efficient operation of

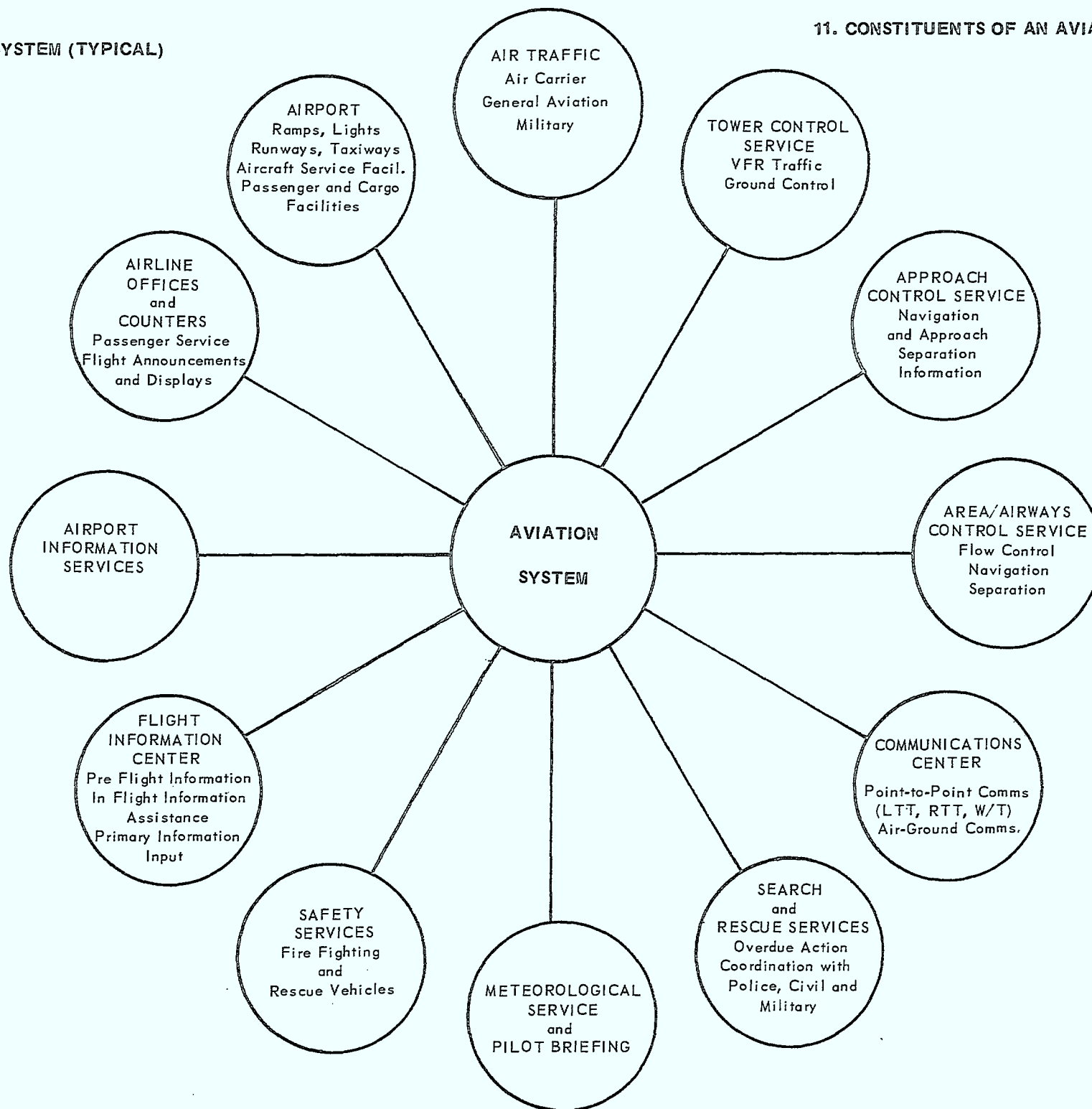
air services, and of air carriers the best possible facilities for the handling of aircraft, passengers and cargo.

Governments require various types of navigation and landing aids, communications systems, operational control systems, training equipments, meteorological equipments and airport safety equipments. Likewise, air carriers need diverse types of equipments for aircraft servicing, and passenger and cargo handling.

The type and the scale of systems and aids to be provided by the government would depend on the type (air carrier, general aviation and military) of air traffic, its volume and the type of aircraft operated.

