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A CRITIQUE OF THE C.A.A. STUDIES ON AIR TRAFFIC GENERATION IN THE UNITED STATES

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THE basic work of D'Arcy Harvey and other C.A.A. pioneers in air traffic generation has more important and far-reaching significance than often is realized. This observation is true because these studies are being used: (1) As the economic basis for the National Airport Plan; (2) As a decisive element in the installation of landing aids, towers and radar instruments at airports; (3) As a definite factor in establishing new airways; (4) As a guide for deciding the need for new airline routes; and (5) As an important consideration in the present proposed airline consolidation cases.

Because of this importance, these findings deserve a thorough review and critical examination as to their validity and reliability. In order to examine some of the more important tenets and to point out the possibility of more research in this area, this study was prepared. First, the published work of the C.A.A. was reviewed, and then the actual results of Chicago's air traffic as found in the last four available issues of the Airline Traffic Survey¹ were checked with C.A.A. proposals.

This type of study comes under the general heading of forecasting. Predicting the future has always been a profitable and enjoyable pastime. The persons who could accurately foretell in which direction prices of commodities or stocks would fluctuate had the advantage over his competitor. Whether he did this from an expert knowledge of his business or by keen observation of the historical trends, he found that it paid. Within the past twenty years forecasting (or attempted forecasting) has become increasingly more scientific. Methods have been borrowed from the mathematical world, especially from statistics and more complete figures have been gathered both by the government and by industries so that forecasting has gradually become more accurate. The most spectacular use has been made in the Gallup and Roper polls, predicting the outcome of elections, but business men also have learned of its advantages and have been using it more and more for their benefit. Among these users were the aviation manufacturers and the airline managements.

¹ March 1949 and 1950; Sept. 1948 and 1949.

In air transportation these predictions have been applied mainly to foretell how much traffic, both passenger and cargo, will be available over a period. At first forecasting was used to estimate passenger traffic for the entire country and the most famous published study of this type was the Curtiss-Wright study, *Air Transportation in the Immediate Post War Period*, which was published in March 1944. Later came other forecasts and also estimates of future air cargo which were especially popular shortly after the second World War. Both the Association of American Railroads and the Air Transport Association were interested in these estimates and in the effects that air transport would make on rail traffic. Beside these published reports, airlines also had their economic research departments working feverishly on research for their own operations.

FORECASTING PASSENGERS AND CARGO

When the National Airport Act was adopted in 1946, the question soon arose as to how fast air traffic would increase at the nation's airports. Even before its passage, some people had been examining this question in the office of the Administrator of Civil Aeronautics. So forecasting turned to a new field. Predictions of passengers and cargo that would be handled by each airport became necessary in order to know how fast to improve each one.

Several approaches were used. First, the relation of population and distance interested D'Arcy Harvey and other men in the office of the Administrator of Civil Aeronautics. At once they realized that the population of the city constituted the potential air passengers, — the number of which would decrease as the distance they desired to travel increased. Before the Airport act was passed, studies by Mr. Harvey were issued under the names of the Administrator, Charles I. Stanton and the Economic Consultant, Martin Taitel, which pointed out the relationship between population and distance.²

A second approach centered around the economic characteristics of the cities. After Harvey became head of the Research and Analysis branch of the Planning division of the Office of Airports in the C.A.A., he applied a technique developed by Dr. Raymond Franzen,³ independent Market Consultant of New York City, and himself, while working for the Equitable Life Insurance Company. The first questions were how many people were in a given place and what kind of people they were; that is, were they air travelers? This problem led to his study of communities and the application of the "economic characteristics" idea.

Later Harvey developed a formula combining the concepts of population and distance. This formula was announced as $\frac{P \times P}{D}$, which

² Statement by Charles I. Stanton, Administrator of Civil Aeronautics, before the CAB Hearing on Local Feeder-Pickup Airline Services, September 1943.

³ Dr. Franzen and Mr. Harvey were doing economic research in the field of real estate values, for the Equitable Life Insurance Company. The basic ideas have so far not been published in any scholarly publication except for the application to air transportation made by Mr. Harvey.

as may be seen, multiplied the populations of the two cities and divided this figure by the distance between the two places.⁴

To develop this formula, Harvey took the concepts relating to population mass and intercity distance, as reviewed by him in a recent article in this journal.⁵ No rational basis is given for the formulation except that it seems to be borne out by an examination of traffic between Chicago and eleven balanced cities, as is analyzed later.

Besides the basic formula, several exceptions were listed:

1. Air distance could be no more than the normal 15% less than rail distance.
2. The minimum competitive distance was set at 100 miles.
3. All cities were divided into one of four classifications: Marketing, Institutional, Balanced, and Industrial and the first two were considered better air traffic generators than the last two.
4. The traffic between any pair of cities varies with the density of cities in the geographic area.
5. Not discussed but listed were management factors, such as direct versus indirect connections, number of schedules, time of schedules, service standards and other human factors.^{5a}

Harvey's work is still continuing. At the present time, several staff studies have been prepared showing "large, medium and small airline passenger hubs," or, in other words, those cities having the largest amount of airline traffic. Then the number of these "hubs" or cities on any airline measure the "market accessibility" which is defined as the "size of the passenger market accessible to the airline." Since this definition does not measure the degree to which an airline route furnishes direct on-line (a passenger using the same airline from origin to destination) service between its pairs of communities, another concept has been employed called "Demonstrated Route Capability." Its meaning is defined as "the number of on-line passengers for the pairs which had 100 or more total passengers in September 1950 and expressing this figure as a percentage of the total on-line passengers for the 100 pairs in September 1950." No official publication detailing this work has yet been issued.⁶

Most of the stimulating conclusions of the work on air traffic generation are outlined in a series of printed pamphlets issued by the C.A.A. known as the *Airport Planning Series*. This group of bulletins analyzes seven major topics, all of which could form separate and distinct research projects: (1) Amount of airline traffic between cities; (2) Influence of distance on airline traffic; (3) Economic type of air traffic city, as shown in the relation between the economic characteristics and

⁴ This whole doctrine is explained in the most detail in any published form in the C.A.A., Airport Planning Series, *Effective Community Air Traffic Potential*.

⁵ Harvey, D'Arcy, "Airline Passenger Traffic Pattern within the United States," *Journal of Air Law and Commerce*, Spring 1951, vol. XVIII, No. 2.

^{5a} Associated with Harvey in these studies were Graham Aldrich, Will Carsel, Francis Smoot, and Jesse Sternberger, all of whom are still working in this field in various capacities.

⁶ Interview with D'Arcy Harvey in Washington, D. C., February 15, 1952.

the amount of airmail and air cargo and the number of airline passengers and personal aircraft; (4) Potentials of commodities for air cargo and the number of airline passengers and personal aircraft; (5) A survey and classification of present airports; (6) Type, classification and needs for airport facilities; and (7) Type of airport required for each city in the future — the economic basis of the National Airport Plan.⁷

Since these bulletins are important but some are not of particular significance to the study, they will be reviewed but for the most part rather briefly:

1. Amount of airline traffic between cities led to the development of the formula $\frac{P \times P}{D}$, which is the main interest of this study and which has already been discussed.

2. Influence of distance on airline traffic⁸ showed that half of all airline passenger travel was less than 300 miles and a fourth less than 200 miles. Regional differences in the length of trip were pronounced. 52% of the air passengers in the northeast but only 14.7% on the Pacific coast travel less than 300 miles. 12% of Pacific coast travellers went more than 2000 miles.

Differences in the trip distance among cities were even sharper than among regions, varying in percentage for those travelling under 300 miles from San Francisco with 10½% to small cities as high as 98% and were related to (1) Population size group; (2) Geographic density of cities; and (3) Basic economic characteristics of communities. The traffic of a city generally was found to be with its nearest large neighbor, if it were at a distance over 100 miles. Many pairs of cities had their largest percentage of traffic with one another such as Detroit and Cleveland. Balanced and industrial cities generated flights of short distance, whereas marketing and institutional centers developed flights of longer distance. Average distances travelled by passengers from larger cities were longer than those taken from less populous places.

Research in this area could be continued in this way: (1) Historical trends of airline distances could be traced to discover any unusual changes. (2) More relationships might be found in tables of the C.A.A. bulletins and in the new A.T.A. publication. (3) All the pairs of cities having similar distances could be studied as a group to ascertain why some pairs generated more traffic than others.

3. The economic type of air traffic city⁹ was the most thoroughly explored. These bulletins compared the economic characteristics of marketing, institutional, balanced, and industrial cities with such indexes as amount of air mail, and air cargo; and number of airline passengers and of personal aircraft.

⁷ C.A.A., *Effective Community Air Traffic Potential*, January 1950.

⁸ C.A.A., *Airline Travel Distances*, December, 1948. The Air Transport Association also has compiled recently for every airline city the percentages of passengers by distance.

⁹ C.A.A., *Airport Planning Series, Economic Character of Communities*, November 1948 *Domestic Air Cargo*, December 1948; *Airline Passengers*, Dec. 1948; *Personal Aircraft*, Dec. 1948; *Airmail Potentials*, Dec. 1948.

Marketing centers were defined as lower than average in number employed in mining and manufacturing and higher than average in wholesale sales. Institutional places were lower than average in both number employed in mining and manufacturing and in wholesale sales. Balanced cities were practically average in both number employed in mining and manufacturing and in wholesale sales. Industrial were higher than average in number employed in mining and manufacturing and lower than average in wholesale sales.

In all cases, balanced cities were below the marketing and institutional centers and the industrial cities were lowest in air traffic generation. Marketing centers outranked institutional cities on air mail dispatched, and in two out of three cases on airline passengers; but institutional cities had more personal aircraft and in one case, more airline passengers.

Is purchasing power considered as carefully as it should be? The publication states: "It was evident, however, that communities with the same economic character have similar, rather than identical attributes, and that differences do exist in purchasing power and air transportation potentials . . . It is to be remembered that these supplementary economic criteria have value when used for a particular community."

What do the authors mean by these statements? How much influence does purchasing power have? How will it be applied to differentiate among the cities? Again, just how do the authors propose to use purchasing power of a city to modify their concept of marketing centers, institutional, balanced, and industrial cities?

Possibly it is through statistics on government employment, finance and professional employment, because the bulletin notes that these cities are high in purchasing power; or possibly through transportation employment because Omaha, high in this respect, is low in purchasing power. As supplementary criteria, therefore, it suggests the use of the following indexes: (1) Percentage of the gainfully employed engaged in transportation; (2) Percentage of the gainfully employed engaged in finance, insurance, real estate, and professional and related services; (3) Percentage of the gainfully employed engaged in government. (4) Potentials of commodities for air freight were developed through an exceedingly simplified classification relating to density and price.¹⁰ All commodities, with certain modifying factors, were divided into three categories: "high value-low density," "medium value and density" and "low value-high density." The first of these contained mainly manufactured products which were the best air transportation possibilities while the third included unfinished, semi-finished, and raw products which were the poorest for air transport.

The value per plane load was calculated from this information and four categories established. Four modifying factors: (1) Concentration of source of supply; (2) Average distance hauled; (3) Commodity's ability to absorb higher transportation costs; and (4) Perishability or

¹⁰ C.A.A., *Domestic Air Cargo*, Dec. 1948.

seasonality, were considered and a total of twelve rating groups were established. Each commodity was then placed in a rating group and in this way the amount of air cargo by commodities and by communities could be predicted. The study estimated that by 1955 the 50 largest communities would still have 76.4% of the enplaned cargo and 54.86% of the deplaned cargo. Airports were surveyed¹¹ according to: (1) The type (municipal or commercial); (2) Class (length of landing strip); (3) Population size of the community (a) independent cities under 10,000, (b) between 10,000 and 49,999, (c) metropolitan districts between 50,000 and 249,900 and (d) over 250,000; and (4) Type of airport landing area (paved or unpaved).

