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THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION INSTITUTE

Final Report

A Background Planning Study of Michigan's Aviation Needs

Part I - Aviation and the Economy of Michigan

Under Contract With:

Michigan Department of Aeronautics
Capitol City Airport
Lansing, Michigan

Administered by: *June 1960*

THE UNIVERSITY OF MICHIGAN RESEARCH INSTITUTE • ANN ARBOR

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INDEX TO PART I

FOREWORD

The planning of aviation facilities and services has had only a limited rational basis and little in the way of a unified approach. Most of the planning efforts have been exerted by national agencies, principally the Department of Defense for military aviation, and the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB) for civil aviation including air commerce. With the creation, in 1959, of the Federal Aviation Agency, aviation planning activities at the national level have been strengthened and more nearly centralized except for purely military aspects which properly remain with the defense agencies.

At the state and local level, much of the planning has been confined to specific airport developments along guide lines prescribed generally by national policy which has not always consistently evolved. In addition, local agencies have engaged in promotional efforts to achieve, expand, and alter commercial air transportation service to their communities.

No clearly defined pattern exists in aviation as it does in highway transportation where the state highway departments form the principal facility planning and financing units in every state. Federal-Aid highway funds have long been channeled exclusively through the state highway departments. Not all states, however, have officially constituted aviation agencies; in those states where they are organized, some are almost purely promotional and even restricted to economic development. In a few, as in Michigan, full-fledged aeronautics departments exist and somewhat parallel the functions of the highway agency.

As a basis for re-examining State policy in aviation matters, and in airport planning and development, it was evident some time ago to the Michigan Department of Aeronautics that more intensive study would be necessary to provide facts and to clarify issues. Because its own staff was limited and already deeply committed to current engineering, fiscal and administrative problems, research aid outside the Department was sought.

The Michigan Aeronautics Commission, at its meeting on September 9, 1957, authorized its director "to contact the universities of the State for the purpose of determining what extent the schools would be able to assist in a state-wide survey of aeronautical needs." (Michigan Department of Aeronautics, Annual Report 1957-58; p.10) After several contacts and discussions, the Commission, on June 3, 1958, approved a project at the University of Michigan Research Institute for a "Background Planning Study of Michigan's Aviation Needs." On September 15, 1958, the project was initiated at the University along the lines indicated in a general statement of scope.

General direction of this research study was assigned to the Transportation Institute, with the cooperation of the Bureau of Business Research and the Department of Aeronautical and Astronautical Engineering in the areas of economic data and aviation technology, respectively.

Broadly, the study was designed to achieve, if possible, the following objectives which are enumerated roughly in their order of apparent importance:

1. Establish a factual basis for evolving State policy in aviation development, primarily airports, and for indicating the rational level of State financial support of such development.

2. Assemble data on the impact, principally economic, of aviation upon typical communities within the State.

3. Identify and relate those economic, social and geographic factors generating demands for aviation services, primarily those of general aviation.

4. Estimate the growth of aviation and evaluate the influence of its rapidly changing technology upon that growth in Michigan.

5. Apply transportation planning approaches to the broad determination of aviation needs, again primarily airports, and their administration and financing.

Because of the magnitude of aviation activity in the Detroit Metropolitan Area - the six counties (Wayne, Washtenaw, St. Clair, Oakland, Monroe, and Macomb) of Southeastern Michigan - and the special nature of the problems, it was the decision of the Department of Aeronautics that the specific needs of that region would be separately studied. Accordingly, no community or local research was carried on by the University as a part of this study in the Detroit Metropolitan Areas. Its aviation and economic statistics are, nevertheless, included in all data pertaining to the State of Michigan. No data cited for "Michigan" excludes any area of the State.

In accordance with the basic outline, modified by experience in the development of research data, this report has been divided somewhat arbitrarily, but nevertheless logically, into five sections or parts:

Part I. Aviation and the Economy of Michigan

II. Impact of Aviation and Airports Upon Michigan Communities

III. Growth and Technological Change in Aviation

IV. Planning for Aviation

V. Summary and Conclusions

SUMMARY - PART I

Consolidation of the various items of statistical information into state-wide totals for the principal economic aspects of Michigan aviation is expressed in the following tabular summaries. The sources of information and its derivation have been discussed in detail in the preceding sections of this report; purposely, such references are here omitted to avoid obscuring the significant figures with numerous qualifications.

As to the calendar period selected for these summarized figures, the fiscal year 1958-59 was chosen as the base because it represents the latest period for which much of the basic data, particularly federal, is available. Certain figures assembled on a calendar year basis have, then, been reconciled to the fiscal year by approximations.

Where both 1958 and 1959 figures are available, but no monthly breakdowns make exact conversion possible, the fiscal year total is assumed to be equal to the average of the two calendar years in which it falls. Statistically, this is questionable and is accepted only as a means of establishing a general level of indication, not as a factor in any comparative series.

For the general aviation data, the Transportation Institute Survey had determined 1958 calendar year data and an annual percentage increase. To develop fiscal 1958-59 data, the 1958 calendar-year figures were increased by a percentage equal to one-half the 1959 growth. Again, the results are not precise but serve to indicate approximate levels rather than as components in a series. A similar estimating procedure was used for the

Michigan Department of Aeronautics and Michigan Air National Guard because the 1958-59 reports were not available.

Table 18

OPERATING EXPENDITURES FOR MICHIGAN AVIATION
Fiscal Year 1958-59

(Includes expenditures for all items except capital improvements.)

Civil Aviation	
Commercial Airlines	$21,797,000
General Aviation - all classes	15,936,000
Federal Aviation Agency	4,605,000
Michigan Department of Aeronautics	660,000
Local Airport Agencies	Not available
Aviation-Allied Activities	Not available
Subtotal	$42,998,000
Military Aviation	
U.S. Department of Defense	
USAF - Selfridge, Kincheloe, Wurtsmith and K.I. Sawyer Bases, Misc. A.C. & W. Units, and Detroit Air Procurement District Office	$55,686,000
U.S. Navy	Not available
U.S. Coast Guard	5,750,000
Subtotal	$61,436,000
Total - Civil and Military	$104,434,000

Obviously, the actual total expenditures exceed this $104 million figures by several million dollars. In the Detroit area alone, an out-dated study revealed the local airports and aviation-allied activities in 1949 contributed some $4 million to the expenditures; on the basis of this indication and that of the 1959 airport community visits, a conservative estimate of aviation's total contribution to the economy of Michigan would be $110 million, of which $48 million derives from civil aviation.

As a part of that spending, that portion going to employment is of particular significance and is displayed in the next tabulation.

Table 19

AVIATION EMPLOYMENT AND PAYROLLS IN MICHIGAN
Fiscal Year 1958-59

Civil Aviation	Personnel (Equiv. Full-time)	Salaries & Wages (Total Payroll)
Commercial Air Carriers	2299	$11,356,000
General Aviation - all classes	1573	7,633,000
Airport Agencies, including Department of Aeronautics	686	3,553,000
Federal Aviation Agency	638	4,271,000
Aviation-Allied Activities	Not available	Not available
Subtotal	5196	$26,813,000
Military Aviation		
U.S. Air Force	6000 (est.)	$27,314,000
Michigan Air National Guard	362	2,140,000
Subtotal	6362	$29,454,000
Totals	11558	$56,267,000

As is the case with total expenditures, the number of employees and their wages are minimum values because several categories just are not represented by reliable figures. A conservative estimate, it is strongly believed, is that civil aviation alone would include approximately 6000 total personnel and a $29 million payroll. No further estimate of military personnel and payrolls is warranted by the information available.

Total expenditures also cover the myriad purchases of supplies and equipment for aircraft operations by both civil and military. Table 20 summarizes these purchases.

Table 20

TOTAL PURCHASES OF SUPPLIES AND EQUIPMENT BY MICHIGAN AVIATION
Fiscal Year 1958-59

(Excludes all capital items for airport construction and improvement)

Civil Aviation	
Commercial Airlines	$8,895,000
General Aviation	14,833,000
Airport and Aviation Agencies	465,000
Aviation-Allied Activities	Not available
Subtotal	$24,193,000
Military Aviation	
U.S. Department of Defense	$10,445,000
Michigan Air National Guard	3,337,000
Subtotal	$13,782,000
Total Purchases for Aviation Operations	$37,975,000

It should be noted that the military purchases do not include the more than $180 million in contracts for the Air Materiel Command, nor for the Navy Office of Air Materiel for general military aviation needs, including missiles. These demands, while a part of the gross aviation picture, seem so far removed from the State's aviation problems that they have not been considered a direct part of this study.

Another economic aspect of basic state-wide interest is in the tax payments generated by aviation activities in Michigan. While taxes paid directly by aviation activities, taxes paid indirectly by secondary agencies allied with aviation, and taxes generated by aviation users, are involved in the complete analysis of the tax picture, the determination of direct taxes alone proved only partially successful and indicated studies of indirect taxes beyond the resources of this project. Dr. C. L. Jamison, economic consultant on this study, advised that he knew of no accurate and simple way to determine indirect payments, nor of any satisfactory definition by which such study could be limited. Table 21 shows the direct taxes generated insofar as they could be determined.