The equipment to be provided by air carriers is based upon the type of aircraft, the frequency of air services and the volume of passengers and cargo to be handled at an airport. It also depends upon any mutual pooling arrangement that may exist among air carriers.

Insofar as the government is concerned the systems and aids required for the operation of international air services are determined at an ICAO Regional Air Navigation Meeting within the criteria and guidelines prescribed by the ICAO. The extent of facilities to be provided for its domestic commercial and general aviation and any military air services rests with the concerned government.



Facility Planning

The **Air Navigation Plan** for the ICAO region is formulated at an **Air Navigation Meeting** for the concerned ICAO region. The regions are as follows:

- Africa - Indian Ocean Region
- Caribbean and South American Regions
- European - Mediterranean Region
- Middle East and South East Asia Regions
- North Atlantic Region
- Pacific Region

The key-note in the preparation of a Regional Plan is that the facilities comprising the airport system and air navigation services should be capable of meeting the requirement of all types of civil aircraft engaged, or planned to be introduced in international air services within the region. A regional plan generally provides for the requirement of five years following a regional meeting. An exception was the recent Fifth Air Navigation Meeting for the North Atlantic Region which aimed at ten years as the planning period.

Air navigation meetings place very great reliance on aircraft operations data and the state of implementation of the existing plan in reaching conclusions on the requirement of improvements to the existing systems and services and additional facilities. At the same time, these meetings keep in view the need for economy in equipment and personnel, as an ICAO directive.

Air navigation plans lay down in detail the facilities, services and

procedures required for international air navigation in the region. However, these may at times go beyond the boundary of a region where such facilities and services are necessary for international air navigation within that region.

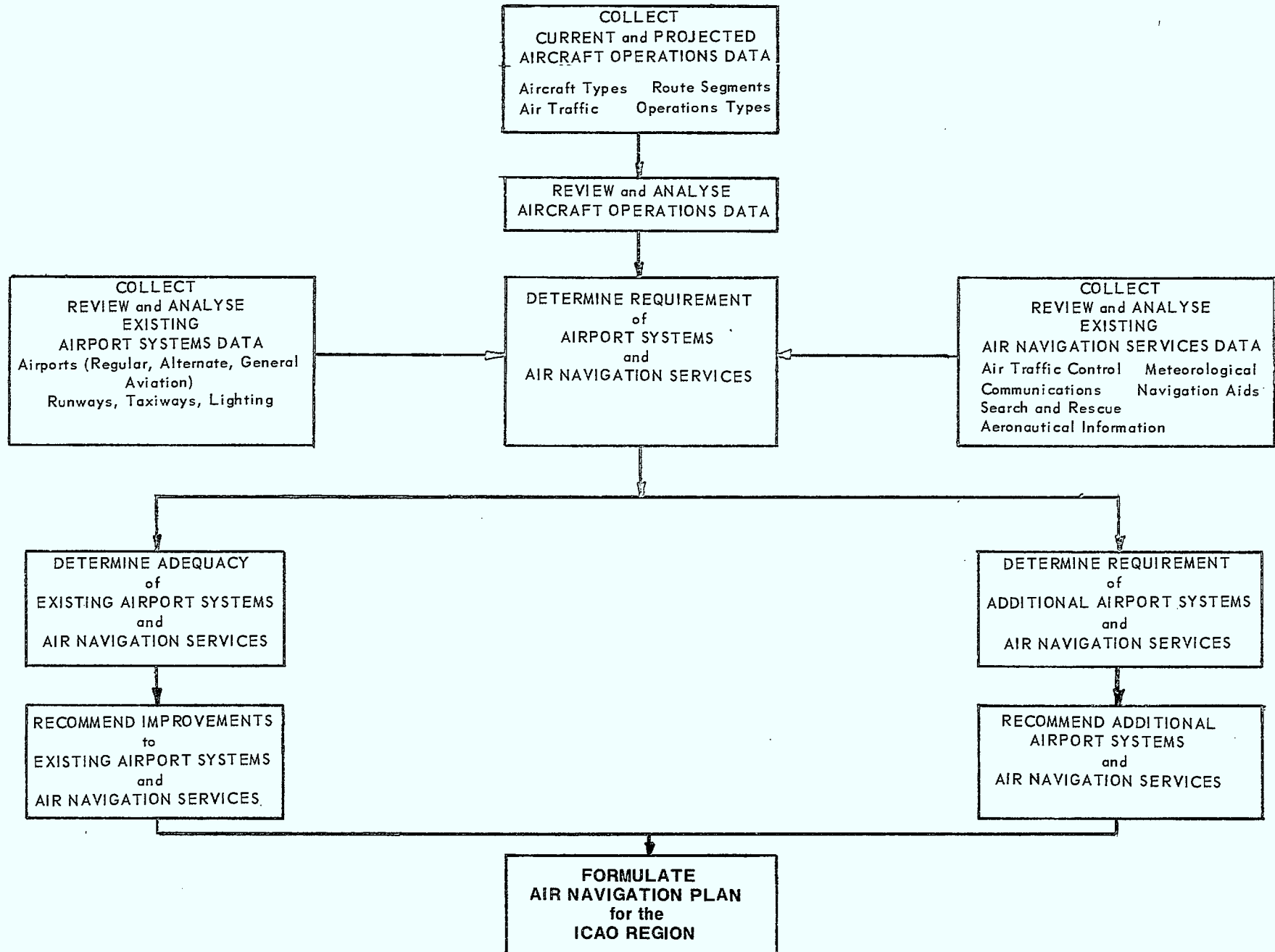
The plans comprise statements of required facilities and services to ensure proper functioning of the plan as a whole and its adequacy to meet present and foreseen operational requirements.