In classifying the airports, non-commercial activities were described for each class of airport. The items were: (1) Total based aircraft; (2) Single and multi-engine based aircraft; (3) Commercial, instructional, business or personal based aircraft; (4) Total aircraft movements for a month; (5) Peak hour aircraft movement; (6) Highest possible aircraft movement possible per hour; (7) The percentage of capacity used in the highest hour; (8) The total employees at the airport; (9) The total fixed base operators and their employees (10) The total membership of all flying clubs at the airport, and (11) The total planes owned by all clubs at the airports. All of this leads toward a more definite basis for deciding the type airport needed by each community.

Airports were classified according to the size of community¹² and were listed to show: (1) Percentages located less than five miles from the city; (2) Those with more than 161 acres; (3) The type of installations, buildings, and services offered. In this way a typical airport was described for each class.

In July 1950, ratios were established between the passenger volume, number of people at the airport and the number of patrons of each concession. Space utilization for lobby, seats, and parking facilities were studied extensively. As the airport grows larger, the concessions, it was noticed, became more specialized. The smaller the volume of activity at the airport, the more concentrated this movement was in a peak hour. Airports with more than 1,000 daily passengers tended to have approximately 12% at the peak hours and those with less than 200 per day, more than 23% in the peak hour.

The basic finding was "that practically all major activities at an airport are closely related to the volume of passenger activity" with the exception of automobile parking.

Conversion factors were offered so a concession could find out how many customers it would have, by using the number of passengers boarding planes.

The study of the type of airport required for each city¹³ includes six

¹¹ C.A.A., December 1948, *Peak Air Carrier Movements at Airports*.

¹² C.A.A., *Airport Facilities*, December 1948; *Airport Terminal Activities and Space Utilization*, July 1950.

¹³ C.A.A. *Community Airport Requirements*.

types of airport: intercontinental express, intercontinental, continental, express, trunk line, and feeder.

Much data about every city over 10,000 was recorded, but the greatest importance was accorded two primary ideas: (1) Traffic volume, stated in terms of annual airline passengers, broken at 375,000, 15,000, 3,000 and under 3,000, and (2) Community traffic character, defined in terms of average length of passenger haul. A long haul was considered over 606 miles, average haul 328 to 606, and short haul under 328 miles. Reasons for selecting these two outstanding characteristics were that they "must largely govern the type of aircraft needed to serve a community and hence its airport runway length requirements."

Other data recorded included population size group, type of purchasing power, number of community enplaned passengers, tons of mail, tons of cargo, number of air carrier departures, and average flight length.

Many exceptions were listed. Airport ratings were to be raised for eight reasons: (1) Eight cities "located along the coast line and serving interoceanic air traffic; (2) A city having a larger percentage of the country's air cargo traffic than passenger traffic; (3) Cities with inadequate service or poor connections; (4) Cities with considerable seasonal traffic; (5) Cities with a large number of passengers who bought tickets over 300 miles; (6) Cities with a large number of international passengers; (7) A city with a feeder type airport serviced by a trunk line, and (8) Cities with peculiarities such as "weather conditions and the general pattern of travel." For two reasons, the type of airport could be reduced in rank: (1) A city with prospects of less than 1000 generated air passengers per year by 1955, and (2) A community within approximately 25 miles of another air carrier airport.

Method of Checking the Formula

What method was used to check the formula $\frac{P \times P}{D}$?

First, the formula was calculated for each route. In order that this number would not be unwieldy, tens of thousands were rounded so that the result was the same as though it had been divided by 100 million.

Second, the average traffic for four months (September 1948 and 1949, March 1949 and 1950) was obtained from the *Airline Traffic Survey*.

Third, to facilitate comparison between theoretical and actual travel the average traffic for the four months was divided by the number obtained by using the formula and called generated traffic or "G."

Fourth, passengers for the same four months (September 1948 and 1949, March 1949 and 1950) the total between Chicago and another city was divided by the total traffic of the other city for the same four months to obtain the percentage of air travellers of that city which went to Chicago.

Fifth, the total passengers between Chicago and another city for September 1940 was divided by the total traffic of the other city in September 1940 in order to obtain the percentage of air travellers of that city which went to Chicago in 1940. Herein was obtained an historical perspective.

Sixth, this information was in columns so that cities out of line could be studied more carefully to ascertain any reason why they differed from the average.

Does the Formula Work

Does the formula show the same pattern as that for traffic generated? Immediately one realizes that the formula is not expected to give the exact amount of traffic, because management factors such as number of schedules, type of schedules and differential cost between the two cities also influence the size of traffic flow. The formula purports to represent the potential that is available. Still a check whether the actual traffic conforms to the results from the formula is worthwhile and, if it does not, find the reasons for its not being comparable.

The original document attempted to prove by use of the traffic between Chicago and the balanced cities that the formula was correct. It was stated that "The actual distribution of Chicago's air traffic during 1948, on the right hand side of the chart, shows the close relationship between theoretical computation and actual performance. Again, be it noted, Chicago's largest traffic actually was with St. Louis, the next largest with Cleveland, etc., and its lowest with New Haven. In fact, only one of the eleven communities, Buffalo, was out of line in this comparison of theoretical versus actual distribution of Chicago's traffic."

The first noticeable characteristic of the list in the C.A.A. bulletin is that the cities are only those over 250,000. Even then certain cities over 250,000 are omitted: Philadelphia, Baltimore, Toledo and Syracuse. Although these cities may have been eliminated because of the exceptions already mentioned they should have been included and the exceptions explained more clearly. Philadelphia and Baltimore would be among those cities that are excluded because "the traffic between any pair of cities varies in accordance with the density of cities in the geographic area." Are Toledo and Syracuse omitted for the same reason? If so, why should Cleveland, Boston, Buffalo, Albany or New Haven be included? Also why does New York generate heavy air traffic if "density of cities in the geographic area" reduces the amount?

Although it was difficult to tell exactly what figures were used: March 1948, September 1948, or a combination of the two months, discrepancies in the figures in the chart also appeared. In any of these months, Cincinnati had less traffic than Indianapolis, but the C.A.A. bulletin showed the opposite.

In order to check the formula, one might look at Table 1 which

compares the formula result with actual traffic. (See Table 1. Balanced Cities Arranged According to Formula $\frac{P \times P}{D}$.)

If particular cities are selected from this list, the formula would work: e.g., selecting those cities with G between 150 and 190, which retains only seven cities out of the twenty-one. Below Nashville on the table one could select three more in descending order, such as Knoxville with 534, Syracuse with 344, and Roanoke with 128. The formula may have some underlying basis, but when all cities are considered, it does not always conform to actual results even after classifying the places according to their characteristics, as suggested by the C.A.A. One needs only to look at Table 1 to see that traffic appears very irregular when column 2 is inspected. This fault, however, does not mean the formula should be discarded. More exceptions may be added, especially in respect to amount of purchasing power. The formula, itself, may be modified in several ways to increase its reliability.

Next, cities were ranked according to G (Average Traffic divided by the formula $\frac{P \times P}{D}$). All those with this factor above 100 follow:

Marketing: Billings 516; Seattle 462; Dallas 445; San Francisco 440; Kansas City 380; Fargo 375; Minneapolis 363; Reno 337; Des Moines 316; Omaha 289; Salt Lake 279; Jacksonville 272; New York 272; Casper 236; Atlanta 235; Boise 226; Amarillo 217; Charlotte 216; Oklahoma City 203; Lexington 179; Memphis 168; Sioux Falls 166; Shreveport 153; Little Rock 145; Corpus Christi 139; Medford 133; Duluth-Superior 116; Twin Falls 101.

TABLE 1

	Balanced cities Arranged According to Formula $\frac{P \times P}{D}$						
	1	2	3	4	5	6	7
	$P \times P$	Traffic	$\frac{\text{Traffic}}{P \times P}$	Pop.	Distance	% of City's Traffic with Chicago	Traffic with Sept. 1940
<i>Balanced Cities</i>	D		D				
St. Louis	368.00	5581	151.00	1681	251	15.9	2047
Philadelphia	301.00	2304	76.50	3672	671	8.6	595
Cleveland	259.00	5220	200.00	1465	307	11.9	1973
Cincinnati	199.00	3048	154.00	903	249	13.5	954
Indianapolis	187.00	3584	191.00	552	162	22.8	1072
Boston	154.00	2711	176.00	2370	859	3.2	876
Buffalo	128.00	1464	113.00	1090	468	6.7	576
Louisville	117.00	2284	165.00	576	271	15.3	564
Baltimore	115.00	458	39.80	1336	640	3.7	43
Peoria	108.00	686	62.10	250	127	32.7	—
Toledo	98.30	1029	105.00	395	221	16.6	—
Columbus, O.	97.20	1641	169.00	502	284	12.1	282
Ft. Wayne	58.70	313	53.30	182	144	13.9	102
Birmingham	53.10	302	56.60	555	574	2.9	75
Lansing	50.00	513	102.00	172	187	2.6	146
Battle Creek	49.30	126	25.60	120	134	2.4	50
Nashville	44.40	689	155.00	321	347	5.3	126
Springfield, Ill.	42.80	274	64.00	131	168	35.4	50
Charleston, W. V.	41.80	484	115.00	320	421	5.1	39
Knoxville	40.10	534	133.00	336	461	6.1	18
Albany	36.40	127	34.90	515	778	1.5	1
Terre Haute	35.30	147	41.60	105	163	23.5	—

	1	2	3	4	5	6	7
	P x P		Traffic ÷ P x P			% of City's Traffic with	Traffic with Chicago Sept. 1940
<i>Balanced Cities</i>	D	Traffic	D	Pop.	Distance	Chicago	
Syracuse	31.60	344	109.00	342	611	3.8	—
Oshkosh	30.50	62	20.30	91	162	27.6	—
Cedar Rapids	27.80	292	105.00	104	205	27.8	—
Harrisburg	27.50	180	65.40	291	583	5.4	47
Chattanooga	27.50	202	73.40	245	490	4.3	77
Tulsa	23.40	666	284.00	249	584	4.4	114
Tampa	22.40	1231	549.00	409	1001	9.1	48
New Haven	18.30	16	8.74	262	785	4.9	—
Wausau	17.30	56	32.40	80	254	24.1	—
Mobile	15.90	48	30.10	229	792	1.2	0
La Crosse	15.60	82	52.50	67	234	17.6	—
Roanoke	11.70	128	109.00	113	611	3.8	—
Augusta, Ga.	11.60	83	61.90	162	672	3.5	2
Charleston, S. Car.	11.50	84	73.50	160	765	2.8	9
St. Joseph	11.30	24	21.40	97	453	5.1	—
Joplin	11.20	116	104.00	107	507	7.4	—
Macon	10.90	45	41.70	134	667	3.8	—
Burlington, Ia.	10.90	80	73.40	42	201	29.1	—
Eau Claire	10.30	61	59.40	54	285	27.2	—
Parkersburg	8.51	34	39.60	66	423	5.9	—
Cumberland	9.82	4	4.00	90	504	2.4	—
Clarksburg	8.59	12	14.50	85	544	1.5	—
Elmira	8.33	43	51.60	87	576	2.3	—
Hagerstown	7.75	6	7.70	75	560	2.2	—
Lynchburg	7.16	18	25.10	76	579	2.5	—
Watertown	7.89	2	3.52	85	659	0.9	—
Anderson	7.00	1	1.71	90	737	0.6	—
Ottumwa	6.93	3	3.89	47	375	0.9	—
Bradford	6.84	17	25.10	56	481	4.3	—
Wichita Falls	6.57	24	36.50	98	806	1.3	2
Chisholm	5.41	13	24.00	50	508	9.4	—
Florence	4.82	19	38.80	54	612	4.4	—
Pueblo	4.82	31	65.30	89	1015	2.6	0
Augusta, Me.	4.58	2	5.45	162	1008	0.3	1
Ponca City	4.17	5	13.10	49	646	3.1	2
Meridian	4.05	4	11.10	64	869	0.9	0
Burlington, Vt.	3.48	11	30.70	62	980	0.4	7
Columbus, Ga.	3.41	12	35.10	38	612	5.9	—
Glens Falls	2.37	4	16.80	39	902	0.3	—
Keene	2.33	3	15.00	38	895	1.2	—
Brunswick	1.82	24	130.00	29	876	4.7	—
Klamath Falls	1.13	110	90.20	42	2043	1.3	—

Institutional: Miami 2718; Rochester, Minn. 905; Tucson 855; Phoenix 581; Hot Springs 530; W. Palm Beach 466; Bismarck 451; Washington, D.C. 399; San Antonio 398; Spokane 339; Rapid City 289; Denver 320; Tallahassee 285; Albuquerque 282; Traverse City 275; Huron 261; Orlando 260; Portland 248; Houston 236; Wichita 225; Daytona Beach 223; New Orleans 204; Great Falls 194; San Diego 191; Sheridan 184; Los Angeles 185; Springfield, Ill. 174; Colorado Springs 172; Raleigh 161; Brownsville 153; Paducah 151; Asheville 149; El Paso 143; Austin 140; Missoula 137; Cheyenne 133; Santa Fe 118; Lincoln 114.