Table 21

TAX PAYMENTS BY MICHIGAN AVIATION
Fiscal Year 1958-59

Commercial Airlines	
Aviation Fuel Tax (net after refunds)	$645,100
Other State and Local Taxes	508,100
Corporation Privilege Fees	15,700
Subtotal	$1,168,900
General Aviation	
Aviation Fuel Tax	$235,600
Sales and Use Taxes	204,900
Registration Fees	23,500
Local Property Taxes	70,700
Subtotal	$534,700
Airports - Privately Owned	
Real Estate and Personal Property Taxes	$61,500
Total Taxes	$1,765,100

Not at all clear in this taxation picture is the assessment against privately-owned property on publicly-owned airports. From the Transportation Institute Survey, many criticisms were voiced, particularly in the Detroit area, and confusion over the application of such levies was evident. A special study of this situation seems warranted, though such taxes as were paid in 1958-59 are included in the above totals.

Finally, as another measure of the economic size of Michigan aviation, the investment or total capital expenditures are summarized in Table 22.

Table 22

INVESTMENT IN MICHIGAN AVIATION FACILITIES AND EQUIPMENT
(As of January 1, 1959)

Civil Aviation	
Airports - Public and Private	$170,479,000
Ground Facilities - General Aviation	14,134,000
Navigation Aids - FAA	17,739,000
Aircraft and Equipment - General Aviation	29,756,000
Total Investment	"232,108,000

This $232 million figure represents 3.4% of the total estimated national investment of $6.9 billion in civil aviation, and is in line percentage-wise with other state-to-national comparisons of aviation statistics.

INTRODUCTION

This general background study of aviation needs in Michigan was undertaken to establish the economic role of aviation in the State, and to provide as much as possible a factual basis for evaluating the State's interest in this broad area. Aviation has expanded and changed so rapidly since the close of World War II that policies then expressed now warrant re-examination and revision in the light of new conditions. The purpose of this study is not, it must be emphasized, the proposal of particular changes of State policy, but primarily is the presentation of significant data upon which the responsible, official agencies may consider and base new policy.

Aviation today consists of several diverse activities, which are in large measure only loosely related. Scheduled air carriers, both passenger and cargo; military flying; general aviation including personal, corporate, commercial and instructional flying, airports and supporting activities; and aircraft and parts manufacturing all contribute to the economy of Michigan, as well as to the national economy. These contributions are generally in terms of transportation and business service, recreation, and military security; specifically, they are represented by employment and payrolls; expenditures for equipment, facilities, supplies, and fuel; and by their generation of taxes.

Initial attempts to determine the magnitude of these aviation economic factors and their pertinent comparison to other activities in the State revealed no general, reliable or official sources of such data. Statistics for most aspects of aviation are collected only on a national basis without breakdown by states, and thus reflect the very strong national interest which has characterized aviation activities throughout most of their development. The almost complete lack of official sources for data localized to Michigan required much more extensive exploration than had been anticipated, and introduced major delays in the progress of the study.

Information about many aspects of general aviation was unavailable, even on the national level, and its obvious importance indicated the desirability of an intensive survey. This need had been recognized by the Michigan Department of Aeronautics which had requested such a survey as a part of this study. Accordingly, the Transportation Institute Survey of General Aviation in Michigan was undertaken as a part of this study; data developed by this survey is utilized as it is applicable throughout this section of the report rather than being set out separately; a description of the survey procedure is included as a supplement to Part I of the report.

Because of the variety of sources, of the unofficial and informal nature of some of the "raw" data, and of the absence of regular reporting, one of the hoped-for byproducts of this economic study cannot be met at this time. It would have been desirable to set up a simple, continuing basis for assembling economic data for aviation in Michigan so that current evaluations could readily be made in the future. Instead, it is necessary to indicate the need for better reporting, and more comprehensive record-keeping before such statistics can be regularly maintained.

Detailed figures, as well as specialized information, are presented in the following sections dealing with the particular categories into which aviation activity in the State readily divides: Commercial Air Transportation; General Aviation; Military Aviation; Airports; Aviation Manufacturing; and Aviation-Allied Activities. Definitions and limitations will be discussed in connection with each category.

As a matter of convenience, many of the individual items of information have been combined to present a more nearly unified statement of the economic impact of aviation in Michigan. These are presented in the Summary section of this part of the report.

COMMERCIAL AIR TRANSPORTATION

Because aviation is, to a very large segment of the public, the activities of commercial air transportation, the role of the air carriers in the Michigan economy was first examined. Almost immediately, that examination was hindered by the difficulties mentioned in the Introduction - few significant statistics are broken down and published for operations at the state level. From a variety of sources, both official and personal, it has been possible, however, to develop a picture of the air carriers in Michigan.

Michigan Services

In 1959, there were seven recognized classes of carriers comprising the commercial air transportation industry in the U.S. Based upon the operations authorized by the Civil Aeronautics Act and the Civil Aeronautics Board, these classes are listed by the Air Transport Association of America as follows:

1. Domestic Trunk Lines

Carriers holding so-called "permanent rights" from the CAB and operating principally on the high-density traffic routes between the major cities of the U.S.

Of the 12 Domestic Trunk Lines in the U.S., Michigan is served by 7 carriers:

American Airlines
Capital Airlines
Delta Airlines
Eastern Air Lines
Northwest Airlines
Trans World Airlines (TWA)
United Air Lines

Of these, only Capital serves cities outside the Detroit Metropolitan Area. These are listed in Table 1 showing airline service to Michigan cities.

2. <u>Domestic Local Service Lines</u>

Carriers holding CAB certificates for operations on routes of lesser traffic density between smaller cities, and between those cities and the principal centers.

Of the 13 Domestic Local Service Lines, Michigan is served by 4 carriers:

Allegheny Airlines
Lake Central Airlines
Mohawk Airlines
North Central Airlines

Of these, Allegheny and Mohawk serve only the Detroit Metropolitan Area while Lake Central and North Central serve Detroit and other cities as shown in Table 1.

3. <u>International and Overseas Lines</u>

U.S. "Flag" carriers operating between U.S. and foreign countries, other than Canada, either as extensions of domestic trunk lines, or exclusively as international carriers.

Not subject to CAB authorization, "foreign flag" carriers operating under control of companies owned outside the U.S. through international agreements, and providing service between the U.S. and foreign countries.

Of the 20 U.S. carriers in the International and Overseas Lines class, Michigan is served directly by only 2 - Northwest and Pan-American - although five of the domestic trunk lines having overseas extensions provide connecting service from Michigan (Detroit) to foreign countries.

Two foreign-flag carriers provide direct international flights from Michigan; British Overseas Airways Company (BOAC) serves Detroit with Trans-Atlantic service, while Trans-Canada Airlines, by virtue of its use of Kinross until a suitable airport in Canadian territory is available, provides Canadian service at Sault Ste. Marie. Through adjacent Windsor, Ontario, Trans-Canada Airlines also, in effect, provides "foreign-flag" service to Detroit.

Additionally, six other foreign-flag carriers maintain their own sales offices in Detroit to facilitate travel and shipping arrangements between Michigan cities and foreign countries via connecting carriers to the principal U.S. international airports.

4. Territorial Lines

Carriers operating in Hawaii, Alaska, and between Alaska and the U.S. (Currently being reconsidered since both of these former territories have become states.)

No services in this category are provided in Michigan.

5. Helicopter Airmail Lines

Carriers operating under temporary CAB certificates and furnishing passenger, mail, express, and freight service via helicopters within major metropolitan areas.

There are at present only three certificated Helicopter Airmail Lines operating in the U.S. - at New York, Chicago and Los Angeles - although additional metropolitan areas such as Miami, St. Louis, and San Francisco are attempting experimental operations. Efforts have been made in Detroit, but to date have been unsuccessful in securing CAB approval for air-mail contracts and subsidies necessary to the financial support of such helicopter operations.

6. All-Cargo Lines

Freight carriers holding temporary CAB certificates and carrying cargo only on scheduled flights between designated cities are officially classified as "All-Cargo" carriers.

Of the 6 certificated All-Cargo Lines, 3 provide service to Detroit - Flying Tigers, Riddle, and Slick, although Flying Tigers serves other Michigan points via connecting truck lines. Scheduled air freight service is also provided at Detroit by the cargo divisions of the domestic trunk lines.

7. Non-Certificated Air Carriers

Carriers operating under authority of CAB exemptions from certification requirements, and limited to air taxi and freight forwarding services constitute a somewhat uncertain group variously referred to as "Non-scheduled," "Exempt," or more recently as "Non-certificated."

Because of the exempt status of the Non-certificated carriers, little information is on file with the CAB. Only one passenger carrier in this category - TAG Airlines - makes any advertised attempt to offer regular schedules; these are indicated between Detroit, Cleveland, Akron, and Chicago in small planes serving the Cleveland Lakefront, Chicago Meigs Field at the Lakefront, and Akron Municipal Airport, but inquiry revealed some irregularities with the fluctuations of traffic demand. Virtually all other Michigan passenger operations would be classed primarily as charter services under General Aviation activities and have been so reported.

Even more difficult to delineate are the so-called "Supplemental" or "Non-scheduled" operators falling within this category. These services, which pooled the efforts of irregular, non-certificated carriers to establish a cut-rate regular, tourist-class of service, have long been under heavy criticism from the certificated trunk lines and under close scrutiny by the CAB. Also, the establishment of air-coach services and fares have lessened their market with the result that little semblance of their former service in Michigan exists. Of the supplemental carriers listed in the Yellow Pages of the 1959 Detroit Telephone Directory, only one still maintained phone service in August 1959, and that one refused to release any information.

Observations indicate that any omissions of this group under Commercial Air Transportation have relatively little effect upon the total statistical picture of aviation in Michigan.