Equipment Provisioning

Air Navigation Plans contain recommendations which governments of member countries of ICAO can follow in programming the facilities and services. The scope of these recommendations is confined only to those that are currently recognized by the ICAO.

It devolves upon a government to take into consideration these recommendations in the preparation of its national plans for the provisioning of equipments so that the requirement of all types of aviation is met. The important point is that the equipment to be procured conform to the ICAO/ITU specifications and perform at the highest possible reliability and efficiency.

National plans provide for two categories of equipment - **Replacement**; and **Additional**. Equipments are to be replaced because of life-expiry or obsolescence; and additional requirements arise out of demands created by advanced types of aircraft and/or increased air traffic. For reasons of economy, national plans also take into account the practicability of reusing a replaced equipment at some domestic airport of lesser importance.



The money needed for a new airport project may be obtained in a number of different ways. The project may be financed by the general public through government grants or loans, or with loans from national or international banks, or it may be financed by the airlines who use the airport through the purchase of airport revenue bonds. The latter is the course being followed by several major world airports, such as the new Paris airport, Roissy-en-France and the Chicago airport, O'Hare. This trend is a departure from the traditional dependence on government loans. There is also a move to set up independent corporations to administer airports and run them as self-supporting entities. This approach is being considered for example, for the new international airports in Brazil and India and for the new Montreal airport at St. Scholastique, Quebec.

However, when considering an airport project in a developing country, it is usually necessary to go to international sources for the money. In most cases, developing countries have no funds of their own available for airport development.

Funds can be obtained from a variety of financial sources (international banks) which have been designed to meet almost any kind of financial problem. Periodically, the member countries of an international bank pledge new funds to replenish the capital of the bank as it is used up in loans and grants. These banks have large sums of money available and wish to see the money usefully employed in development projects.

Until recently the involvement of international and regional development banks in airport development projects in developing countries was marginal when compared to their participation to other modes of

transportation such as roads, waterways, railways. The aim of development banks is to invest in projects most beneficial to the economy of the borrowing country. The conventional transportation modes have always carried the bulk of the goods flowing in, out or through those countries while air transport has mainly been considered as a better form of passenger transportation. With the rapid growth of air freight the picture is changing and the effect of air transportation development on improvement of the economy becomes more evident.