Balanced: Tampa 549; Tulsa 284; Cleveland 200; Indianapolis 191; Boston 176; Columbus, Ohio 169; Louisville 165; Nashville 155; Cincinnati 154; St. Louis 151; Knoxville 133; Brunswick, Ga. 130; Charleston, W. Va. 115; Buffalo 113; Syracuse 109; Roanoke 109; Toledo 105; Cedar Rapids 105; Joplin 104; Lansing 102.

Industrial: Muskegon 200; Grand Rapids 188; Sault Ste. Marie 179; Butte 172; Dayton 147; Evansville 141; Detroit 124; Akron 121; Bristol, Tenn. 121; Moline 120; Hartford-Springfield 117; Greensboro 114; Norfolk 106; Pittsburgh 104.

Inasmuch as this table showed that traffic with institutional cities was stronger than with marketing centers, one wonders whether a separate classification for institutional cities is necessary. Possibly it should be subdivided. The first five institutional cities generated a higher percentage of traffic as related to the formula than did the first marketing city of the same rank and institutional cities were higher throughout the entire list.

Since resort and gateway cities ranked very high, while governmental cities were lower, new classifications of these types might be considered. High institutionals, for the most part, are resort cities, although Rochester, Minnesota, is a medical center. Some of the state capitals and university cities rank low, but more study and research should be necessary to say that they generate less traffic for their potential than other institutionals. Possibly traffic is higher between cities of the same type: such as governmental communities. A study of the traffic among Washington, D. C., and the state capitals would be worthwhile.

Only three state capitals, Bismarck, Denver, and Tallahassee appear on the list of institutionals before Raleigh, which is in twenty-ninth place. Below Raleigh on the list are: Austin, Cheyenne, Santa Fe, Lincoln, Helena, Columbia, Jackson, Sacramento, Topeka, Madison, Iowa City, and Concord. More study of the characteristics, i.e., proportion of the population engaged in government, should also be made.

Some other exceptions were noted to economic classification. Both Reno, among marketing centers, and Tampa, among balanced cities, are more like institutional or resort cities.

Whereas the high traffic producers among marketing and institutional centers are those at a long distance from Chicago, the high traffic producers among industrial cities are nearby with the exception of Butte, which is in the northwest, a strong territory for Chicago. This difference between industrial and marketing centers confirms the finding of the C.A.A. in this respect. No pattern on distance is apparent for balanced cities. Muskegon, Grand Rapids, and Sault Ste. Marie are all high because flying over the lake cuts time from the slower surface transportation, which is forced to move around the body of water.

A peculiar arrangement of marketing centers was noticed. Thirty-six cities classified as marketing are located west of the Mississippi; nine east of Chicago and north of Georgia along the Atlantic seaboard; eleven south and southwest in Georgia, Florida, Kentucky and Tennessee and three north of Chicago in Wisconsin and Minnesota. Curiously enough, no marketing center exists in Ohio, Illinois, Indiana or Michigan, and outside of Maine, none in New England.

Chicago received large amounts of traffic from particular areas. Many leading traffic generators are located in the northwest: Billings,

Seattle, Fargo, Minneapolis, Rochester, Minn., Bismarck, Spokane, Rapid City, and Butte. Other sections of the country which are high traffic producers are: Florida and the states in the southwest especially Arizona, Arkansas, Oklahoma, and Texas. Slightly below cities in these regions are others directly west of Chicago, such as Denver and Kansas City. Nearby cities over 100 miles like Indianapolis and many in Michigan and Ohio exchange considerable traffic with Chicago.

Cities which received air service after September 1940 were at the bottom of the list. Only a few had managed to rise higher; such as Hot Springs, a resort with 20 percent of its traffic with Chicago; Lexington, Kentucky, a marketing center at the favorable distance of 320 miles.

Another worthwhile study might be made of cities above 250,000 with a weak generating factor. Marketing and institutional cities with less than 200 are: San Diego, Los Angeles, Memphis, Duluth, Ft. Worth, Richmond, Fresno, and Sacramento. Balanced cities with less than 150 are Knoxville, Charleston, W. Va., Syracuse, Toledo, Philadelphia, Harrisburg, Peoria, Birmingham, Baltimore, Albany and New Haven. Industrial cities with less than 100 are: Rochester, N. Y., Scranton, Providence, Flint, Youngstown, Allentown, Worcester, Wilmington, Reading, Wheeling, Bridgeport and Johnstown, Pa. Many of these cities are either on the east coast or on the west coast, appearing as though their traffic goes north and south rather than east and west.

What Population Figure Should Be Used?

If one factor in the formula is population, the question soon arises as to the meaning of this term and the definition which should be used. Present cities include many communities and many people living outside the central area. The census of 1950 has changed the concept of a metropolitan district to that of a metropolitan area. How much does this affect a formula like $\frac{P \times P}{D}$?

First, let us consider the concept of a metropolitan city. The new 1950 definition of a metropolitan area states:

Each standard metropolitan area contains at least one city of 50,000 or more. In general, each comprises an entire county or group of 2 or more counties that are economically and socially integrated. The outlying counties must meet several qualifications, regarding population density and the volume of non-agricultural employment. In New England standard metropolitan areas comprise groups of contiguous cities and towns.

The 1940 definition of a metropolitan district included all adjacent and contiguous minor civil divisions having a population of 150 or more per square mile. In some metropolitan districts a few less densely populated districts were included on the basis of special qualifications, especially all the thickly settled territory in and around a city or group of cities.

Metropolitan New York City is used as an example of this shift. In the 1940 census all of Bronx, Kings, Nassau, New York, and Queens

counties, New York, and Bergen, Essex, Hudson, and Union counties New Jersey, were part of the New York metropolitan area. Included also were parts of Rockland, Suffolk, Westchester counties, New York; Fairfield county, Connecticut; and Middlesex, Monmouth, Morris, Passaic, and Somerset counties, New Jersey. In the 1950 metropolitan area, the parts of Fairfield county, Connecticut, and Monmouth county, New Jersey, were omitted entirely and the rest of Rockland, Suffolk, Westchester counties, New York, and of Middlesex, Morris, Passaic, and Somerset counties, New Jersey, were added.¹⁴

Besides the definition using counties as a basis, the population of the city by itself could be used. In order to compare the three concepts $\frac{P \times P}{D}$ was computed for balanced cities, using as a basis, each of the following definitions: (1) Population of metropolitan area in 1950; (2) Population of central city in 1950, and (3) Population of metropolitan district of 1940.

By using the population of central cities, Indianapolis and Cincinnati reversed positions, thus placing both communities in their proper order in relation to traffic. Cincinnati has about 44% of its population outside the central area, while Indianapolis has only 22% outside the city. Although Boston with 65% outside the central area is placed below its natural traffic position, Columbus and Toledo are reversed into a correct pattern. Peoria, Nashville, Tampa and Toledo are reversed into a correct pattern. Peoria, Nashville, Tampa and Tulsa are brought nearer their proper place, because Peoria has a much higher percentage outside the city than either Nashville or Tulsa.

What cities were pushed in the wrong direction? Philadelphia, which is atypical; Boston, which has already been mentioned; Syracuse, which has a large proportion within the city limits; and Charleston, W. Va., Knoxville, and New Haven. The Albany metropolitan area included

¹⁴ Since this paper was written the census bureau has introduced a new concept in the final form of the computations. This area is now called "Urbanized area" and changes the definition to the following: "Contains at least one city of 50,000 inhabitants or more in 1940 and also the surrounding closely settled incorporated places that meet the criteria listed in section on 'urban fringe'." Urban fringe is defined as: "The following types of areas are embraced if they are contiguous to the central city or cities or if they are contiguous to any area already included in the urban fringe: 1. Incorporated places with 2500 inhabitants or more in 1940 or at a subsequent special census conducted prior to 1950. 2. Incorporated places with fewer than 2500 inhabitants containing an area with a concentration of 100 dwelling units or more with a density in this concentration of 500 units or more per square mile. This density represents approximately 2000 persons per square mile and normally is the minimum found associated with any closely spaced street pattern. 3. Unincorporated territory with at least 500 dwelling units per square mile. 4. Territory devoted to commercial, industrial, transportation, recreational, and other purposes functional, related to the central city. 5. Also included are outlying noncontiguous areas with the required dwelling unit density located within 1½ miles of the main contiguous urbanized part, measured along the shortest connecting highway and other outlying areas within one-half mile of such non-contiguous areas which meet the minimum residential density rule." New York's population is reduced from 12,903,500 to 12,296,117 under this definition. Under the new definition all of Bronx, Brooklyn New York, Queens, and Richmond counties are included and now parts of all the other counties. This differs from the 1940 census of metropolitan districts by omitting entirely Monmouth county, New Jersey, and Fairfield, county, Connecticut, and parts of Bergen, Essex, Hudson and Union counties, New Jersey, all of which formerly were included.

Schenectady and Troy; when only the population of Albany itself is used, it moves toward its proper place.

The conclusion of this study, is that some compromise is necessary between using the population of the metropolitan area given in the census and the size of the population within the central city.

If time permits, or course, a more detailed analysis of the traffic generation of each airport would be the most valuable and correct method to determine how much population should be included. Where do people boarding the planes originate? Some studies have been made but literature on the subject has not been collected.¹⁵ If enough of these studies are made, the pattern of the use of the airport as related to a metropolitan city might be generalized. The problem as to location of city limits still remains.

This study indicates that the population should be that of the central city plus part of its outer fringe. Although this theory is not perfect, the actual traffic pattern it forms resembles more closely the actual situation.

Likewise, the question of an aggregate of communities is raised. What should be done about the economic characteristics and what has been done by the C.A.A. when one community is marketing, one community is industrial and one is balanced? The C.A.A. has not published enough information to reveal what they did, and this study did not consider changes in the economic characteristics because census figures for 1950 are not sufficiently complete to make any research profitable as yet.

Lastly, a comparison was made between the results obtained with the formula by using the 1940 population figures which were used by the C.A.A. and by using the 1950 figures; i. e., to see whether the new definition by county is better or worse than the old metropolitan definition and whether the new figures improved the sequence.