Geographical Coverage

To establish the geographical coverage afforded by the scheduled air carriers serving Michigan, a study was made of the location of all Michigan cities, except in the Detroit Metropolitan Area where separate studies were being made by others, with respect to the airline airports. On the basis of numerous observations of air travelers, the area of typical airline airport influence was considered to be 45 minutes ground travel time, or approximately 25 miles in distance; for major hubs such as Detroit, this area may be considerably larger because of longer, unbroken flights, but for all other Michigan airline airports, the 25-mile criteria seems a desirable maximum distance.

Table 2, showing scheduled air carrier coverage in Michigan, was prepared by applying this criteria, and indicates that 66 of the 96 cities of 5,000 population or more are served. Should additional service be established in accordance with the recom-

Table 1

SCHEDULED AIR CARRIER COVERAGE IN MICHIGAN, 1959

AIRPORT CITY	OTHER CITIES (over 5000 population and within 25 miles of airport)	CARRIER
<u>Lower Peninsula</u>		
Battle Creek	Albion, Marshall	North Central
Detroit (3 airports)	39 cities in Detroit Metropolitan Area and Windsor, Ontario (Wayne, Macomb, St. Clair, Oakland, Washtenaw, and Monroe Counties - subject of separate study by others.)	Allegheny American BOAC Capital Delta Eastern Flying Tiger (All Cargo) Lake Central Mohawk North Central Northwest Pan American Riddle (All Cargo) Slick (All Cargo) Trans Canada (via Windsor) TWA United
Flint	Flint Metropolitan Area and Fenton, Lapeer, Owosso	Capital
Grand Rapids	Grand Rapids Metropolitan Area and East Grand Rapids	Capital Flying Tiger (All Cargo) Lake Central North Central
Jackson	Albion (also via Battle Creek)	North Central
Kalamazoo	Metropolitan Area, Allegan, Otsego	Lake Central North Central

Table 1 (continued)

AIRPORT CITY	OTHER CITIES (Over 5000 population and within 25 miles of airport)	CARRIER
Lansing	Metropolitan Area, Charlotte, East Lansing, Grand Ledge, and St. Johns	Capital North Central
Muskegon	Metropolitan Area and Grand Haven, Muskegon Heights	Capital
Pellston	Cheboygan, Mackinaw, Petosky	Capital
Traverse City	---	Capital
Tri Cities	Bay City, Midland and Saginaw	Capital

Summary for Lower Peninsula: 13 Airports, 58 cities of 5000 population or more.

<u>Upper Peninsula</u>

AIRPORT CITY	OTHER CITIES	CARRIER
Escanaba	Gladstone	North Central
Houghton	Houghton, Hancock, Laurium, Calumet (all less than 5000 population)	North Central
Iron Mountain	Kingsford	North Central
Ironwood	---	North Central
Kinross	Sault Ste. Marie (and Soo, Ontario)	Capital North Central Trans Canada
Marquette	Ishpeming, Negaunee	North Central
Menominee	(Marinette, Wisconsin)	North Central

Summary for Upper Peninsula: 7 airports, 8 cities (4 less than 5000 population).

Michigan: 20 Air Carrier Airports serving 66 cities (of 5000 population or more as estimated by Michigan Department of Health, 1958).

Table 2

CITIES GAINING AIR CARRIER SERVICE BY RECOMMENDATIONS OF EXAMINER IN CAB GREAT LAKES SERVICE CASE, 1959
(Population 5000 or more, and within 25 miles of airport)

*1. Alpena, Alpena County

*2. Benton Harbor, Berrien County (Note 2)

3. Big Rapids, Mecosta County

4. Buchanan, Berrien County (Note 2)

*5. Cadillac, Wexford County

*6. Ludington, Mason County

*7. Manistee, Manistee County

8. Niles, Berrien County (Note 2)

*9. Port Huron, St. Clair County

10. St. Joseph, Berrien County (Note 2)

* Airport location

Note - When new service is effective, 6 additional carrier airports and 10 cities will increase Michigan's total to 26 Airline Airports and 76 Cities served.

Note 2 - Presently served via South Bend, Indiana.

Table 3

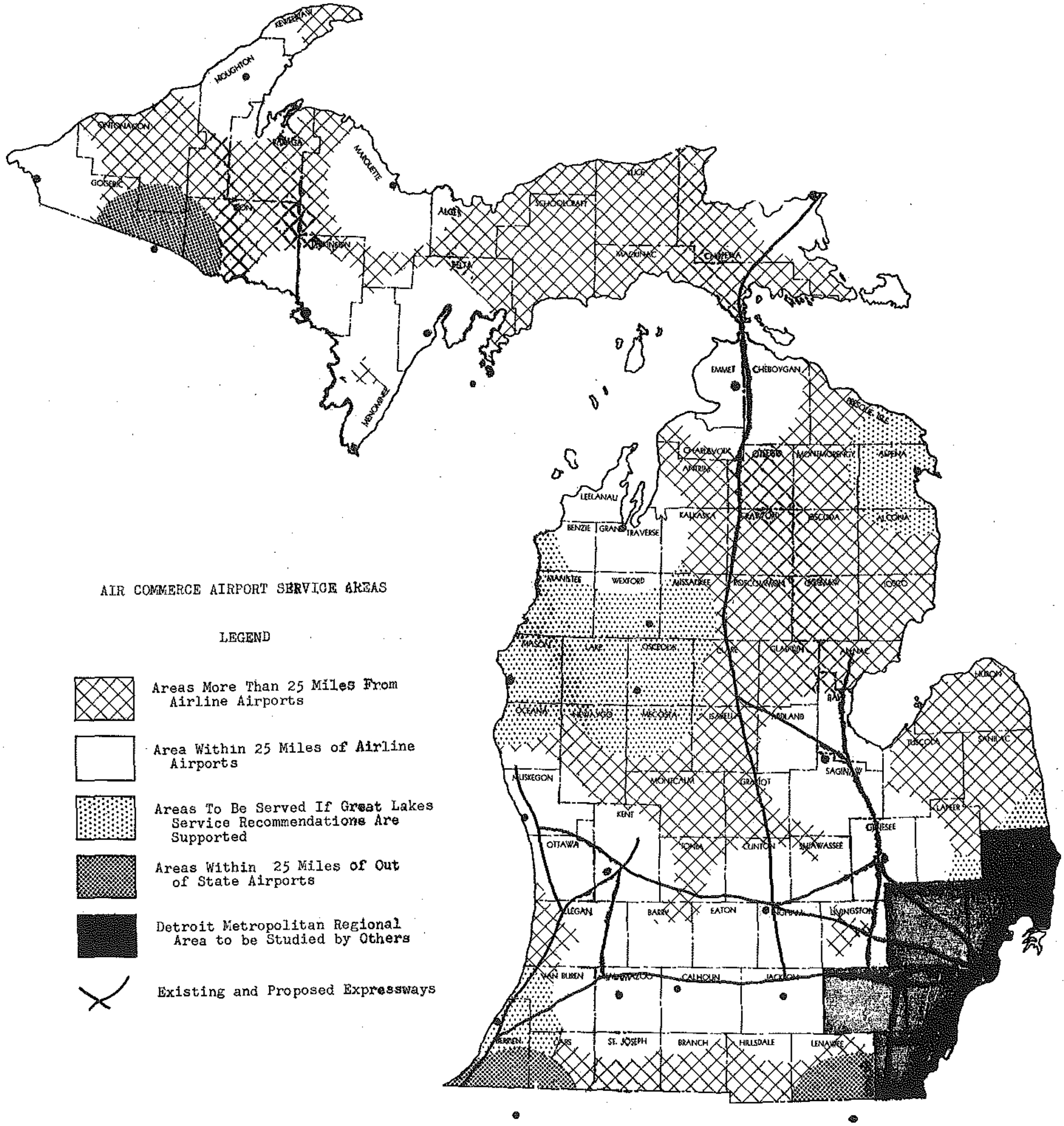
CITIES WITHOUT AIR CARRIER SERVICE, EXISTING OR PROPOSED
(and more than 25 miles from Airline Airports)
(1959)

		Population
1.	Adrian, Lenawee County	25,000
2.	Alma - St. Louis, Gratiot County	12,500
3.	Coldwater, Branch County	11,200
*4.	Dowagiac, Cass County	8,400
5.	Greenville, Montcalm County	8,400
6.	Hastings, Barry County	7,400
7.	Hillsdale, Hillsdale County	7,400
8.	Holland, Ottawa County	20,000
9.	Howell, Livingston County	5,900
10.	Ionia, Ionia County	7,000
11.	Mt. Pleasant, Isabella County	12,100
12.	South Haven, Van Buren County	7,700
13.	Sturgis, St. Joseph County	10,500
14.	Tecumseh, Lenawee County	5,400
15.	Three Rivers, St. Joseph County	9,000

* Served by South Bend, Indiana (20 miles)

Total Cities, Population 5000 or more	96
Cities presently having airline service	66
Cities expecting airline service	10
Cities without service within 25 miles	15

AIR COMMERCE AIRPORT SERVICE AREAS



LEGEND

Areas More Than 25 Miles From Airline Airports

Area Within 25 Miles of Airline Airports

Areas To Be Served If Great Lakes Service Recommendations Are Supported

Areas Within 25 Miles of Out of State Airports

Detroit Metropolitan Regional Area to be Studied by Others

Existing and Proposed Expressways

mendations of the CAB Examiner in the current Great Lakes Service Case, 10 more cities would be added to bring the total to 76. Including those cities having a population less than 5,000, but already airline airports - such as Houghton-Hancock, Kingsford, Pellston, and similar communities - the actual number of cities having scheduled airline service available would be significantly increased.