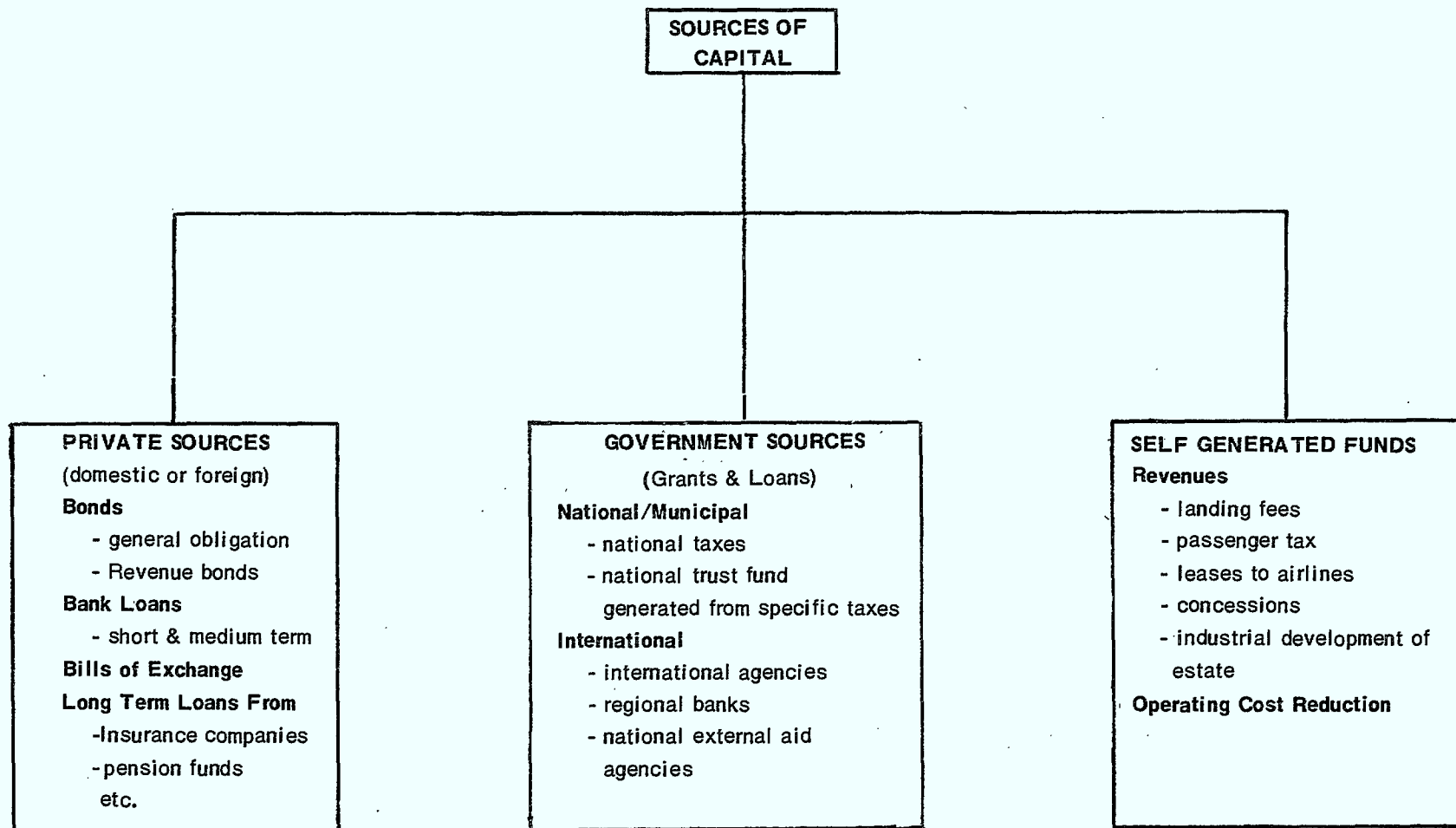
One of the difficulties encountered by a borrower attempting to secure a loan for an airport project is to evaluate and demonstrate the beneficial effect of the project on the development of the country. It is therefore most important for the borrower to not only seek advice from technical people but also from economists.

The accompanying table lists the major financial sources from which funds for airport development may be obtained, if the requirements can be met. The table although not exhaustive, lists four types of sources:

- (1) United Nation Development Program
- (2) Canadian and U.S. government sources
- (3) European government sources
- (4) Regional sources.

The list gives only brief notes on the amounts of money available and on the requirements set by the various banks.

As indicated, some of these sources are partly financed by Canadian funds and may be used for development of projects using Canadian goods and services. The other sources are listed for reference in order to show the relative amounts of financial competition which exist in the various regions of the world.