The population for 1950 in all cases improved the order, except for cities which already were very atypical, such as Tulsa and Tampa. This fact probably shows only that the old census was out of date. New statistics employing the old definition would be worthwhile to see whether further improvement would be realized. The new definition of urbanized areas, now being published, may be even better for this purpose.

In the case of cities under 50,000, the lower limit for metropolitan areas, should the city or county unit be used? Why should the population of the county containing Lima, Ohio, which has slightly more than 50,000 population be the unit and only the population of the city be applied for Battle Creek or Muskegon, Mich., both of which have 48,000 and 49,000 in the central city? For cities under 50,000 the C.A.A. took the population of the city only, but in this report, population of counties was employed for those cities under 50,000.

¹⁵ Horonjeff, Robert; Belmont, Daniel M; Jones, John Hugh, *The Use of California Airports Served by Scheduled Air Carriers as Related to Passengers' Homes and Origins*, Research Report No. 10-1, Transportation and Traffic Engineering, University of California. Berkeley, 1951.

The market area surrounding an airport needs much more study. Probably the population of the city plus about one half of the persons in the county would be a fair comparison. The census bureau should help by offering a district akin to the metropolitan area concept for the places under 50,000. In some states the county unit is obviously too big, and in a few cases more than one county should be included. With the changes in areas created by the automobile, this whole problem of what comprises a market area offers a great challenge to market researchers, the census bureau, geographers and economists in this field for the next few years. Especially is this study necessary in the field of air transport. As each airport is added to the ones having scheduled service, the market area served by surrounding airports will change in size. The whole question as to how small or how large an area should be in the radius of one airport to render adequate service, is introduced.

Does there seem to be any bias in the formula due to size of city? To answer this question the generating factors for routes from Chicago to the various cities in order of their population were compared. A check indicated little, if any, distortion in the formula due to size of city. The generating factor for a number of metropolitan cities less than 100,000 rises to 100 and 200. A glance through the non-metropolitans also reveals the same kind of information. Many of the smaller cities may be weak in traffic generation for the same reason that large places have few passengers or the fact that they have not had service as long may be important.

Air traffic is directly related to the location of cities. How does the map of other cities over one million population appear when they are located in relation to Chicago as a hub? Nine of these large centers are east and four of them west of Chicago. The closest is Detroit, 219 miles; the farthest, San Francisco, 1856 miles; their average, 716 miles. They furnish 51% of the Chicago traffic. A similar view of the major cities could be visualized by using any one of them as the hub.

QUALIFICATIONS OF DISTANCE

Qualifications of the factor "distance" also should be considered:

1. Time Saved. The principal question facing the traveller in deciding whether to go by air is how much time he will save between two cities. Instead of distance, therefore, time saved might be included in the formula.

2. Cost of Service. The difference in cost between air travel and rail travel is another important factor that should be considered.

3. Number of schedules. The number of schedules has considerable influence. A study of the cities under consideration shows that those with the highest traffic generation do have more available schedules by air than by rail.

4. Quality of Schedules. What constitutes an attractive schedule? Most people seem to agree that time of arrival and departure are most

important. If a train or plane brings a person to his destination after midnight, the schedule is very weak because hotel accommodations are not held after that time, and women especially hesitate to arrive in a strange city during the hours after midnight. Early morning planes from large cities seem to be unpopular although they can leave smaller places earlier, especially if they arrive at their destination in time to do business and return to the home city in the evening. All daytime schedules are better than schedules departing after 10 p. m.

The number of stops would be important, although in most cases the time required for the trip reflects (i. e., the fastest plane usually makes no stops, etc.) the number of stops. Type of plane or train would also be important, and this comfort factor is difficult to measure, but speed again reflects comfort since the faster the plane or train, the more modern and comfortable it usually is.

5. Direct Connections. Planes or trains that require no change between origin and destination are also more popular. This possibly accounts for the low generative power of New Haven, since many people may purchase air tickets from New York because of the superior air service available from that terminal.

6. Terminal to terminal. Schedulers seem to agree that practical problems determine the schedules. In the first place, if a city is fortunate enough to be on a run from one large city to another large city, it will receive more service from the plane or train. So people in those cities will prefer the type of transport that renders the better service. Eventually as traffic increases, shuttle service between cities will be more feasible for the smaller planes than for the larger train, since the plane is more like the size of the bus and does not require as many passengers per trip as per train.

Other practical factors, of course, reflect the difficulty of keeping the plane at the right place at the right time and in getting the crew at the proper location so that employees are not away from home too long and yet work the correct number of hours under labor contracts.

Chicago Traffic Pattern

Cities with the most passengers from Chicago are not always the places with the most air traffic in the United States. For example, Detroit, which ranked second in its Chicago traffic, was sixth in the nation and Minneapolis, third with Chicago, nationally was thirteenth.

New York was first on both lists, but Los Angeles was thirteenth with Chicago and third in the nation. Chicago, itself, was the second largest nation-wide air traffic generator. Detroit, second with Chicago, was sixth nationally. When a city has a high percentage of its traffic with Chicago, such as Indianapolis with 22.8%, it ranks much higher with Chicago than it does nationally. In this case it was ninth on Chicago's list but twenty-eighth in national air traffic. Opposite to this was Atlanta, Georgia, with only 4.4% of its traffic with Chicago and twenty-second on that list whereas it is ninth in the nation.

Nearby cities usually are higher and communities usually fall in rank as the distance grows. The averages by distance of the percentages of each city's traffic with Chicago follow:

TABLE 2
AVERAGE PERCENTAGES OF TRAFFIC OF EACH CITY
BY MILEAGE GROUPS

Mileage	Average	Mileage	Average	Mileage	Average
0-99	12.6	800-899	2.3	1600-1699	1.4
100-199	27.6	900-999	2.3	1700-1799	1.3
200-299	20.7	1000-1099	3.5	1800-1899	1.9
300-399	13.7	1100-1199	3.3	1900-1999	1.0
400-499	7.0	1200-1299	2.8	2000-2099	1.0
500-599	5.2	1300-1399	2.4		
600-699	4.3	1400-1499	3.7		
700-799	3.1	1500-1599	2.0		

The bulges between 1000 and 1200 miles were caused by the Florida cities and the one between 1400 and 1499 by Tucson and Phoenix, Arizona. If tables of this kind were prepared for other cities, generalizations might be discovered.

An inspection of each distance group showed some cities lower and some cities higher than the average. In many cases higher cities seem to be the more populous centers like New York City, Minneapolis, Kansas City, Philadelphia, the cities in the northwest, Florida, Arizona and California, a few industrial cities and some of the smaller nearby cities. Cities having smaller percentages of their traffic with Chicago would require individual study of the traffic of each. Two groups stand out: those in upper New York state, New England, especially resort cities like Hyannis, and those in Ohio. The first question on individual studies would be where the highest percentage of the traffic for these cities goes. Cities with below average traffic in each distance group are: 0-199 miles: Milwaukee 5.7; Ft. Wayne 13.9; Detroit 15.1; 200-299 miles: Toledo 16.6; Cincinnati 13.5; St. Louis 15.9; Evansville 11.1; Columbus 12.1; Mansfield 10.9; 300-399 miles: Ottumwa 0.9; Nashville 5.3; 400-499 miles: Waterloo 1.3; Erie 2.8; Mason City 3.3; Johnstown 2.1; 500-599 miles: Cumberland, Md. 2.4; Elkins, W. Va. 2.1; Bellefonte, Pa. 2.4; Clarksburg, W. Va. 1.5; Hagerstown, Md. 2.2; Elmira, N. Y. 2.3; 600-699 miles: Hutchinson, Kan. 1.8; Grand Forks, N. D. 1.1; Watertown, N. Y. 0.9; 700-799 miles: Anderson, S. C. 0.6; Massena, N. Y. 0.5; Garden City, Kan. 0.9; Texarkana, Ark. 1.7; Albany, N. Y. 1.5; Mobile, Ala. 1.2; 800-899 miles: Monroe, La. 1.0; Mineral Wells, Tex. 1.0; Meridian, Miss. 0.9; New Bedford, Mass. 0.6; Baton Rouge, La. 0.7; 900-999 miles: Glens Falls 0.3; Hyannis, Mass. 0.3; Burlington, Vt. 0.4; 1000-1099 miles: Augusta, Me. 0.2; 1100-1199 miles: Midland, Tex. 0.7; Bangor, Me. 0.8; 1200-1699 miles: Helena, Mont. 1.3; El Paso, Tex. 1.8; Provo, Utah 1.0; Pocatello, Ida. 0.4; 1700-1899 miles: Walla Walla, Wash. 0.6. Those with above average traffic are: 0-199 miles: Kokomo 39.8; Grand Rapids 37.1; Moline 36.7; Springfield, Ill. 35.4; 200-299 miles: Richmond 31.2; Hannibal 27.6; Eau Claire 27.2; 300-399 miles: Cheboygan 28.8; Rhinelander 27.9; Minneapolis 20.8; Sault.

Ste. Marie 21.8; 400-499 miles: Kansas City 12.1; Omaha 12.4; Springfield 14.0; Lincoln 13.1; Duluth 21.4; 500-599 miles: Fargo, N. D. 11.7; Hot Springs, Ark. 20.3; 600-699 miles: Allentown, Pa. 14.6; Jamestown, N. Dak. 10.0; Philadelphia, Pa. 8.6; 700-799 miles: New York, N. Y. 8.7; Bismarck, N. D. 7.3; Hartford, Conn. 6.4; 800-899 miles: Tallahassee, Fla. 3.6; New Orleans 3.9; Rapid City, N. D. 6.3; Minot, N. D. 4.8; Jacksonville, Fla. 4.2; Brunswick, Ga. 4.7; 900-999 miles: Denver, Colo. 4.9; Daytona Beach, Fla. 5.4; Colorado Springs, Colo. 4.7; Orlando, Fla. 4.3; 1000-1099 miles: Tampa, Fla. 9.1; San Antonio, Tex. 6.5; San Angelo, Tex. 5.9; 1100-1199 miles: Miami, Fla. 11.5; Palm Beach, Fla. 5.3; 1200-1699 miles: Bozeman, Mont. 5.5; Brownsville, Tex. 4.3; Phoenix, Ariz. 6.4; Tucson, Ariz. 9.9; 1700-1899 miles: Los Angeles, Calif. 2.9; San Francisco, Calif. 4.0.

Quite often this large percentage of traffic shown by nearby cities when the service first starts, gradually decreases in later years. As shown by the comparisons between recent traffic and in 1940, most of the cities showed a smaller percentage of their traffic with Chicago in the months studied than in 1940. The few exceptions to this were: both nearby and eastern industrial centers and some Michigan, North and South Carolina cities.

The ten cities with the most traffic with Chicago had more than half of that traffic and the first forty cities had 83% of the Chicago passengers.

CONCLUSION

The formula, proposed by the C.A.A., contains some basic merit, but does not cover all cases. The answer of course, may be that it fits potential and not actual traffic. That remains to be seen. Since the differences in actual traffic among the cities are so great, they must be explained by other exceptions than have so far been advanced.

Complaint should also be made about the hazy presentation of the theory in many places, which creates difficulty in following the ideas and the proof. For example, exactly how the concept of economic character of cities was proved has never been published. This idea which was conceived originally for real estate, should be modified for use in air transportation. Marketing and industrial cities might as well be combined, but separate categories should be established for gateway, resort, governmental and transportation cities. Purchasing power should be given more weight.

The same criticism applies to the application of the formula to the traffic between Chicago and each of eleven balanced cities. Since figures employed were indicated very indefinitely, a check of their accuracy was very difficult. Several places were omitted and, in one case, the rank of cities was reversed. When certain cities are selected from the list and other communities are omitted, the formula appears more plausible than when all cities are considered.