More significant, however, is the lack of service to certain cities beyond the 45-minute, or 25-mile limit. These, together with their estimated 1958 populations, are listed in Table 3. Of these cities, Hastings, Holland and Three Rivers are just beyond the 25-mile limit, and may be well within the 45-minute criteria when the present Michigan expressway program is farther along. Adrian, the largest of the cities without a conveniently available airport in Michigan, is approximately 45 minutes from the Toledo, Ohio, airport and, thus, cannot be considered isolated.

The map, Figure 1, illustrated the existing and probably coverage by scheduled airlines and delineates these areas remote from regular air transportation.

Economic Data

Statistics indicating the contributions of the scheduled air carriers to the economy of Michigan are shown in Table 4. The information tabulated includes all CAB certificated carriers operating in Michigan - Trunkline, Local service, International and Overseas, and All-Cargo, but excludes foreign flag carriers -

BOAC and Trans Canada - and their Detroit sales offices which are separately tabulated.

As previously noted, statistics for the air carriers are not published in any form which shows separate figures by states. Only after an appeal to the Air Transport Association of America, supported by a direct request from Mr. James D. Ramsey, Director of the Michigan Department of Aeronautics, was it possible to obtain the figures shown in Table 4. These were supplied in letter form by Mr. H. G. Murtha of Capital Airlines who was serving as Coordinator for the Air Carriers Serving Michigan, and supplemented by his personal explanation.

In comparison with these contributions, the revenues earned in Michigan by the air carriers are an indication of the value of transportation service which they provide. Using statements of income reported to the CAB and published by the CAA, Dr. C. L. Jamison of the University of Michigan Bureau of Business Research, derived the following estimates of the Michigan portion of the total revenues from domestic passenger traffic, air mail and air cargo originating at Michigan airline airports:

Year ending September 30, 1957:

Passenger Revenue	$41,570,000
Air Mail Revenue	811,000
Air Cargo and Express	3,491,000
Total	$45,872,000

Year ending September 30, 1958: $49,000,000
(or approximately 3% of total system operating revenue)

These figures cover the 11 principal air carriers - domestic

Table 4

AIR CARRIER ECONOMIC DATA FOR MICHIGAN OPERATIONS
(All CAB Certificated Carriers in Michigan)

Item	1956	1957	1958	1959 (est.)
Total Number of Employees in Michigan	1,791	2,037	2,260	2,373
Total Payroll in Michigan	$ 7,910,579	$ 9,890,828	$10,613,258	$12,099,144
Purchases in Michigan	5,633,000	7,984,000	8,092,000	9,969,000
Total Taxes - State and Local	632,750	915,426	990,715	1,315,687
Landing Fees Paid at Michigan Airports	103,680	104,450	128,367	186,000
Airport Rentals (excludes Willow Run)	38,363	43,808	73,933	125,000
Total Contribution to Michigan Economy	$14,318,372	$18,938,512	$19,898,273	$23,694,801

trunklines and local service lines - serving Michigan and do not include any overseas, foreign-flag, or all-cargo carriers.

Additionally, the seven foreign-flag air carriers maintaining offices in Detroit, also contribute to the economy of the State through their employment, payroll, purchases and taxes. While both BOAC and Trans-Canada also fly directly from Michigan airports, they make only enroute stops and maintain no service staff to augment their totals. On the basis of information obtained by correspondence with the individual carriers, the following estimates were made for the calendar year 1958:

Foreign Air Carriers in Michigan - 1958

Employees	39
Payroll	$220,000
Purchases	57,000
State and Local Taxes	8,700
Total Economic Contribution	$285,700

Thus, for the calendar year 1958, the air carriers' economic contribution to the State of Michigan was approximately $20,000,000, of which just under $1 million ($999,400) was paid in state and local taxes. And, from the incomplete figures for 1959, it is apparent that this contribution was substantially increased by 19%; the bax portion alone increased by 34% principally as a result of assessments on new facilities at Detroit Metropolitan Airport, although expanded operations were also a factor.

It is difficult to evaluate these totals because meaningful standards and comparisons cannot be established from the available data. Statistics for other states are not compiled by the airlines, nor maintained by the CAB or FAA in any form from which comparisons might be derived. It is the contention of the airlines that such comparisons would be meaningless because the local conditions influencing the data cannot be expressed in any commensurate terms.

In Michigan, for example, it must be recognized that no airline maintains more than the regular ground crews necessary to perform routine service operations typical of an intermediate stop or subordinate terminal. No major overhaul bases or maintenance centers are locally operated, and only four of the some 1800 air carrier aircraft are assigned to Michigan bases on FAA listings of U.S. Active Civil Aircraft as published in the 1959 annual edition of the "Statistical Handbook of Civil Aviation." Without the large payrolls and purchases associated with base operations, the airline contributions to the State's economy are derived entirely from transport operations, and sales efforts, which are largely concentrated in the Detroit Metropolitan Area.

So far as the scheduled air carriers are concerned, Michigan airports are either "way stations" or the outer "end of the line" and their limited economic contribution is accordingly established on a lower level than that of major terminal airports.

Air Commerce Traffic

An axiom of FAA planning is, "The community's population size and economic character fix its air traffic potential." And statistics collected annually from the commercial airlines show this relationship between traffic, population, and economy to hold true in general, though geographic position may modify these principal influences. Because economic data for a community served by the commercial airlines is quite frequently unavailable for the precise area served by the airport, the airline statistics are more significant in establishing the relative importance of air transportation service to the State of Michigan.

As an indicator, the FAA regularly collects a count of all revenue passengers boarding the carriers' planes at each on-line station, and reports the totals as "On-line Passenger Originations" separated as to domestic and international flights. There is duplication because of overlapping counts between airlines, although the importance of junction airports is thus high-lighted.

Another indication of growing importance is the record of enplaned cargo tonnage which is also regularly collected by the FAA. Air express and freight are combined in the totals, and the all-cargo lines are included along with the scheduled airlines carrying cargo.

A third indication, but less satisfactory because its implications are complex, is the count of actual aircraft departures from the on-line stations of all air carriers. These include both scheduled and non-scheduled flights of the certificated air carriers, and thus may produce a distorted picture of frequency and variety of service; also, as larger planes go into service at the largest airports, there can be a decline in the number of departures along with increases in originating passengers. In a rough way, however, aircraft departures provide an index of the relative importance of scheduled air carrier service.

Also recorded, but considered insignificant for purposes of this study, is data for air mail tonnage loaded at each on-line station. Because so-called "non-priority" mail is included, and yet is loaded on a "space-available" basis, and because Post Office routings are subject to a variety of considerations not necessarily related to air carrier service, air mail data has been omitted from comparisons.

From the air commerce data just described, two major comparisons may be established for Michigan: the first group indicates the relative position of the State of Michigan with respect to other states, and of its principal city (Detroit) with respect to other metropolitan areas; the second group of comparisons indicates the relative standings, within the state, of Michigan's airline communities.

Study of Table 5, which shows the ranking of the top 12 states originating the large bulk of domestic airline traffic, reveals that Michigan is in a position somewhat below its population rank - 10th on the basis of 1959 air passenger originations, and 7th on the basis of its 1959 estimated population. Reasons for this downward displacement are: the relative high place of the District of Columbia, which, as the National Capital, generates traffic far out of proportion to its population (a factor illustrated in Table 6); the character of Detroit, the principal generator in Michigan, as a less important junction point when compared to such airports as Kansas City and St. Louis, both in Missouri and the presence of some duplication in counts at such interchange points; the diversion of some of the State's traffic to other

Table 5

AIRLINE PASSENGER ORIGINATIONS - SCHEDULED AIR CARRIERS

(Totals by states for all airline communities within the state for fiscal year 1959 - Domestic traffic only.)

Rank	State	Passengers	Percent U.S. Total
1	New York	6,726,061	14.77%
2	California	4,921,858	10.81
3	Illinois	4,399,316	9.66
4	Texas	2,750,391	6.04
5	Florida	2,624,222	5.76
6	Ohio	2,340,353	5.14
7	District of Columbia	2,112,879	4.64
8	Pennsylvania	2,049,340	4.50
9	Missouri	1,512,152	3.32
10	MICHIGAN	1,497,992	3.29
11	Massachusetts	1,333,158	2.93
12	Georgia	1,177,303	2.59
Total	12 States	33,445,025	73.45%
Remaining States		12,086,442	26.55%
Total U.S. (not including Alaska and Hawaii)		45,531,467	100.00%

Table 6

AVERAGE ORIGINATING PASSENGERS PER DAY (1959 Fiscal Year)
(U.S. Domestic Traffic Only)

Rank	Community	Pass. Per Day
1	New York-Newark	14850
2	Chicago	11500
3	Los Angeles	6570
4	Washington	5790
5	San Francisco-Oakland	4730
6	Miami	3910
7	Boston	3380
8	DETROIT	3270
9	Dallas	2940
10	Atlanta	2720
11	Cleveland	2540
12	Pittsburgh	2410
13	Philadelphia	2250
14	St. Louis	2200
15	Denver	1990

airports in adjacent states, principally Ohio, Indiana, and Illinois.

Table 7, showing the ranking of the top 12 states with respect to air cargo, places Michigan slightly ahead of its normal population position. Its industrial character, with supplies based in the State for several national manufacturing organizations, would make such a rank logical and expected.