13. FINANCING AN AIRPORT

BANK	H.Q. ADDRESS	PURPOSE	INTEREST AND TERMS	PROCUREMENT/BORROWERS	MEMBERS
IBRD (World Bank)	International Bank for Reconstruction and Development Washington, D.C. 20431	Loans for projects and technical assistance where other financing is not available. The aim is economic development of a member country.	Maturities range from 8-25 years with interest - currently charged at 6% plus a commitment fee: grace periods run 2-4 years from commitment. Large loans, \$5 million minimum \$20 million average.	The procurement is made from member countries. Borrowers are more frequently less developed countries - government agencies and private enterprises.	107 members Canada ranks 6th in voting power.
IDA (World Bank)	International Development Assoc., Washington, D.C. 20453	Project loans (called credits) made for high priority development projects to countries whose capacity to make productive use of capital is greater than their ability to service conventional loans.	Long term (50 year) loans at no interest-service charge of 0.75% only loans on terms which are more flexible and bear less heavily than conventional loans. Bank consists of 18 Part I Members (developed countries).	Borrowers are member government or their agencies and private enterprises located in a member country (to date no credits have been made available to private enterprises). No restriction on source of equipment or supplies.	18 Part I Members (developed countries) Canada ranks 5th 84 Part II Members (developing countries)
IFC (World Bank)	International Finance Corp., (affiliate of the World Bank)	Long term loans for development of mines & industries, private finance companies; risk capital for private enterprise.	Terms vary in range of 8% and up for interest with 7-12 year maturities, 2-5 years' grace period; 1% commitment fee; in equity transactions, stock purchase up to 25% of capital. Maximum \$50 million for a single project.	Operates in member countries with emphasis on less developed countries. Borrowers are private enterprises located in a member country.	91 members Canada ranks 5th in voting power.
CIDA (Canada)	Canadian International Development Agency Fuller Bldg 75 Albert St., Ottawa, Canada.	Development of the less developed countries: those with per capita income of less than \$500 a year.	Loans for up to 50 years at little or no interest.	These loans are tied to procurement in Canada.	Main Canadian source for financing overseas projects.
EDC (ex ECIC) (Canada)		Insurance of Canadian financial institutions and/or Canadian private capital abroad. Also provides long term loans to purchase Canadian goods and services.	Maximum export credits insurance \$1,000 million (\$500 million of which requires Cabinet approval). Export financing \$800 million (\$200 million of which requires Cabinet approval). Maximum foreign investment insurance \$50 million (all of which requires Cabinet approval). Period of loan (s) up to 20 years.	Canadian content should be at least 80%. All resident persons or Corporations carrying on business in Canada are eligible for export credits insurance.	
AID (U.S. Dept of State)	Agency for International Development Dept. of State 2201 C Street N.W. Washington D.C. 20520	Dollar and local currency loans investment surveys; technical assistance; political and commercial investment insurance and guarantees.	Loan period: up to 40 years plus 10 years grace at 2% to 3%. Policy: loans only provided if the borrowing country cannot obtain other financing on terms which are realistic in relation to its foreign exchange earnings. Minimum terms: 10 year period of 2% interest followed by 30 year period at 2.5% interest.	Loans are made to US friendly less developed countries. The procurement is normally from US sources.	
EXIMB (U.S.)	Export Import Bank 811 Vermont Ave., N.W. Washington DC 20571	Dollar loans to foreign buyers for import of U.S. goods and related services: commercial and political risk guarantees for medium- and long-term transactions; newly established discount loan facility.	For loans, 5-20 years, but usually in the 7-10 year range, with about 2 years' grace: 6% interest at present; 40% or more equity, often accompanied by a guarantee of repayment from a responsible guarantor. Size of transaction unlimited.	Borrowers: For loans, foreign governments or their agencies, foreign corporations, and U.S. enterprises operating abroad; for guarantees, U.S. enterprises and exporters doing business in the U.S.	Canadian funds can be used for purchase of U.S. products (Guaranteed by EXIMB)