When all the places are included, the question arises as to whether

the population of the entire suburban area or that of the central city should be employed and as the size of the community becomes smaller, this question becomes more important. As the first definition of metropolitan areas by the 1950 census used the county as the basis, the question arose whether the county should not be the unit for those cities under 50,000. The census should provide some term that includes suburban population for those places under 50,000 or else an arbitrary method should be used, because these cities are as much suburbanized as larger communities. This paper discovered that in the case of the few cities investigated that if only about one-half of the population outside the central city were used, the order was more like their rank on the basis of actual air traffic. More research in this area should be carried out, however, and this study could take the form of the origination of airline passengers relative to airports.

Suggestions were considered for the modification of the distance factor in the formula. On the cities studied, flying or transport time saved did not seem as important as number of schedules provided, but many more routes should be compared to establish this relationship. Cost of service and direct service with no change of plane also are very important. At the present time, airline scheduling still follows the railroad concept of large terminal to large terminal traffic. If the actual passenger travel on each schedule were available for research, it would be worthwhile to consider whether more shuttle service might be introduced between certain cities where traffic justifies it. The airline has a natural advantage over the railroad, because it does not require as much traffic for one plane as a railroad does for a train. Airline scheduling, from the traveller's viewpoint, is a field that seems to be untouched and could be given much more thought.

What were the more specific conclusions discovered in this paper and especially what were those relating to the air traffic pattern of Chicago.

1. Resort cities such as those in Florida, Hot Springs, Phoenix and Tucson, have a high percentage of their traffic with Chicago. However, resort cities on the east coast attract very little Chicago traffic, so the conclusion is that each resort city draws its clientele from a particular section and that a definite map could be drawn showing each resort city as a hub for traffic from a particular region or several regions.

2. Governmental cities, such as state capitals, do not rank high in their traffic with Chicago. These cities could be studied to see whether their traffic is larger with other governmental cities than with balanced and industrial centers. Such a study should notice that some of the state capitals are a combination of people with different interests and are not as typical as others.

3. Industrial cities in many cases exchange with Chicago a high percentage of their traffic.

4. High traffic producers among industrial cities are those close to

Chicago, while high traffic producers among marketing and institutional centers are at a long distance.

5. No marketing centers exist according to the C.A.A. in Ohio, Michigan, Illinois, or most of New England, or Indiana. Most of these marketing centers are west of Chicago.

6. Geographic regions, highest as traffic producers for Chicago, are the northwestern states, Washington, Montana, and the Dakotas; the southwestern states, Arizona, Arkansas, Oklahoma and Texas; and Florida. Those directly west such as Kansas City and Denver, are slightly below these.

7. Cities that had no air service in 1940 are lowest on the list of traffic producers.

8. Geographic situations of other large cities over one million, using Chicago as a hub, show that Detroit is closest, 219 miles and San Francisco farthest, 1856 miles. Nine of them are east and four of them west of Chicago. They furnish 51% of the Chicago traffic.

9. Cities between 100 and 199 miles average 27.6% of their traffic with Chicago; between 200 and 299 miles, 20.7%; 300 to 399 miles, 13.7%; and below 900 miles from 1 to 2% of their traffic.

10. As the distance from Chicago increases, the cities with a higher percentage of their traffic with Chicago are the larger cities, and the percentage of the traffic of the smaller communities decreases rapidly as distance increases.

11. Cities with the largest traffic with Chicago are: (1) New York; (2) Detroit; (3) Minneapolis; (4) Miami; (5) St. Louis; (6) Washington; (7) Cleveland; (8) Kansas City; (9) Indianapolis; and (10) Cincinnati. These first ten cities furnished 52% of the Chicago traffic and the highest forty cities 83%.

12. Most cities have a lower percentage of their own traffic with Chicago than in 1940, although there were a few exceptions.

13. A very noticeable decrease in the percentage of the traffic of Minneapolis, Detroit, St. Louis and Kansas City with Chicago leads to the question whether this is realignment of the traffic pattern in the country and whether people from these populous middlewestern cities may be by-passing Chicago by air more often now than in 1940 or simply whether the air service by-passes Chicago more than in 1940.

14. This study may be used as a model for other studies of cities in the United States, so that eventually a rather complete picture of the air traffic pattern in the country may be drawn.

SCANDINAVIAN AIRLINES SYSTEM COOPERATION IN THE AIR

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SCANDINAVIAN Airlines System pioneering in commercial polar flying in recent months has demonstrated again its aptitude for innovation in the field of international commercial aviation. With its formation in February 1951, SAS became the first — in the sense of ownership — international air carrier. Denmark, Norway, and Sweden had decided that they could best meet their needs in civil aviation by cooperation, and in its two years of existence, SAS has borne out the judgment of its creators. Owned jointly by the three Scandinavian countries, SAS has no parallel in aviation and few in the realm of business.

SAS is one of the world's big airlines with routes extending across Asia to Tokyo, to South Africa, and North and South America. A large part of its traffic of course moves within Western Europe. At the time of the final step in 1951 in the evolution of SAS, the airline had fifty-nine planes and had placed orders for more. In the accounting year October 1, 1950 to September 30, 1951, SAS flew 26,287,000 kilometers and carried 481,697 passengers. It has been among the leading carriers on the North Atlantic route, more than holding its own in United States-Scandinavian traffic.

Three phases marked the joining of three national airline companies into a single operating unit. In 1946 Danish Airlines (DDL), Norwegian Airlines (DNL), and Swedish Intercontinental Airline (SILA) formed a consortium for intercontinental flying. The companies continued to carry on European and African operations separately until 1948 when they fashioned a pooling arrangement for that traffic. Having by then gone a considerable way toward complete unification, and being dissatisfied with the multiple organization form, the three airlines in 1951 merged their airline activities.¹

The SAS development is significant and worthy of evaluation because (1) It reflects the impact of legal-economic-political forces in international aviation. SAS is an evolutionary product of these forces. (2) It represents economic cooperation for at least a part of Western Europe. This article deals with the formation of SAS, the factors which induced its formation, the general place and impact of SAS in

¹ The name Scandinavian Airlines System was used from 1946 to 1948 to apply to the consortium. From 1948 to 1951 all three companies used this name in their external relations. After 1948 within the organization the term Scandinavian Airlines System-Overseas Division was used for the consortium and Scandinavian Airlines System-European Division for the European pooling.

international aviation, and a discussion of the problems which inevitably arise in an attempt at economic cooperation.

Because of the limitations and restrictions on international air transport imposed by right of national sovereignty over airspace, small nations tend to have small airlines. Negotiation on bilateral air agreements is on a *quid pro quo* basis, often working to the disadvantage of the smaller nations. The large powers with greater populations and population concentrations contain the air traffic centers of the world. The airlines of small nations are obliged, in order to provide adequate service, to fly to such traffic centers as Paris and London. Airline nations of big powers, however, are not under the same compulsion to maintain connections to points within the borders of small powers. The terms of air agreements between large and small powers tend to reflect the relative aviation strength and needs of the parties.

Thus a small power may be somewhat circumscribed in the scope of its air operations. Norway, for example, cannot on a sound economic basis have the third largest air fleet in the world as she does a merchant marine.

Several factors however make small airline establishments undesirable even to small nations. The economics of contemporary airline operation favor large carriers. Over a considerable range, unit costs decline appreciably with increases in the size of the plane and the fleet. Secondly, a nation with widespread trade relationships may find necessary an airline with extensive connections throughout the world. In that airlines are instruments of commerce, nations with expanding trade may want their airlines to keep pace. Thirdly, commercial aviation is closely related to national defense. Commercial airliners will undoubtedly have great and immediate utility in any future war. In so far as planes necessary for defense are employed commercially for income, a reduction in defense cost results. Small nations thus face the dilemma that relatively large airlines are economically desirable, but because of international restrictions on air transport, difficult to attain. The three countries have found that many of the disadvantages of their individual small size can be overcome by joint operation and that the loss of individual autonomy over their air establishments is not too great a price to pay. The decision to combine air establishments came after five years' experience of limited cooperation and ten or more years of its consideration. The 25-year term of the present agreement indicates the faith of the three countries in their joint project.

In February 1951 representatives of the three national companies, Danish Airlines (DDL), Norwegian Airlines (DNL), and Swedish Airlines (ABA), signed a consortium agreement. Under its terms, the three national companies contribute their assets in the ratio 2:2:3 respectively to an operating entity, known as Scandinavian Airlines System. The three companies carry on no airline operations individually, but rather function as a kind of holding company. In essence, the consortium is a partnership of the three limited liability share com-

panies incorporated within each country. The consortium Scandinavian Airlines System has no separate nationality, being subject in some ways to the laws of all three nations.

The fusing of the national companies into a single operating entity directly involves the three Scandinavian governments as part-owners and as underwriters. At present, each state owns 50 percent of its company participating in SAS. Also the governments have agreed to provide limited financial aid during the initial period of adjustment and development. It is presumed by the governments that ultimately SAS will be completely self-supporting.

The three companies separately have long operating histories. Danish Airlines (DDL) competes with Royal Dutch Airlines (KLM) for the distinction of being the world's oldest airline. Before and after World War II, the three companies exercised practical, if not always complete, monopoly over their countries' international air transport. Each company, being partly a state investment, has been a "chosen instrument" airline. As the size and the importance of the State's investment in air transportation has increased, each government has played a more and more dominant part in its company's activities. SAS represents an interplay of public and private initiative.

EARLIER EXPERIENCE WITH COOPERATION

Danish Airlines (DDL), Norwegian Airlines (DNL), and Swedish Airlines (ABA) had considered and experimented with cooperation as early as 1938. Much of the initiative came from Norwegian Airlines which aspired to a North Atlantic service. In the mid-thirties after unsuccessful negotiations with Pan-American Airways, DNL recognized that Norwegian traffic was too small to support commercial flights. In 1939, DDL and ABA were persuaded to join with DNL in considering a joint North Atlantic operation.

Planning was carried to the point of sending representatives to the United States to arrange for landing rights, equipment, and navigational facilities. The advent of war to Denmark and Norway in April 1940 blotted out all preparations for the immediate future. Nevertheless much had been achieved by way of mutual understanding of the problem and in working relationships among the participants.²

During the latter stages of World War II, discussions concerning cooperation on the North Atlantic were resumed. This time negotiations were carried on in an atmosphere of great optimism looking to the post-war "air age." An urgency was felt to have an organization in existence for the purpose of exploiting early opportunities after the War. However uncertainties about the Norwegian post-war government's policies prevented actual agreement until the middle of 1946.³

Swedish representatives led the way in these latter negotiations partly because of Sweden's neutral position which permitted such ac-

² Storting Proposition No. 12, 18 January 1946, Oslo, Norway. Om medvirkning til dannelse av nasjonalt luftfartsselskap til drift av lufruter. p. 4.

³ SAS Special DIP 5. 108 pp. 1-4.

tivity and partly because Swedish businessmen had become interested in commercial aviation as a vital factor in international trade.

In 1943, Swedish Intercontinental Airlines (SILA) was formed by private interests to carry on overseas activity. This action was necessary because the government-owned airline ABA⁴ was then unwilling to incur the risks of pioneering overseas flying.⁵

At the end of World War II, Sweden's airlines had a very considerable advantage over all the other airlines of Europe in respect to organization, airport and maintenance facilities, and trained crews. If after the War the concept of the full five freedoms⁶ had prevailed as an international concord, SILA and ABA would have held an enviable competitive position. In all likelihood, Norway and Denmark would have found their international traffic being carried by Swedish companies. At the Chicago Conference in 1944, the Air Transport Agreement was drawn up which would multi-laterally grant the five freedoms to the signers. However, the number of nations, including Sweden, who ratified the agreement was not enough to bring it into force.