Table 8, showing a normal position for the State with respect to aircraft departures, reflects the relatively high service to the State by the local airlines and the number of smaller points - 17 outside the Detroit Metropolitan Area - enjoying air carrier service.

In the comparison of metropolitan areas, Detroit again falls closely into its normal position based upon relative population and originating passengers. Detroit, in fact, probably depends upon the traffic generation of its industrial complex to a heavier degree than any other city in the top ten; all of the others combine several factors, or display unique characteristics, such as Washington, to sustain their traffic level. Since a large portion of the 1959 fiscal year for which the traffic was reported was a "recession" period particularly acute in Michigan, the fact that Detroit maintained a "normal" position reflects the underlying importance of air as a passenger transportation medium in the State.

The second group of comparisons, as illustrated by Tables 9 and 10, indicate the sharp demarcations among Michigan cities with respect to airline passenger and air cargo volumes. Detroit, displaying nearly 14 times the passenger originations and almost

Table 7

AIR CARGO ORIGINATION

(Total tonnage by states for all airline airports within state - fiscal year 1959.)

Rank	State	Tons-Air Cargo	% U.S.
1	New York	84,559.1	17.83%
2	California	71,578.1	15.11
3	Illinois	68,148.1	14.40
4	Ohio	29,014.4	6.13
5	Texas	27,480.0	5.80
6	MICHIGAN	22,210.0	4.68
7	Pennsylvania	19,655.9	4.14
8	Georgia	17,127.1	3.61
9	Florida	14,873.1	3.13
10	Massachusetts	13,549.6	2.85
11	Missouri	11,891.6	2.51
12	District of Columbia	10,249.5	2.16
All Remaining States		83,821.8	17.65%
Total for U.S.		474,157.3	100.00%

Note: Domestic traffic only and including all-cargo carriers.

Source: FAA: Air Commerce Traffic Pattern - Fiscal Year 1959; November 1959.

Table 8

AIR CARRIER AIRCRAFT DEPARTURES

(Totals by states for all airline airports within state - Fiscal Year 1959.)

Rank	State	Aircraft Departure	% U.S.
1	New York	300,534	9.39
2	California	241,153	7.47
3	Texas	236,003	7.32
4	Illinois	203,598	6.28
5	Ohio	162,721	5.03
6	Pennsylvania	155,410	4.81
7	Florida	152,441	4.72
8	MICHIGAN	121,683	3.76
9	District of Columbia	110,026	3.41
10	Georgia	105,417	3.27
11	Missouri	94,810	2.92
12	Wisconsin	75,742	2.34
Remaining States		1,273,328	39.28
U.S. Total		3,232,866	100.00%

30 times the cargo enplaned at the next largest city, so dominates the air transportation picture as to "shadow" much of southern Michigan. This comparison underlines the arguments of the CAB's Great Lakes Service Case that frequency of schedule becomes a critical factor when convenient highway connections exist, and further emphasizes the difficulty of estimating the value of local air service.

It should be noted that the communities presently served all generated more than the minimum five passengers per day established under the CAB "Use It or Lose It" policy for evaluating the continuing need for service. All of the communities generating twelve or fewer originating passengers per day are in the Upper Peninsula and will not be affected by any transfer to newly established stations should the recommendations in the Great Lakes Service Case take effect. In fact, some of the proposed routes should materially increase traffic by affording more direct connections than presently enjoyed.

In summary of Michigan's air commerce positions, the State in 1959 was served by 18 on-line stations, utilizing 20 airports. Of these, one - Detroit - ranks as one of the 22 "large" air carrier hubs (a station originating 1.00% or more of the total airline passengers), while four others as "small" hubs (.05% to .24% of total) are counted among the 91 communities of the U.S. in this category. An additional 13 non-hubs in the state are among the 403 stations each generating less than .05% of the traffic.

Table 9

COMMERCIAL AIRLINE TRAFFIC ORIGINATING IN MICHIGAN CITIES
Fiscal Year 1959

Rank in State	Community	Total Orig. Pass.	Av. Pass./Day
1	Detroit	1,196,348	3,280
2	Grand Rapids	87,840	240
3	Lansing	34,920	96
4	Saginaw-Bay City-Midland	34,288	94
5	Kalamazoo	28,521	78
6	Muskegon	21,014	58
7	Flint	20,284	56
8	Battle Creek	18,372	50
9	Traverse City	13,010	36
10	Pellston-Cheboygan	8,691	24
11	Sault Ste. Marie	6,716	18
12	Jackson	6,526	18
13	Marquette	6,127	17
14	Houghton-Hancock	4,496	12
15	Escanaba	4,324	12
16	Iron Mountain	4,029	11
17	Menominee-Marinette, Wisconsin	3,630	10
18	Ironwood	2,806	8

Table 10

COMMERCIAL AIRLINES - AIR CARGO ORIGINATING IN MICHIGAN CITIES
Fiscal Year 1959

Rank in State	Community	Tons-Cargo
1	Detroit	20,409.1
2	Grand Rapids	688.0
3	Saginaw-Bay City-Midland	278.8
4	Flint	192.0
5	Lansing	164.6
6	Muskegon	151.8
7	Kalamazoo	137.0
8	Jackson	79.2
9	Battle Creek	45.7
10	Traverse City	21.2
11	Escanaba	18.4
12	Pellston-Cheboygan	12.0
13	Menominee	10.6
14	Iron Mountain	9.0
15	Marquette	6.3
16	Sault Ste. Marie	2.3
17	Houghton-Hancock	1.8
18	Ironwood	1.5

In total number of on-line stations, Michigan is exceeded by only three states, Texas, California, and Florida, and equals New York with its 18 stations. With the probable increase of some six new stations, Michigan seems likely to hold its place with respect to geographical coverage of its area. Adequacy of airline service is, it must be noted, not at issue here and is beyond the limits of this discussion.

Among the East North Central States, in which Michigan is officially grouped for national comparisons, the following tabulation is of interest:

State	Hub Category			Non-Hub	Total
	Large	Medium	Small		
Michigan	1	0	4	13	18
Ohio	2	2	3	6	13
Wisconsin	0	1	2	10	13
Illinois	1	0	4	7	12
Indiana	0	1	3	6	10

Only Ohio outgrades Michigan in hub categories; this is logically expected in view, both of Ohio's larger population and its more uniform distribution over that state's compact area.

The almost obvious conclusion as a result of analysis of FAA air commerce data, together with the other aspects of scheduled airline statistics for Michigan, is that there is nothing unusually outstanding or lacking. Basically, routes and stations serve the State's areas and population concentrations; the service potential is established, even though levels of services can be substantially lifted in quality.

GENERAL AVIATION

Virtually unknown to the public which largely "sees" aviation either as military flying or as commercial air transportation, general aviation is in reality the most active area increasing aviation importance to the economy of Michigan. According to usage developed by official agencies, the field is sub-divided into four general aviation categories:

1. Business or Executive Flying - the aviation activities in connection with business and industry in which the predominant purpose is the transportation of personnel.

2. Commercial, Industrial, or Service Flying - those aviation activities, including charter and air taxi, in which the flying is an essential part of the service - agricultural crop dusting, aerial mapping, and like activities are included.

3. Instructional Flying - aviation activities in connection with flying schools and other air education endeavors.

4. Pleasure or Personal Flying - aviation activities in which the primary purpose is pleasure or sport, rather than the transportation or service. When efforts of individuals are pooled, these activities are classed with "flying clubs."

The distinctions among these categories is not clear-cut because a particular aircraft or individual flier may, at various times, be involved in different categories. In particular is this true in Pleasure and Business flying; an individual may use his plane on weekdays for business trips while, on weekends, his flying is solely for personal pleasure. Rather than attempt to apportion such divided use among the several categories, this study has assigned any plane or pilot to the area of predominant use; an individually owned plane, even though flown by the owner on business trips, is classified as "Pleasure" if it is so used more than 50% of its flight time.

Statistical information on General Aviation has been collected for some years by the Federal Aviation Agency through periodic sampling studies on a nation-wide basis. Almost none of this information could be broken down to the state level; only the registrations of planes and pilots is normally assembled by states. And, to gain a clear picture of the place of general aviation in Michigan, a survey of general aviation was undertaken by the Transportation Institute and is described in detail in Appendix A of the report. Only the pertinent results of this study are reported here.

Tables 11, 12, 13, 14, 15, and 16 summarize the major items of information developed in the survey. Under the appropriate headings which follow, these results are discussed in greater detail together with other findings.

Table 11

GENERAL AVIATION IN MICHIGAN
Active Aircraft and Flying Hours - 1958

Classification (FAA)	No. Active Aircraft	%	No. of Owning Units	%	Flying Hours	%
Business	549	19.5	448	18.9	164,100	36.7
Commercial-Industrial	288	10.2	136	5.8	56,900	12.7
Instructional(1)	269	9.5	96	4.1	87,600	19.6
Pleasure(2)	1706	60.8	1686	71.2	138,600	31.0
	2812(3)	100.0	2366	100.0	447,200	100.0

Notes:

(1) Instructional classification includes only flying schools owning aircraft registered in Michigan, and licensed instructors reporting more than 50% flight time devoted to instruction.

(2) Pleasure classification includes some business, industrial and instructional flying when reported flight hours in those categories totaled less than 50% of flight time. Also includes 15 planes registered in Michigan by owners with out-of-state addresses.