BANK	H.Q. ADDRESS	PURPOSE	INTEREST AND TERMS	PROCUREMENT/BORROWERS	MEMBERS
KfW (Germany)	Kreditanstalt für Wiederaufbau 6000 Frankfurt/Moin Lindenstrasse 27 Germany	Loans to all non-communist developing countries. KfW is the official agency for the German government foreign aid development program.	KfW will finance up to 76.5% of a large scale project in a developing country. Repayment is required in 18 semi-annual installments. Interest rate is usually from 6% to 6.5%. The foreign buyer must pay 15% down plus 8.5% during the warranty period. Up to 85% of the credit is insured by 2 export credit in- surance agencies.	Goods bought with these credits must be made in West Germany or have a high content of West German Labour.	
OMD (U.K.)	Ministry of Overseas Development Eland House Stag Place London SW1., England	To help developing countries in their efforts to raise living standards; to promote social and economic development; to encourage expansion of inter- national trade.		90% of the loans are made to about 30 Commonwealth countries. Loans are made to friendly developing countries. Aid must be used for purpose agreed upon: about 2/3 of the aid is used to pay for British goods or services.	
FAC (France)	Le Fonds d'Aide et de Coopération Coisse Centrale de Coopération Economique 233 Boulevard St. Germain Paris 7, France	Development of French-speaking developing countries in Africa and overseas territories.		Procurement from France or from local suppliers in borrow- ing nations.	
ADB (Asia)	The Asian Development Bank, Commercial Center P.O. Box 126 Makati Rizal, D-708, Philippines	Fostering of economic growth in the Asian Region.	Two types of lending operations: Ordinary loans to cover foreign exchange component of the project cost. Special loans for projects of high development priority and colling for lower interest rates and longer mat- urities.	International competition for tenders. Ordinary loans may be used only for procurement in member countries.	The Bank includes 20 members of the Asian region plus 13 non- regional members. Working language for tenders, contracts, etc. is English. Canada's subscription ranks 4th for the non-regional members.
ADB (Africa)	The African Development Bank, B.P. 1387 Abidjan Cote d'Ivoire	Economic development of the member countries.		Borrowers are required to em- ploy consultants if own re- sources are inadequate for project. Firms of consulting engineers employed by the borrower must have the approval of the Bank.	The Bank consists of 31 African members only.
BCIE	Banco Centroamericano de Integración Económica Apartado Postal 772 Tegucigalpa, Honduras	Promotion of economic devel- opment of the Central American isthmus.	Minimum loans: U.S. \$50,000		5 members
CDB	The Caribbean Development Bank, Finance Building Bridgetown, Barbados	To finance development projects in the Caribbean. To promote social and economic develop- ment; to encourage expansion of international trade.		Funds are available to procure- ment in member countries only.	18 members 16 of the Caribbean region plus Canada and Britain.
IDB/IADB (known as BID in Latin America)	The President Inter-American Development Bank 808 17th Street N.W. Washington, D.C.	Loans and technical assistance for projects through three funds: Ordinary Capital Resources, Fund for Special Operations, and the Social Progress Trust Fund. Social development and economic growth stressed; self-help ini- tiatives often required.	Ordinary Capital Resources: 8- 25 years, flexible grace periods, interest at 6½%. Fund for Special Operations: longer maturities, up to 30 years with 5-10 years' grace and inter- est between 2¼ and 5¾%. Social Progress Trust Fund: 30 or more years with interest between 1¼ and 2¾%.	Procurement Ordinary Capital Resources and Fund for Special Operations: world-wide; Social Progress Trust Fund: U.S. Borrowers Member governments or their agencies and private enterprises located in their territories.	21 members Canadian Loans via IADB (1961-66) equals \$8.1 million.

LIST OF COMMONLY USED AVIATION ABBREVIATIONS

ACC Area Control Center
 ADF Automatic direction finder
 AFS Aeronautical Fixed Service
 A/G Air/Ground
 AGL Above ground level
 AFTN Aeronautical Fixed Telecommunication Network
 AIA Aerospace Industries Association or
 American Institute of Aeronautics
 AID Agency for International Development
 AILS Advanced instrument landing system
 AIM Airmen's information manual
 AIP Aeronautical information publication
 AIRMET Airmen's Meteorological Information
 ALS Approach light system
 A/N Alpha Numerics
 ANF Air Navigation Facilities
 ANP Air Navigation Plan
 AOCI Airport Operators Council International
 APC Area Positive Control
 APP Approach Control Office
 APS Airway Planning Standard
 ARSR Air route surveillance radar
 ARTCC Air Route Traffic Control Centre
 ARTS Automated radar terminal system
 ASCE American Society of Civil Engineers
 ASDE Airport surface detection equipment
 ASR Airport surveillance radar
 ATA Air Transport Association
 ATC Air Traffic Control
 ATCA Air Traffic Controllers' Association
 ATCRBS Air Traffic Control radar beacon system
 ATCT Airport traffic control tower
 ATIS Automatic terminal information service
 AWLS All weather landing system
 CAB Civil Aeronautics Board
 CACOM Central American Common Market
 CAS Collision avoidance system