The prospect of bilateral bargaining based on positions of strength in the post-war era acted to pull the airlines of the three countries together. Sweden recognized that the obstacles to her airline expansion would be large enough without being checkmated by Norway's and Denmark's airlines. It was better to combine than compete. Furthermore, plans for the North Atlantic traffic called for use of the huge 75-100-passenger Boeing Stratocruiser promised for delivery in 1947. Scandinavian aviation experts believed that the only existing airfield in Scandinavia which could safely accommodate the Stratocruiser was at Sola⁷ Airport built up by the Germans at Stavanger on the southwest coast of Norway.⁸ The limited accessibility of the Stratocruiser within Scandinavia and the need for a sizeable traffic volume for its use were factors favoring cooperation.

The form and terms of cooperation on North Atlantic service were agreed upon in August 1946. In the interest of efficiency, the three airline companies rejected the conventional pooling arrangement and turned to the consortium form of organization, familiar to shipping

⁴ A close working relationship was maintained between SILA and ABA until July 1948 when the two merged under the name ABA.

⁵ *Ibid.* p. 1.

⁶ The varying degree of privilege extended to foreign air carriers is expressed by the rather euphemistic phrase "five freedoms of the air." The first freedom permits innocent passage through air space. The second, landing for non-commercial purposes. The third and fourth freedoms refer to the privilege of carrying commercial traffic between a second nation and the homeland of the airline. The most desirable and therefore most jealously guarded freedom is the fifth, the privilege of carrying traffic between nations other than the homeland of the airline.

⁷ It was expected that shuttle operations would be carried on between Sola and other points in Scandinavia.

⁸ Fremstilling av hovedtrekkene i Det Norske Luftfartselskap A/S's utvikling 1946-1948 og forslag til retningslinjer for selskapets fremtidige virksomhet Oslo, 14 January 1949, p. 91.

people in Scandinavia.⁹ The agreement setting up Scandinavian Airlines System (the first SAS) was to be in force for five years until December 31, 1951, unless terminated earlier by action of the parties.¹⁰ Although conduct of North Atlantic traffic was the prime objective of the consortium, provision was made that SAS should also carry on South American traffic (later amended to include Far Eastern).

The consortium SAS was to carry on most of the normal activities of an airline in its own name. However, ownership of the airplanes used by the consortium was retained by the parent companies. Each company received an agreed payment for the use of the aircraft and was responsible for its heavy maintenance.¹¹ The interests of the parties were divided 3:2:2 to Swedish Intercontinental Airlines (SILA), Danish Airlines (DDL), and Norwegian Airlines (DNL) respectively. The proportion represented a compromise of SILA's greater resources and the unwillingness of DDL and DNL to be dominated in the consortium by SILA. Each company had two members on the board of directors of the consortium.¹²

The consortium was considered by its members to be a success. Operations were extended to South America in early 1947 and in 1949 to the Far East. The headquarters were set up in Stockholm and personnel were recruited aiming for a reasonable division between the three nationalities. A considerable "esprit de corps" was generated within the organization and contributed to its success. The headquarters were located in Sweden where the higher wage and salary level obviated any problem of differences in that respect between the three countries. By and large, representatives of the three nationalities worked well together and traditional animosities, if they existed, did not flare.

An eventuality which nearly shattered the first SAS structure, and which in so doing forced the Scandinavian airlines to greater cooperation in Europe in order to protect the consortium agreement, concerned airplane maintenance. Each of the three airlines, supported or directed by its government, desired that some overhauling of the SAS fleet be performed at its installations. This was for reason of national defense, use of existing facilities, and so on. However, it appeared after the first year of operation that very little SAS maintenance would go to Norwegian Airlines. Bromma Airport at Stockholm was declared technically capable for the landing of Stratocruisers, contrary to earlier supposition. Furthermore, the Norwegian government had failed to build at Sola necessary additional facilities for the basing of large planes.¹³

Norwegian Airlines' officials became perturbed at the trend of

⁹ The consortium form as used by SAS is essentially a partnership of share companies.

¹⁰ Konsortialoverenskomst (Consortium Agreement) signed in Oslo, 21 July 1946. par. 1.

¹¹ *Ibid.* par. 4.

¹² *Ibid.* par. 3.

¹³ *Op cit.* Fremstilling av hovedtrekkene pp. 90-92.

developments. An intrinsic aspect of cooperation was the sharing of maintenance. Since maintenance performed in Sweden was paid for in hard currency it constituted a real burden upon Norwegian Airlines and on the Norwegian economy.

In order to salvage the overseas cooperation, an admitted success, the three airlines decided to extend the cooperation to European service. By this means maintenance of two-motor planes could be allocated to Norwegian Airlines. Along with a more satisfactory division of maintenance, it was believed that cooperation on European traffic would permit the elimination of duplication in service and sales effort.¹⁴ A provisional pooling arrangement was put into effect in April 1948, pending more careful working out of details. In June 1949, the three companies signed a two-year agreement for European cooperation. However this agreement was never fully approved by the Norwegian government and was permitted to go into force on condition of termination as soon as possible.¹⁵

The European cooperation, known as Scandinavian Airlines System-European Division (E-SAS), was kept separate from the consortium which now became known as Scandinavian Airlines System-Overseas Division (O-SAS). In the E-SAS pool the individual company organizations were kept intact. Superimposed on them was a planning and selling agency called E-SAS, set up in Copenhagen with responsibility to a joint board of directors of the three companies.

The E-SAS arrangement essentially involved independent operation by the three lines, Swedish Airlines, Norwegian Airlines, and Danish Airlines. Each carrier was responsible for its own costs except those incurred jointly, as in the E-SAS agency at Copenhagen and at installations outside Scandinavia. Operations were planned and joint cost shared on the same 3:2:2 ratio, used in O-SAS.¹⁶ All the income from European operations, excepting each country's domestic routes, was pooled and divided on the basis of the ton/kilometre performance of each carrier. The carrier having the largest volume of offered ton/kilometres, regardless of passengers carried, received the largest return from the pooled income.¹⁷

The E-SAS cooperation reflected the extemporaneous nature of its formation. Its organization was an administrative monstrosity. Unlike O-SAS where all activity was for joint account, it was possible in E-SAS for one party to exploit its own advantages to the detriment of the other two.

Norwegian Airlines, particularly, was dissatisfied with E-SAS.¹⁸ The maintenance of DC-3's which was to come to Norway through E-SAS

¹⁴ *Ibid.* p. 11. Also Pro Memoria from DNL Board of Directors to Boards of DDL and ABA 18 March 1949.

¹⁵ Storting Proposition No. 138 17 November 1950 Oslo, Norway.

¹⁶ Traffic Agreement of 25 June 1949 between A. B. Aerotransport, Det Danske Luftfartselskab A/S and Det Norske Luftfartselskap par. 8.

of a rule.

¹⁷ *Ibid.* par. 12.

¹⁸ Pro memoria from DNL Board of Directors to Boards of DDL and ABA 18 March 1949.

was delayed. DC-3's belonging to Swedish Airlines were never sent to Norway for maintenance, and Danish Airline's DC-3's were not turned over to Norwegian Airlines for maintenance until the summer of 1949.¹⁹ Officials of Swedish Airlines stated that their government, for defense reasons, would not permit maintenance of DC-3's to be performed outside of the country. Of indeterminable importance is the fact that Swedish Airlines had at that time considerable excess capacity in its workshops at Bromma, Stockholm. In any case, Norwegian Airlines had to pay maintenance charges for its DC-6's in Stockholm and DC-4's in Copenhagen for well over a year before it got any compensating maintenance in its own shops.

The income pooling arrangement turned out to be a source of friction and cross purposes. Since costs were borne individually, it became apparent quite soon that the advantage for each company would be to have that operation which yielded the lowest cost per ton/kilometre, however small the traffic volume. The most desirable operation was with a large plane on a long haul with few stops, building up a large number of performed ton/kilometres at relatively low unit cost. To make the problem more acute, the three companies' fleets were not uniform as to plane type. Swedish Airlines alone had DC-6's which were put into use on longer routes to Southern Europe. Norway and Denmark had no DC-6's in European traffic and fewer DC-4's than the objective 3:2:2 relationship between the carriers. The resultant pulling and hauling for the best routes and schedules seriously strained the cooperation.²⁰ No action could be taken unless there was unanimous agreement between the companies. To the limited extent that E-SAS operated, it had to serve three masters. Executives of the three companies spent their days in conference and correspondence with their opposite numbers in the other companies, thus neglecting their regular functions. The atmosphere of difference and dissension contributed little to efficiency of operation.

The experience of the pooling arrangement E-SAS indicates that such a setup for cooperation tends to be unworkable. If organizations are meshed together in their activities, it should be done on joint account so that one party may not profit at the other's expense. The contrast between the success of O-SAS and the misfortunes of E-SAS is quite apparent. The shortcoming of E-SAS was that it went beyond simple pooling, as often practiced by European airlines, yet attempted to preserve the operating entities of the parties.

In the spring of 1949, the Norwegian government came to the conclusion that commercial air transport was costing the economy too much. It was decided that Norwegian Airlines' activities would have to be cut down to reduce the annual loss. (Deficit of \$3 to \$4 million in 1948.) Government officials believed that participation in E-SAS involved a greater commitment than Norway could afford. Norway

¹⁹ Verdens Gang, Oslo, Norway, 14 November 1949 "Norwegian Aviation at the Crossroads."

²⁰ Memorandum from DNL Board to DDL and ABA.

had small interest in some of the E-SAS routes in southern Europe and the Mediterranean on which traffic was thin and losses were suffered. Through the income pooling provision, part of the burden of maintaining these routes was shifted to Norway. Accordingly, in the discussions carried on during the spring of 1949, Norwegian Airlines proposed a looser form of cooperation of the more conventional pooling type which would permit greater control over expenditures.²¹

However DDL and ABA strongly opposed a partial liquidation of the cooperation, and after a period of testing of position the companies decided in August 1949 that if the Norwegian government would not continue the existing European cooperation as proposed, it might be possible to construct some form which would be more acceptable to Norway and all parties concerned. A committee of three, the "Little Committee," was appointed from the boards of directors of the three companies to investigate the feasibility of various alternatives.

The "Little Committee" submitted its report in December 1949. It recommended that the three companies form a consortium to carry on all their air activities.²² The boards of the companies accepted the report as a working document for the carrying on of negotiations at the company and government level. From December 1949 to November 1950 there was discussion and conference within the companies and the government as to the feasibility, the form, and the implementation of greater cooperation.

To some extent the "Little Committee" report rationalized and justified decisions already made. The Norwegian government had decided in September and October 1949 that Scandinavian cooperation, for political reasons, had to continue.²³ This was probably a key decision in the whole later SAS development. Since E-SAS was unsatisfactory from the point of view of efficiency and effectiveness, it had to be scrapped. Without public aid the Norwegian company would have had to curtail its activities drastically. The decision by the Norwegian government to support stronger cooperation — and that involved the necessity of making certain concessions to Denmark and Sweden — made the big SAS a practical possibility.

After the report of the "Little Committee" was rendered, the three governments actively entered the negotiations. Accomplishment of so radical²⁴ a plan for cooperation required immediate government participation. Also by the middle of 1950, as a result of mergers and reorganization, the Norwegian and Swedish governments had come to hold 50 per cent of the capital shares in their respective companies.

²¹ *Ibid.*

²² Betänkande Angående Det Skandinaviska Luftfartssamarbetet Utarbetat av Einar Isdahl, Oslo; Per Kampmann, Köbenhavn; Marcus Wallenberg, Stockholm, December 1949.

²³ This conclusion was derived by the author from personal interviews with Norwegian government officials.

²⁴ It should be emphasized that up to this time (1950) the three airlines were run as three separate national companies. O-SAS was thought of as a special case. Therefore the idea of one airline for three countries was still a radical one both to company personnel and to government officials.