(3) Excludes 10 planes (13 in 1959) owned by State of Michigan and operated by Departments of Aeronautics, Conservation, and State Police.

Source: Survey of General Aviation in Michigan, conducted by Transportation Institute, The University of Michigan, 1959.

Table 12

GENERAL AVIATION IN MICHIGAN
Investment and Expenditures - 1958

Classification	Total Aviation Investment	Percent of Total	Total Flying Expense	Percent of Total
Business	$27,038,000	61.7	$10,700,000	71.3
Commercial-Industrial	8,236,000	18.8	1,950,000	12.9
Instructional	1,587,000	3.5	749,000	5.0
Pleasure	7,029,000	16.0	1,635,000	10.8
Total	$43,890,000	100.0	$15,034,000	100.0

Source: Survey of General Aviation in Michigan, Transportation Institute, The University of Michigan, 1959.

Table 13

GENERAL AVIATION IN MICHIGAN

Investment in Planes and Ground Facilities - 1958

Class	Investment in Planes and Equipment	Investment in Ground Facilities	Total	Investment per Plane
Business	$ 18,380,000	$ 8,658,000	$27,038,000	$49,400
Commercial-Industrial	4,945,000	3,292,300	8,237,300	28,500
Instructional	1,182,000	404,500	1,586,000	5,890
Pleasure-Private	5,249,000	1,779,800	7,028,800	4,120
Total	$29,756,000	$14,134,600	$47,890,600	

Table 14

GENERAL AVIATION IN MICHIGAN

Employment, Payroll and Flying Expenses

Class	Equiv. Full-Time Employees (1)	Total Payroll	Purchases Fuel & Supplies	Total Flying Expense	Flying Expenses per Plane Hour
Business	827	$5,040,000	$5,660,000	$10,700,000	$65.20
Commercial	361	482,500	1,467,500	1,950,000	34.27
Instructional	310	929,000	749,000	1,678,000	19.10
Pleasure	---	---	1,634,800	1,634,800	11.70 (2)
Total	1498	$6,451,500	$9,511,300	$15,962,800	

(1) Where part-time employees were reported, their numbers were reduced to equivalent on full-time basis; in commercial flying service, for example, 284 full-time and 154 part-time employees are equivalent to a full-time employment of 361 persons; of the 310 reported for Instructional aviation employment, 160 work on a part-time basis.

(2) Flying expense ranges from a low of $8.75 in flying clubs to $12.75 per plane hour in individually owned and operated aircraft.

Table 15

GENERAL AVIATION IN MICHIGAN

Taxes, other than Payroll, and Income - 1958

Class	Fuel Taxes	Sales & Use	Reg. Fees & Local Tax	Total	%
Business	$152,300	$ 95,600	$ 26,550	$274,450	51.4
Commercial	19,080	31,700	21,600	72,380	13.5
Instructional	24,100	28,800	30,650	83,550	15.6
Pleasure	40,200	48,800	15,405	104,405	19.5
Total	$235,680	$204,900	$ 94,205	$534,785	100.0

Table 16

GENERAL AVIATION IN MICHIGAN
Distribution of Flying Activity by Months of Year and Days of Week
(Percent of Total Flying Hours in Year - 1958)

Month	Classification			
	Business	Commercial	Instructional	Pleasure
January	5%	3%	5%	3%
February	6	2	5	3
March	7	7	5	3
April	9	5	5	6
May	10	12	5	12
June	12	12	20	16
July	12	12	15	17
August	9	22	10	14
September	9	10	10	11
October	9	9	10	8
November	7	5	5	4
December	5	2	5	3
	100	100	100	100

Day of Week	Business	Commercial	Instructional	Pleasure
Monday	19%	20%	6%	3%
Tuesday	18	16	6	3
Wednesday	15	13	6	3
Thursday	13	11	6	2
Friday	16	11	14	9
Saturday	10	15	33	26
Sunday	9	14	29	54
	100	100	100	100

Source: Reported Percentages as estimated by respondents to Survey of General Aviation in Michigan by Transportation Institute, University of Michigan, 1959.

Business Aviation

Of the 2825 aircraft comprising the active, civil, and privately-owned plane population of Michigan, as registed by the FAA in January, 1959, for general aviation use, the survey indicated that 549, or 19.4%, were principally employed for business, corporate, or executive flying. Some multiple ownership, as is known to be a fact, is indicated by the 448 individuals or companies in whose hames the planes were registered; typically, though, the business usage is limited to one plane with only the larger corporations maintaining fleets. (It should be noted that not all of the larger-company fleets are entirely registered in Michigan, or any other single state.)

These 549 aircraft represent an investment of slightly more than $27 million, as of the end of 1958. This is an average of $49,400 per plane and reflects the use of larger, more completely equipped aircraft in business flying as contrasted with other categories of general aviation.

Business flying amounted to more than 164,000 hours, or some 37% of the total in general aviation during 1958. This is an average of 299 hours annually per plane, a figure well above the 221-hour national average use of business aircraft found in the 1957 CAA Survey of General Aviation in the United States. Nationally, business flying was reported in 1958 to account for 45% of total flying hours in general aviation while the Michigan figure was only 37%. As indicated in the footnote in Table 11, the actual business flying in Michigan is somewhat above the reported figures because the smaller part-time business use of personal planes could not be separately obtained nor segregated in these totals.

Expenditures on business flying, not including any depreciation on aircraft or equipment, amounted in 1958 to approximately $10,700,000, or some 71.3% of the total general aviation expenditures in Michigan. This reduces to $19,500 per plane, or $65 per flying hour, with these figures reflecting the greater cost of operating heavier planes, and usually with a paid pilot or crew whose wages must be averaged into relatively few hours.

As might be expected, this flying time is fairly well distributed throughout the year, and also throughout the week in decided contrast to other categories in general aviation. The lower totals for the mid-winter months reflect curtailment due to weather, while the mid-summer and weekend figures represent the added use of business aircraft in connection with employee vacation travel. An inspection of Table 16 shows that Mondays, Tuesdays, and Fridays in June and July have the greatest amounts of business air trips, but that this category is musth more stable than the flying for pleasure or instruction categories.

In a group of 133 company-owned planes, in contrast to personally-owned in this business category, a special tabulation indicated an average of 14 trips per month and an average flight duration of approximately 2 hours away from the airport at which the plane was based. Thus, these business trips covered an average distance of 350 to 400 miles in which a one-day round trip by air permitted a large measure of the day to be devoted to work rather than travel. Flights made by company planes were chiefly made for sales purposes and, by descending order of indicated importance, executive trips, repair and maintenance service calls, and in connection with miscellaneous professional services.

This same group of company planes averaged 4,900 pounds of cargo items each month during 1958 in shipments ranging from 12 pounds to 14,400 pounds. Repair parts or critical production items needed in a hurry to avoid plant shutdowns made up virtually all the cargo so handled. In most instances, it was reported that no direct commercial air transportation was either available or adapted to the urgent schedule; and only the company plane immediately available and directly routed could have met the emergency.

As an outstanding example of the importance of business flying to a company located in a community without direct airline service, one Michigan corporation doing business on a national scale reported a daily average of 10 passengers - salesmen, executives, customers and service experts - transported in its company planes. On weekdays, an average of 2 flights per day went to Chicago to maintain connections with the scheduled airlines alone.

Commercial Aviation

As used by the FAA with reference to general aviation, the term "Commercial" includes not only that flying which is an inherent part of the service being rendered - aerial mapping, crop dusting, spraying, seeding, patrol services and the like - but also passenger and cargo transportation on a charter or air-taxi basis which does not qualify under CAB regulations for certificated airline status. Also included are the miscellaneous flying activities associated with testing, sale, and delivery of aircraft to customers. Because it covers such a variety of activities, it is most difficult to develop any finely drawn statistical pictures.

In Michigan, as indicated by the registration records of the Department of Aeronautics and by the Transportation Institute Survey, there are (in 1959) 136 commercial aviation operations owning 288 active aircraft. These aircraft together with other flight equipment and ground facilities owned by the commercial operator represented an investment, as of January 1, 1959, of \$8,237,000; this was divided \$4,945,000 in planes and \$3,292,300 in ground facilities, mostly hangars, shops and shop equipment. In a few instances, however, ownership of air strips was indicated. Of the total general aviation investment in Michigan, the commercial category represented 18.8%, exceeded only by the business-executive group.

Employment in this commercial-industrial-service area of aviation totaled only 361 equivalent full-time employees, or an average of only 2.7 per operator. Almost one-half, or 154, were only part-time employees. This factor accounts in large measure for the surprisingly low payroll reported as approximately \$482,500 for 1958 and up about 10%, to \$520,000, in 1959.

These figures are probably biased and conservative because of the reluctance and failure of the few large operators in the State to report in any detail. In several cases, it was felt that release of figures would reveal an individual operator's data and subject him to undue competition or embarrassment. For this reason, commercial aviation measurements herein used are considered minimum and conservative values.

Total expenditures for flying amounted to just under $2 million in 1958, and to approximately $2,150,000 in 1959, or roughly $34.50 per hour of flying. This is just over one-half the hourly cost of business flying and reflects, in general, the use of lighter, less elaborate aircraft. Also, since virtually all commercial flying - over 99% as indicated by the Survey - was for commercial purposes at direct expense to the customer, there was every pressure to keep costs, and flying as well, to a minimum.