CAT 1, 11, 111 Landing Minima Categories
 CRAF Civil Reserve Air Fleet
 CRT Cathode ray tube
 CS/T Combined station/tower
 CTA Control area
 CTOL Conventional take-off and landing
 CTR Control zone
 DAC Development Assistance Committee
 DAIR Direct altitude and identity read-out
 DF Direction Finder
 DITC Department of Industry, Trade & Commerce
 DME Distance measuring equipment
 DND Department of National Defence
 DOT Department of Transport or Transportation
 ECC European Economic Community
 EEC Eastern European Center
 EFTA European Free Trade Association
 EVS Electronic voice switching
 FAA Federal Aviation Administration
 FAAP Federal-aid Airport Program
 F & E Facilities and Equipment Appropriation (FAA)
 FDP Flight data processing
 FIC Flight information center
 FIR Flight information region
 FL Flight level
 FSS Flight Service Station
 FY Fiscal Year
 GA General Aviation
 GATT General Agreement on Tariffs and Trade
 GDP Gross Domestic Product
 GMT Greenwich Mean Time
 GNP Gross National Product
 IATA International Air Transport Association
 IBRD International Bank for Reconstruction and
 Development
 ICAO International Civil Aviation Organization
 IFF Identification, friend or foe
 IFR Instrument flight rules

LIST OF COMMONLY USED AVIATION ABBREVIATIONS

IFSS	International Flight Service Station	RATCC	Radar air traffic control center
ILS	Instrument landing system	RCAG	Remote Center air/ground communications
INS	Inertial navigation system	REIL	Runway and identification lights
IPC	Intermittent positive control	RTCA	Radio Technical Commission for Aeronautics
ITU	International Telecommunications Union	RTF	Radiotelephone
LDIN	Lead-in lighting system	RTG	Radiotelegraph
LAFTA	Latin American Free Trade Association	RTR	Remote transmitter receiver
LAWRS	Limited airport weather reporting station	RTT	Radio teletypewriter
L/MF	Low/medium frequency	R & D	Research and development
LORAN	Long range navigation	RML	Radar microwave link
LRR	Long range radar	RVR	Runway visual range
LTF	Landline telephone	SAGE	Semi-automatic ground environment
LTT	Landline teletypewriter	(S) SALS	(Simplified) short approach light system
MALS	Medium (intensity) approach light system	SIC	Standard industrial classification
MEA	Minimum enroute IFR altitude	SIGMET	Significant meteorological information
MOTNE	Meteorological operational telecommunication network (Europe)	SMC	Surface movement control
MSL	Mean sea level	SRV	Slant range visibility
MTBF	Mean time between failures	SST	Supersonic transport
MTI	Moving target indicator	STOL	Short take-off and landing
NAFEC	National Aviation Facilities Experimental Center	TACAN	Tactical air navigation
NAP	National Airport Plan	TAIR	Terminal area instrument range
NAS	National airspace system or National aviation system	TERPS	Terminal Instrument Procedures
NASA	National Aeronautics and Space Administration	TMA	Terminal control area
NDB	Non-directional beacon	TRACON	Terminal radar approach control facility
NMSS	National Meteorological System	TVOR	Terminal VOR
NOTAM	Notice to Airmen	TWEB	Transcribed weather broadcast
NOTOF	Notice to Airmen Office	TWR	Aerodrome control tower
O & M	Operations and maintenance appropriation (FAA)	UHF	Ultra high frequency
PAR	Precision approach radar	UIR	Upper flight information region
PATWAS	Pilot Automatic Weather Answering Service	VASI	Visual approach slope indicator
PIREPs	Pilot Reports	VDF	Very high frequency direction finder
PNdB	Perceived noise decibels	VFR	Visual flight rules
PPI	Plan position indicator	VHF	Very high frequency
PVOR	Precision VOR	VOR	Very high frequency omnirange
TVOR	Terminal VOR	VORTAC	Co-located VOR and TACAN
RAIL	Runway alignment indicator lights	VOT	VOR test signal
RAPCON	Radar approach control facility	VTOL	Vertical take-off and landing
		WMO	World Meteorological Organization
		WMSC	Weather Message Switching Centre



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