Thus the governments entered negotiations, both as shareholders in the companies and as controllers and protectors of the public interest in aviation.

Inasmuch as the governments were involved, the public of the three countries was involved. Particularly in Norway, the SAS issue flared out in public controversy. In all three countries there were groups in the airline companies and in the governments who, for private or patriotic reasons, opposed SAS. The strength of the criticism and public concern was sufficient in Norway to force the three companies to append a so-called "aide memoire" to the proposed SAS agreement. The "aide memoire" protected vital national interests by assuring each country its established proportion of employees, maintenance facilities, and so on.²⁵

On November 8, 1950, the responsible ministers in the governments met and endorsed the agreement as proposed by the three companies. As the agreement involved an appropriation of funds, it had to be approved by the legislative bodies of each nation. Last to approve, the Norwegian Storting voted in favor of SAS January 23, 1951, and on February 8, 1951, with accompanying fanfare, the final documents were signed, which made close-knit Scandinavian air cooperation a reality — in form anyway.

THE EXPANDED SAS

The new cooperation has taken the form of a 25-year consortium. Under its terms, all Scandinavian international air transport is carried on by SAS.²⁶ Domestic air transport is provided for on a contract basis, the governments' having the right to utilize other carriers than SAS if they see fit. Thus the national companies are now paper organizations, in a sense holding companies in the consortium venture.

In legal form, the "big" consortium is like the former overseas consortium, *i.e.*, the parties are "jointly and severally liable" to third parties. Six members chosen from each of the companies' boards of directors comprise the board of the consortium. The top executive officer of the consortium bears to the board, employees, and third parties the same relationship as does the president of a corporation.²⁷ The executive office bears the marks of compromise to nationalistic concern in that the managing director has two assistants who, according to the "aide memoire" (the supplement to the consortium agreement), will be of different nationality from each other and the managing director. Thus down to the executive level, each country has a representative to uphold its interest. This arrangement may inhibit freedom of the executive function which traditionally resides in one man. In that case, it may be labelled a cost of cooperation.

²⁵ *Op. cit.* Storting Proposition No. 138 17 November 1950 Oslo, Norway.

²⁶ A Norwegian company, South American and Far East Airlines, holds a concession from Norway to the Far East. The concession runs out in 1954 and will probably not be renewed.

²⁷ Consortium Agreement 8 February 1951, pp. 2, 7.

The SAS agreement forged out of experience is a strong document intended to hold the parties together for 25 years. It contains penalties for withdrawal except where withdrawal is necessary because of grave national emergency. For example, the withdrawing party or parties is denied the further use of the name SAS, while the remaining party or parties may continue with cooperation under that name. Also a withdrawing party may not receive any value for goodwill. The interest shares are again Swedish Airlines, Danish Airline, and Norwegian Airlines 3:2:2 respectively.²⁸

Several terms of the agreement are worth noting. It is stated that the activity of the consortium shall be governed by "sound business considerations, practice, and policy." Further stated, "the Consortium shall make every effort towards allocating in a reasonable way, the business activities of the Consortium between the three countries."²⁹ Such phrases indicate the desire of the framers of the agreement to minimize political-nationalistic considerations as much as possible in the operation of the consortium. However, the realities of national interest are interposed in the "aide memoire" qualifications which state that "the business principle in certain cases must yield in order to preserve and enhance the Consortium's Scandinavian character and in order to consider national interest." Furthermore, it is "appropriate to use the phrase 'in a reasonable way' " as a flexible "expression of the desire to come as soon as possible to the relationship 3:2:2." Provision is made in the "aide memoire" for workshops as follows: "a tolerable division according to the relation 3:2:2."³⁰

The above terms reveal the clash and compromise of national considerations and the desire to make the consortium as efficient as possible. Undoubtedly there will be some "costs" of cooperation, that is, costs which would not be incurred if SAS were a private company without national complications. For example, it might be preferable to concentrate all workshop activity in one of the three countries instead of apportioning it over the three. Administrative and operating organizations have to be maintained in each of the three countries. The position of Norway in the SAS routenet probably does not justify a regional establishment of the size that will be maintained for reason of national requirements. These are costs of cooperation. In the words of a Company executive, it will be some time before SAS costs are reduced to those of a comparable national company. On the other hand undoubtedly, there will be savings over separate individual operations by the three companies.

LEGAL PROBLEMS

Knotty legal problems are raised by the consortium agreement. For instance, one concerns liability to third parties. Presumably a damaged party would sue one of the three companies in the courts

²⁸ *Ibid.* pp. 15, 2.

²⁹ *Ibid.* pp. 1, 3.

³⁰ *Op. cit.* Storting Proposition No. 138, p. 5.

of that company's homeland. Since the companies are jointly and severally liable, judgment could net up to the extent of the one company's assets, including the investment in SAS. The sued company might then turn to the partners for their proportionate share of the damages paid. Difficulty could arise if the laws of the other two countries were different in respect to liability. In practice, the three companies may accept liability under the laws of all three countries.

Another problem concerns the functions and responsibilities of the managing director of the consortium. The agreement states that the managing director shall have the same powers and duties as are normally held by the General Manager (president) of a company.³¹ However, the share company laws in the three countries differ. In Sweden the managing director has a stronger position in relation to the board of directors than in the other two countries. Probably the corporate laws of the nation in which the headquarters of the company is located will be applied.

At first the framers of the consortium agreement intended that the companies turn over to the consortium title to all their property, except real estate. The planes were to be registered on a 3:2:2 basis in each country, but title was to reside in the consortium. However, the Norwegian government decided that ownership by the consortium would not meet the legal requirement that aircraft registered in Norway be owned by Norwegian companies. Furthermore, the Ministry of Defense in Norway was not receptive to the idea that title of Norwegian planes which might be needed immediately in an emergency should pass out of Norwegian hands.

GOVERNMENT RELATIONSHIPS AND CONTROL IN SAS

The SAS consortium agreement necessitated agreements at the government level. A single air authority—a counterpart of SAS—was contemplated, but there were too many obstructions to such action. For the time being, it was decided that the aviation authorities in the three countries be directed to work closely with each other. It was also agreed that each country would accept automatically the certification of personnel and equipment made by the others. Cooperation between the air authorities extends only to those areas in which they individually have control. Some change in air laws was required to make controls within the three countries more uniform.³²

How much joint action will be required on the part of the governments to facilitate the functioning of SAS is a matter of conjecture. It is feasible that as commercial aviation grows in economic importance cooperation may be induced in other areas. One such case has occurred with regard to customs. If SAS is to function efficiently, equipment, reserve parts inventory, and the general impediments of an airplane must be interchanged by the three companies. Each country has customs

³¹ *Op. cit.* Consortium Agreement 8 February 1951, pp. 10.

³² Odelsting Proposition No. 18, 9 March 1951, Oslo, Norway.

duties which are ordinarily levied upon entry on goods of the above nature. Thus a shipment of aircraft parts entering Sweden would pay duty, later be transferred to Norway, and pay another duty. In order to avoid this multiple taxation, the three governments have agreed that property of SAS will be subject to one duty at the time of entry into Scandinavia. Once in, there may be free movement through Scandinavia without levy.³³

The building of SAS has required meetings and conferences at many levels both in business and government. From this experience, there is a continuing legacy of acquaintance, working relationship, and goodwill which will make further cooperation easier.

In each country control by the air authorities is mostly limited to technical licensing and inspection. The three governments depend for economic control upon their 50 percent representation on the boards of directors of the companies and on the board of SAS. The channel of control and information between the national legislative body and the company passes through the communications minister to the government appointees on the boards of directors. In so far as the companies are not required to make extensive published reports to the air authority, and since the annual report of the company to its stockholders is no more than cursory, the public must place its trust in the minister of communications and his representatives on the board of directors. It is generally accepted procedure in Scandinavian joint government-private corporations that the government representatives on the company board of directors consider the immediate interest of the company as primary. Where the company or consortium interest conflicts with that of the general public, as may be true in the case of subsidies, rental of public property, etc. the company is in a sense on one side of the table and the public on the other. The Scandinavians have had considerable experience with control by government corporate ownership. Nevertheless, there is disagreement within Scandinavian government circles as to its soundness and effectiveness as a sole means of economic regulation of commercial aviation.

It is feared that the SAS management may by the complexity of three-company participation, and consequent lag in action, become in a sense autonomous and unresponsive to government controls.³⁴ Experience with O-SAS and E-SAS evidenced that cooperation acted as a kind of insulating device between the active management and the controlling agencies. Oftentimes, the exigencies of a situation required policy-making before reference could be made back to the government and private interests for approval or disapproval. A policy or decision once made is sometimes not easily retracted. However limiting managerial prerogatives as a means of tightening the reins of government control would probably reduce the level of efficiency.

³³ An effect of this procedure will probably be to bring about uniformity of duties on aviation material, since otherwise import will tend to take place through that country which has the lowest level of duties.

³⁴ This impression was gained by the author in interviews with government officials.

WHY SAS WAS FORMED

Undoubtedly the cultural affinities of the Scandinavian countries smoothed the way for cooperation; nevertheless, the reasons why SAS was formed were solidly based on the realities of economics and the international political climate.

Political Circumstances

The political atmosphere in Scandinavia in 1950 was extremely favorable to the idea of SAS. Otherwise it is quite certain that it could not have been formed. SAS was politically attractive not because it was necessarily sound from the standpoint of commercial aviation, but because to the governments, cooperation was a desirable end in itself.³⁵ In the years since World War II, several projects for Scandinavian cooperation have failed to materialize. By 1950, the governments had come to feel an urgency to arrive at some form of economic cooperation, a will o' the wisp ideal rather unsuccessfully pursued by the Scandinavian countries for the last several decades.³⁶ The costs to one or more of the three have always overridden any advantages which might accrue.

Unquestionably the Marshall Plan program in Europe affected the SAS issue. A many-times-stated objective of the European Cooperation Administration was greater economic cooperation and integration between European nations. An OEEC resolution of 2 November 1949 stated that regional cooperation is in conformance with ECA objectives and should be encouraged.³⁷ ECA has placed a degree of pressure and suasion upon Western European countries to enter into various forms of cooperation, such as the European Payments Union and the customs unions. This pressure has often encountered determined opposition from national groups which might be adversely affected. At times such opposition has been embarrassing to the governments involved in their relations with American government agencies. Therefore when the Scandinavian governments perceived an opportunity for cooperation which would have quite limited impact within the economy and which might on balance prove economically sound, it was seized upon eagerly. In particular, the Norwegian government which had found itself in a dissenting position in negotiations on the customs union welcomed an opportunity to demonstrate its faith and belief in Scandinavian cooperation and its support of Marshall Plan aims.

Economic Considerations

Although the governments supported SAS for political reasons, the most aggressive exponents of cooperation were the private interests. Prior to reorganization in 1950 Norwegian Airlines and Danish Air-

³⁵ Kungl. maj:ts proposition No. 260, 17 Nov. 50, Stockholm, Sweden.

³⁶ Storting Proposition No. 138, p. 13.

³⁷ *Ibid.* p. 13.

lines were 80 per cent and 82.4 per cent privately owned, and Swedish Airlines after merger in 1948 with the Swedish company SILA, 50 per cent privately owned. The private groups proposed and supported cooperation on the supposition that: (a) A more efficient and extensive operation would result, and (b) Financing of such an extended operation could be more easily accomplished.

The greater efficiency of cooperation over separate operation was the reiterated argument of the promoters of SAS.³⁸ It is based on the presumption that none of the three national airlines has, or can develop, sufficient traffic to justify expansion to the scale of most efficient airline operation. In air transport, advantages of scale may be realized in terms of the size of the plane used and the size of the fleet operated. In setting up overseas cooperation in 1946 the three companies gave recognition to the probability that their individual traffic was inadequate to support the use of four-motor planes.