Of the more than $½ million in taxes paid in Michigan by general aviation in 1958, 13.5% or $72,380, was paid by commercial operators. Because of their fixed real property at their bases, these tax payments are somewhat greater than the other categories of aviation with respect to their proportion of total flying hours, which was only 12.7% of the total. With increased activity, and with increased assessments from many local governments, the 1959 tax payments increased approximately 15% to $83,000 from commercial operators.

During the calendar year 1958, these flying services reported a total of 14,380 flights which accumulated a total of 56,900 flight hours - actually the lowest in all of the general aviation categories in Michigan. On the for-hire flights, 27,500 passengers were transported in air-taxi and charter service along with 10,560 pounds of air cargo over an average flight distance of 200 miles. Other details of service and work flights could not be established on any statistical basis because information supplied was so fragmentary; interesting examples will be cited in other sections of this report. Approximately two-thirds of all flights were cross-country, rather than local.

A significant aspect of this activity is its distribution pattern throughout the year. Table 16 indicates a low-level of flying during the mid-winter months, and a substantial peak (22% of total flying hours) in August when charter and air-taxi trips in connection with vacation and recreation reach their maximum. Comments indicated that an increase in such trips might be expected during the winter ski season if more runways at smaller airports could be assuredly clear of snow and ice.

Throughout a week, however, commercial operations, again indicated in Table 16, show more stability than other classifications. The variety of flying activities is so influenced by many factors, both business and recreational as well as emergency, that the sharp rise or drop on weekends is averaged out in the commercial category.

These flying services range from the part-time activities of an individual owning a plane and equipment representing an investment of as little as $3,000 to corporate operations in which the largest reported investments were almost $400,000 in planes and flight equipment, and $220,000 in ground facilities including hangars, shops and miscellaneous equipment and tools; inventories of planes and accessories for sale were not reported. On an average, a typical Michigan commercial operator in 1959 had $36,300 investment in planes (at $28,500 per plane) and $16,700 in ground facilities for a total of $53,000.

Data from the questionnaire indicated that the gross income on this investment averaged only $6,845 per operator, or a total for all operators of slightly over $1 million on the $8.2 million investment earlier noted. Since total expenditures were reported at almost $2 million, commercial aviation services would seem to operate at a substantial loss which, presumably, could not continue. Actually, the omissions in reporting such data by the larger operators seriously distort the gross income totals, and permit no realistic estimate of actual overall revenues.

It may be observed, however, that the commercial operations performing a widely useful range of flying services to Michigan are not fantastically profitable, and are primarily in the small-business, small-income category. With 288 active aircraft distributed among 136 owning units, it should be obvious that a substantial number are single-plane operators.

Instructional Services

The third category of general aviation is that of instructional flying which, according to FAA, includes all flying by civilians under the supervision of an accredited instructor. Such instruction may be carried on by licensed instructors, or by licensed aviation schools; in this survey, 96 instructional activities were identified in Michigan as owning 269 aircraft and accumulating 87,600 flight hours, or 19.6% of the total in the State in 1958.

As noted in Table 11, the surveyed activities of aviation instruction are incomplete because the licensed instructors owning planes but reporting less than 50% of educational flight time, or those associated with flying clubs are included with the "Pleasure" classification. From studies of individual returns, it was concluded that these more informal training activities constituted less than 10% of the reported instructional flying and hence their inclusion, at great expense in tabulating time, was not felt justified.

Facilities for aviation instruction represented, in 1959, an investment of $1,587,000 - 3.5% of the total and the smallest of any category. For flight instruction, little equipment beyond a suitable aircraft is needed; for ground school, more elaborate facilities are needed, but these may be associated with a physical plant serving other aviation needs and hence would not require substantial added investment. On a per-plane basis, the typical flying school had invested $4,300, or only a little more than the private individual using his plane for pleasure and far less than the business and commercial group.

In 1958, instructional activities continued the gradual recovery from the low point of the early 1950's when the veteran's educational privileges terminated, and a total of 5,900 student pilots were enrolled. The smallest instructional activity reported 8 students, while the largest indicated 431 and the average number per school was 61 students with three full-time and part-time instructors.

Flight instruction charges, as reported in the Transportation Institute survey, ranged from $11 to $46 per hour, and averaged $14.70 per hour of flight time. On the ground, charges averaged only $1.11 per hour, and reflect the opportunity for group instruction which very appreciably increases the economy.

To provide this instruction, $1,678,000 was spent in 1958 of which $929,000 was for payroll, and $749,000 for fuel and other supplies, maintenance and repairs. Insurance premiums, alone, totaled almost $77,000, and taxes, license fees and registration were just under $31,000. Flying expenses per plane hour averaged $19.10, considerably under business and commercial rates and somewhat higher than pleasure flying.

On the basis of issuances of student pilot certificates, 1959 should, when final figures are available, show a gain of approximately 25% and more nearly approach the long-time trend which is anticipated.

As indicated in Table 16, Instructional Flying is highly seasonal with one-third of its yearly total accumulated in June and July, and three-fourths from June to October. And, it will be noted, that it is largely a weekend operation with 76% of flight-time incurred on Friday, Saturday, and Sunday; Saturday, alone, accounts for 33% of instructional time. Such concentration explains the relatively high part-time employment of instructors; more than two-thirds of the equivalent full-time personnel were reported as actually part-time employees.

Pleasure Flying

As defined by FAA, pleasure flying represents all pleasure and personal activities in general aviation and is compared to the use of the family automobile. Such terminology, it may be remarked, is unfortunately employed because, like the automobile industry, aviation may have to campaign a long time to get rid of the implications of a "non-essential" status denoted by "Pleasure." Much more applicable is the term "private" flying which denotes personal transportation regardless of purpose - pleasure or personal business.

Hence, in the Transportation Institute survey, this "Pleasure" category was classes as "Private Flying." Also, to include that pleasure flying done as a group activity, a separate pleasure category of "Flying Clubs" was also canvassed. And, as previously noted, this category includes some activity in the other areas of general aviation in Michigan; whenever the personal use of any aircraft exceeded 50% of the total flight-hours, the questionnaire replies were assigned to "Pleasure" tabulations.

In both number of active aircraft and number of owners, the Pleasure fleet was the largest in Michigan. Referring to Table 11, it will be noted that the 1706 active aircraft constituted 60.8% of the total, while the 1,686 owners were 71.2% of the State's total. This relationship shows, of course, the very high single-plane ownership (and in a number of cases joint ownership by individuals or by flying clubs).

Of the 1686 owning units, 142 (or 8.5%) were clubs which owned 162 aircraft, or an average of 1.15 aircraft per club. Membership averaged just over ten members per club, of whom more than seven were licensed pilots; the smallest club, reported only two members while the largest indicated 53, with a State total of 1430, almost double the membership of 1955.

Indicative of the overlapping of activities, by the use of the "Pleasure" classification on the arbitrary basis described above, is the inclusion of licensed flight instructors in flying club membership. Almost one-half the clubs had one or more flight instructors as members, and almost one-half of their total reported flight hours was assigned to "gaining flight experience." So it must be concluded that an appreciable amount of instructional flying time here has not been credited to "Instructional Flying." The complications involved in breaking out these partial amounts precluded such tabulations.

The 138,600 flying hours in the "Pleasure" category represented the second-largest activity, or 31.0% of the State's total, and were exceeded only by Business Flying. Yet, the utilization of the aircraft in this category is by far the lowest of any group in general aviation as the following table shows:

Category	Average Flying Hours per Aircraft
Business	299
Commercial	197
Instructional	326
Pleasure	81

This figure of 81 flying hours per aircraft per year is just slightly below the average for the U.S. - 83 hours, or practically $1\frac{1}{2}$ hours per week - as reported by the FAA in its national studies of general aviation.

This pleasure flying is also highly seasonal and overwhelmingly weekend, as Table 16 shows. June, July, and August are the top months and account for 47% of the total hours. And Sunday, alone, accounts for 54% of the week's flying; together with Saturday, the two days include eight out of every ten hours that pleasure aircraft are in the air.

Such concentration as these statistics indicate merely confirms what observers have long known of the airports where personal planes are based, and constitute a major problem in airport planning. Any facility incurring sharp peak demand with low average utilization faces costs which cannot be readily reduced because of the need for high-capacity installation.

This situation is reflected in part in the operating costs found in the Survey. On the overall average, the cost of operation of a pleasure aircraft in Michigan was $11.70 per hour; for the individually owned plane, it was higher at $12.75 while the flying clubs, through group economy and higher utilization per plane per year, achieved a low of $8.75 per hour. In 1958, these private fliers expended a total of $1,634,800, including some $104,000 in taxes and registration fees.

Their planes and ground facilities (over 6% have a privately-owned flight strip and hangar) represented, as of January 1, 1959, an investment of slightly over $7,000,000, or an average of $4,120 per plane - the equivalent of one of the middle-priced automobiles. Yet only 17% of the owners had planes one year old or less, while 45% owned planes 10-12 years old. Since the typical period of ownership was indicated as between two and three years, it seems evident that there is a large turnover along with an active market in used planes.

These circumstances, along with the cost of operation and storage (an average of $53 per year for tie-down privileges and $165 in hangar space) delineate a strong influence holding back the expansion of personal aviation despite widespread interest. On the basis of the Survey, it is estimated that there were last year in Michigan less than 4,000 individuals actually flying planes regularly in general aviation, or only one out of four of the 13,528 total Michigan residents holding active FAA licenses. Or, on a population basis, only one out of each 2,000 Michigan residents was actually flying on other than a casual or random basis in 1959, although nearly four of each 2,000 were eligible by virtue of license.