When the DC-3 was the most generally used plane for shorter distances, the three individual airlines could obtain satisfactory plane utilization. However, the shift by competitors to larger and more economic two- and four-motor planes placed pressure on the Scandinavian companies to do likewise. The three companies saw that, on a number of routes, cooperation would offer better utilization of the larger planes.

Probably the greatest economic advantage of cooperation lies in more efficient use of maintenance facilities and reserve parts inventories. In general, efficient utilization of workshops requires that a certain minimum number of planes of each type be maintained. It is uneconomic to have a workshop and spare parts for two or three planes. (Realizing that four planes would not justify extensive maintenance facilities, SAS Overseas sold its contract for Boeing Stratocruisers.) SAS cost analysts and statisticians have calculated that there should be at least eight to ten planes in each type to make efficient use of facilities set up for each type.

Obviously, neither Danish Airlines nor Norwegian Airlines could utilize fleets of eight to ten planes of each type needed for their operations. The advantages of cooperation in maintenance were apparent and availed of well before the final cooperation was achieved in February 1951. Planes used by O-SAS were consistently maintained at Swedish Airlines workshops in Stockholm, except for a period in 1948. By cooperation, further specialization is obtained. SAS planners expect to have three plane types, one of each being overhauled in each country. At present, DC-6's and DC-3's are maintained in Sweden, DC-4's and DC-3's in Denmark and Scandias and DC-3's in Norway.

Utilization of workshop facilities has constituted a major economic problem for Swedish Airlines and Danish Airlines. Both have workshop capacities quite in excess of the fleets which they have maintained. This situation results from the optimism which prevailed in

³⁸ *Op. cit.* Betankande Angående Det Skandinaviska Luftfartssamarbetet.

aviation circles in 1945-46 and the fact that it was desirable to construct at one time adequate capacity for the future. In fact, the need to assure or guarantee use of their facilities in the future has been a factor in Swedish Airlines' and Danish Airlines' desire for cooperation.

Other economic advantages of cooperation are less apparent, although SAS leaders have pointed out many potential savings. They have calculated that elimination of duplication through cooperative sales effort, centralization of operations and administration will result in increased efficiency. However, there is some doubt that such efficiency will materialize. If SAS could operate completely removed from national considerations, these savings might appear. However, the control exercised by the governments through their representatives and the terms of the "aide memoire" may make them difficult to obtain. Regional organizations must be maintained in each country in order that there be trained administrative and operational personnel available in time of emergency. For example, seven to eight hundred people, exclusive of workshop employees, will be employed in Norway. In order to keep such a number occupied, functions which might better be performed at headquarters in Stockholm will be carried on in Norway. It is true that some attempt is being made to allocate certain functions to one or another of the regional organizations, thus permitting concentration and specialization. However, there are definite limitations to this procedure if the desired balanced organizations are to be achieved.⁸⁹

The cooperation will realize definite economic advantages of overriding importance, such as improved utilization of the fleet and of maintenance facilities. On the other hand, certain costs will be incurred above those of a purely national airline of similar size to SAS. These costs may be labelled "costs of cooperation." They include: certain inhibitions of the executive function imposed by the multiple interests, government and private, in SAS; the necessity of maintaining to a considerable extent balanced airline organizations, complete even to workshops in each country; and by adherence to a 3:2:2 division of activity including personnel, the possibility that on occasion the best man, or men, or the best location will not be chosen for a job.

After the staggering financial losses reported for 1947 and 1948 by the three airlines, private capital became less willing to invest in Scandinavian commercial air transport. The indebtedness of the Norwegian company was largely held by the government. In Sweden and Denmark, loans for commercial aviation from private sources became more difficult to obtain in that international commercial air transport did not appear to have a profitable future. Nevertheless, there was a desire among business interests in Scandinavia for extensive airline operation. The Scandinavian countries have a high per capita export

⁸⁹ To the layman, the irrational requirements of currency exchange control are shown here in the stated necessity of having an establishment in Norway of sufficient cost to use up accumulations of income in Norwegian currency. Norway has one of the softer currencies in Western Europe.

figure, much of which is in industrial goods, such as machinery and electrical equipment. This type of export good needs close contact between the buyer and seller for instruction and servicing. Therefore, Scandinavian businessmen were most anxious to have quick connections with markets throughout the world. Furthermore, a large first-class airline itself functions as an effective advertising medium.

Businessmen did not indicate a willingness to subsidize commercial air transport further, probably because an equation of cost and benefit would be difficult to achieve for individual investors. On the presumption of general public interest in an airline businessmen have turned to the governments for aid. The three governments, until November 1950 all Socialist,⁴⁰ had not been inclined either to subsidize or invest to any great degree. Swedish government officials stated on a number of occasions that there would be little or no public financial support for international air operations.⁴¹ And as discussed earlier, the Norwegian government in 1949 became quite alarmed about the amount of public money being expended for commercial air transportation.

However, the cooperative aspect of SAS has made commercial aviation more appealing as an area of public investment. Scandinavian cooperation is a political objective in itself, capable of obtaining public support. Each of the national legislative bodies in approving the SAS consortium agreement appropriated funds to guarantee SAS against losses up to \$1 million per year for five years.

How far the governments will go in the use of public funds in the interest of Scandinavian air cooperation cannot be estimated. The terms of the consortium make it quite onerous for one party to default for financial or other reasons. By majority vote, two of the parties can oblige the third to make further contributions.⁴² Such an obligation can be evaded only by withdrawal from the consortium, which in itself might be costly and undesirable. Thus the governments may be committed through cooperation to expenditures which they individually would not make.

Cooperation has earned for Scandinavian commercial aviation financial backing from the three governments which probably could not have been obtained otherwise. From that point view, cooperation has been an objective and advantage for the commercial interests represented in the national companies.

International-legal Factors

The third set of factors which induced the formation of SAS reflects the nature of the international conventions and practices which are applied to international civil aviation.

The scope of operation of an international airline depends on the

⁴⁰ In November 1950 the Socialist government in Denmark was replaced by a coalition government.

⁴¹ *Op. cit.* Kungl. Maj:ts proposition No. 260, p. 8.

⁴² *Op. cit.* Consortium Agreement, pp. 15.

terms of the air agreements which the airline's government is able to make with the governments of other nations. In general, these agreements may be distinguished on the basis of the liberality of their terms. One type of agreement is that which grants the five freedoms of the air. Others are more restrictive, limiting scheduled activity to the first four freedoms and sometimes containing even more restrictive clauses, such as the setting of traffic quotas.

Denmark, Norway, and Sweden have individually not a great deal to offer in the bargaining process for air rights. The population of the three together is about 14 million. Furthermore, located in the "quiet corner of Europe" the three countries are not strategically situated in the flow of air traffic. Sweden is quite at the end of the line. Only a relatively small amount of air traffic continues east to Finland and on behind the Iron Curtain. Denmark has a relatively good position, and its airport Kastrup at Copenhagen is one of the busiest in Europe. Traffic in and out of Scandinavia largely passes through Kastrup. Norway, like Sweden, is off the beaten path with no traffic passing through except flights going directly from Sweden across the North Atlantic (and possibly polar flights).

With the United States and the nations of northern Europe, Denmark, Norway, and Sweden have had little difficulty in obtaining adequate air rights. The situation with regard to those nations whose airlines do not desire to fly into Scandinavia is less satisfactory. In Italy, Spain, and even France some restrictions have been encountered. Outside of Europe, where O-SAS has operated, the three governments have worked together since 1946 to obtain air rights. However, in spite of this advantage, there have been obstructions presented because of the desire of the hitherto backward economies to protect their infant airlines.

Air cooperation overcomes two disadvantages which face the Scandinavian countries. First, it makes of the three countries a bargaining block in their negotiations with other nations. Secondly, it transmutes the conflict of interest between the three concerning air freedom into a joint effort vis a vis the rest of the world.

The separate advantages of the three countries when bound together give Denmark, Norway, and Sweden a stronger position in negotiation for air rights. Denial of entry into all three countries is a much more serious threat than denial into one or two of the three. Before cooperation, the three could be played off against each other by an outside power. Now the three Foreign Departments work together in negotiations with other nations. Or if it appears more advantageous one of the three bargains separately. In any case, the Scandinavian representatives attempt to obtain inclusion in air agreements the so-called "SAS clause." The "SAS clause" permits planes licensed in one Scandinavian country to fly commercially into a country which has an agreement with a second Scandinavian country. Thus a Norwegian plane may fly into Spain which has an air agreement with Sweden alone

of the Scandinavian countries. If the SAS clause cannot be obtained then schedules are planned so that planes licensed in the Scandinavian country which is party to the agreement are flown into the territory of the other party to the agreement.

Sweden has sufficient economic resources, but not a geographic position, to dominate Scandinavian aviation. If the geographic positions of Sweden and Denmark were exchanged, other things remaining equal, there would likely be no Scandinavian air cooperation, for Sweden would then have no need for Denmark's aviation resources. However, as things are, Sweden's air traffic moves down into and across Denmark on its way to most destinations in the world. Copenhagen is the natural air center of Scandinavia. From it traffic splits off in all directions north and south. It is nearly essential to a Swedish air carrier that it be permitted to land for commercial purposes in Denmark and further that it have fifth freedom rights there as well. However, Denmark has not been willing to give up its locational advantage without receiving something substantial in return. Since World War II, Denmark has abstained from signing the multilateral Air Transit and Air Transport Agreements.⁴³ Also Denmark has refused, except on the basis of SAS, to sign air agreements with Sweden and Norway which would grant reciprocally fifth freedom rights. Danish aviation people believe that if fifth freedom rights were granted Sweden aside from a cooperation agreement, Denmark would be overwhelmed by a financially stronger Swedish airlines.

Thus Sweden, in order to achieve a more economically sound commercial air operation, has been obliged to cooperate in greater or lesser degree with Denmark. Cooperation is mutually beneficial in that Sweden has greater aviation resources in equipment, personnel and traffic potential, while Denmark has a superior location. Copenhagen which has long been a major seaport in Northern Europe is greatly interested in continuing that position in air transport. An air center brings to an economy very definite commercial benefits in terms of foreign currency income, tourist expenditures, and generally stimulates commercial activity. Cooperation with Sweden and Norway assures Denmark of a regular flow of traffic and the opportunity to share in the proceeds of that traffic. More explicitly, Danish Airlines is able to share in revenue accruing to Norwegian and Swedish Airlines in return for which it shares with the other two Copenhagen's strategic position in air traffic.

Norway's aviation resources are weakest of the three, and as a result, perhaps Norway will benefit least from the cooperation. Probably the desire to preserve the Scandinavian nature of the cooperation, and also the potential threat of Norwegian collaboration with an American company on the North Atlantic, brought certain palatable concessions

⁴³ The first gives to signatory powers the privilege of scheduled commercial transit and noncommercial landing rights in the territory of co-signing powers. (First two freedoms.) The second grants full commercial rights between the signatory powers (five freedoms).

to Norway during the negotiations, and in the SAS agreement. Undoubtedly, also, the protestations of the Norwegian press during the negotiations period strengthened the hand of the Norwegian representatives.

Under the existing legal practices and procedures of international commercial aviation, the Scandinavian countries have been strongly motivated to cooperate closely. The whole is greater than the sum of the parts. Instead of using the accepted restrictive policies of international aviation as competitive weapons against each other, they have combined to mutual advantage. Because of their relatively small traffic potential and weaker bargaining position individually, it has been worthwhile to join together to meet the larger powers on a more even footing. It is perhaps to the everlasting credit of the Scandinavian countries that they have had the vision to recognize their common lot and to overcome the nationalistic inclinations which so often sabotage a proposal of this nature.