Pleasure Flying - Seaplanes

On the basis of questionnaire returns, it is indicated that a total of 30 seaplanes are included in the 1544 Michigan planes owned by individuals and used primarily for pleasure. This may not be the actual total of planes which possess floats and can be converted to seaplane use; data in the questionnaires is not sufficiently detailed in most cases to ascertain the maximum probable number.

Only 11 out of the entire number of returns specifically mentioned "seaplanes" or "floats." Assuming that this ratio would hold for those not replying, expansion to 100% yields the indication of 30. While this group represents only 1.8% of the total reported hours flown, the relatively insignificant size does not warrant complete disregard of them in considerations of general aviation in Michigan; the abundance of water areas throughout and around the State could easily stimulate renewed interest in the future, as population pressure exclude private landing strips inland.

Average annual hours flown by seaplanes in 1958, according to the Transportation Institute Survey, was 90.5, or slightly above the average of all personal planes.

Average investment in seaplanes was $6,009 compared to $3,936 for the personal plane, while the yearly expenditure on seaplanes in 1958 averaged $1,943 as against $1,109 for all pleasure craft.

Those owners including comments were uniformly enthusiastic that seaplane flying is "more fun," but were critical of the lack of facilities - particularly the difficulty of getting gas - and the apparent lack of official interest or funds for their expansion.

The CAA Statistical Handbook of Civil Aviation, 1958 Edition, lists only 246 seaplane bases in the U.S. and 721 based seaplanes. As of January, 1959, the Michigan Department of Aeronautics reported nine seaplane bases and emergency landing areas, three publicly owned and six privately owned - a decrease of four since 1949 and marked by the shift from 11 bases, privately owned in 1949 to only two in 1958; of these nine, four became "emergency" while five were abandoned. One "public" seaplane base was added in this ten-year period to hold net loss to four.

MILITARY AVIATION

In addition to the civil aviation activities, which include both air carrier operations and the several categories of general aviation, military air operations constitute a significant part of the economic picture of the State. Even to a greater degree than is the case with civil aviation, the military orientation is so national that accurate and detailed breakdowns of information at the State level have proved almost impossible.

Military aviation activities within Michigan are maintained under the U.S. Department of Defense, but are subdivided to include the Air Defense Command, the Air Materiel Command, the Strategic Air Command, and the Naval Air Service as of this writing. Changes are occurring quite rapidly with the situation likely to be changed again so that no stable pattern can be drawn.

From time to time, public relations releases indicate substantial lump-sum amounts of expenditures for improvements, additions, and operations of various military facilitis within the State. Analysis of the figures in such announcements, and attempts to develop a consistent tabulation of statistical validity met uniformly with failure because sufficient details could not be obtained, even on direct contact to the facilities and public relations officers releasing the published information.

Finally, with the assistance of Hon. George Meader, Member of Congress from the Second District of Michigan, the following data was obtained from Major-General W. P. Fisher, USAF, Director of Legislature Liaison, Department of the Air Force, with the notation: "Accounting records (of the Air Force) do not reflect specific information by individual states, and this information was obtained from the major commands having activities in Michigan:"

Military Aviation in Michigan
(Calendar Year 1958)

Operation of Selfridge, Kincheloe, Wurtsmith and K.I. Sawyer Bases and Miscellaneous AC & W units	$ 53,285,594
Local Purchases and Travel	10,445,000
Civilian and Military Payroll	27,312,937
Contracts Let to Michigan Concerns	178,466,986
Operations, Detroit Air Procurement District Office	2,400,000

Contract figures represent total awards, $10,000 and over, to prime contractors maintaining principal offices in Michigan, and do not include any sub-contracts with Michigan sources. It is further noted that award of the contract in a State does not mean that actual fulfillment of the contract production will take place within that state; the location of the expenditures is dependent upon the contractor's operations for which detailed locations cannot be developed from contract-award information.

No totals are shown for any of the above figures because it is uncertain whether purchases and payrolls have been included already in the "operations" totals cited.

For naval aviation in Michigan, similar efforts through members of Michigan's Congressional delegation were necessary to gain figures at all. In the 1958 fiscal year, the latest for which figures could be produced, the Navy Department reported by letter that total aviation expenditures in Michigan, including guided missiles, were $4,463,105. This total also included "prime contracts of $10,000 or more placed with Michigan industries," and commented that "No records of subcontracts are developed or maintained.

Air National Guard

Much more meaningful and specific information was obtained for the activities of the Michigan Air National Guard, as reported in an interview in August, 1959, with Lieut. Col. G. M. Rynerson, Assistant Adjutant General:

Michigan Air National Guard Expenditures
Fiscal Year 1958-59

Employees	362
Payroll	$2,140,000
Service Contracts (in lieu of rentals)	337,000
Flight Expenditures, excluding payroll	3,000,000
Total	$5,477,000

The above total, it is understood, includes Michigan's share of expenditures during the active-duty training periods at Phelps-Collins Airport in Alpena where a total of some 5,000 personnel are trained during the summer months. Activities at Alpena are not confined to Michigan units, and could not be sufficiently identified, because they are largely Federal funds, to establish valid statistical measures of economic impact.

Further data regarding the State's investment in Air National Guard Facilities was received by interviews with Captains Ewen Fitzpatrick, Operations Officer and Finance Officer respectively of the Air National Guard Base at Detroit Metropolitan Airport, Inkster, Michigan.

Michigan Air National Guard Investment in Facilities
(as of July 1, 1959)

Planes and Flight Equipment	$43,000,000
Ground Equipment	3,112,000
Hangars and Other Buildings	9,081,000
Total Investment	$55,193,000

Information regarding flying hour costs was also obtained in the course of the interview with Captain Fitzpatrick. Based upon tabulations assembled by the National Guard Bureau in Washington, standard flying hour costs for the various types of planes flown in National Guard Service ranged from a low of $9.57 per flying hour to a high of $110.72 per flying hour. The lighter, single-engine training planes similar to civilian aircraft showed costs within the range of the costs determined by the Transportation Institute study; the military jet aircraft accounted for the higher costs.

Total flying time for Michigan Air National Guard planes was estimated at 5,200 to 5,400 hours annually, with approximately five yet hours to every one in propeller-driven planes. Busiest days of the week, because of training schedules, are Tuesday, Wednesday, and Saturday; with reserve training activities reaching a peak during vacation times, the summer months show the greatest accumulation of flying time; winter training flights follow good weather and frequently are made to southern points.

Although Air National Guard units are based at Lansing (also utilizing airport at Grand Ledge), Inkster, and Battle Creek, as well as the summer training base at Alpena, training flights visit many of the airports of the State. No particular pattern can be charted, and no particular contribution economically can be established at any airport.

Civil Air Patrol

An auxiliary activity of the U.S. Air Force is the Civil Air Patrol which is composed of civilian volunteers with the exception of a small Air Force administrative staff. In Michigan, a Civil Air Patrol Liaison Officer is stationed in Detroit and several local units are scattered throughout the State.

Repeated efforts to gain factual information about specific activities in Michigan revealed no useful data. As with the Air Force activities, statistics are not accumulated on any local basis. Since all of the activity is volunteer, and no direct expenses are involved, Civil Air Patrol activities have virtually no direct economic impact upon aviation. Its benefits are largely those in the area of public relations - the building of good will and enthusiasm, particularly among younger people of high school age, for aviation.

U.S. Coast Guard

One of the nine Coast Guard Air Stations in the continental U.S. is located at Traverse City as a base for search, rescue, and patrol activities of this peace-time unit of the Treasury Department. Since the Coast Guard has, in times of national emergency, been designated as a naval unit under wartime direction of the Defense Department, it is included here as a section of military aviation.

As is the situation with other Federal activities, the official reports show no breakdown from which the Coast Guard air activities in Michigan may be measured. Direct inquiry at the Traverse City headquarters indicated that no figures on planes, personnel, activities, nor expenditures could be made available.

It is known, however, that the Coast Guard provides an essential service to transportation on the Great Lakes, and an invaluable resource in times of any aviation accident in and around the waters of the Lakes.

Despite extensive efforts, both through correspondence and personal contact, it has not been possible to supplement existing official sources of statistical information on military and allied aviation within Michigan. This lack of economic data does not seriously hamper aviation planning for the State because traditional military considerations no longer maintain their significance. The rapid shift from manned aircraft to missiles has introduced new elements in defense planning in which logistic support has replaced purely military flying as prime consideration for civil airports. Thus, in this transitional period, economic contributions from military aviation to Michigan's total aviation picture present a highly uncertain and unstable aspect.

AIRPORTS

Records of the Michigan Department of Aeronautics show that the year 1949 was the high point in airport development in the State with 270 facilities of all types - licensed airports, landing fields, limited-use fields, military air bases, seaplane facilities and emergency fields. At the beginning of 1959, after ten years, this total had declined to 225; or a net loss of 16-2/3%. Nationally, the numbers of "existing airports and airfields recorded with CAA" show through 1957 (the latest year for which official data was available) a modest upward trend; differences in definition and inherent lags in reporting on a national basis make specific comparisons largely meaningless.

Of great significance to general aviation, nevertheless, are the trends reflecting the situation with the smaller airports and so-called "emergency" fields typical in Michigan. Loss of small airports can handicap private and business flying to a degree not realized by the users of commercial aviation at the larger, established airports. An analysis of the ten-year change, beginning in 1949, of Michigan's civilian airports and airfields has been developed to indicate the nature of these changes.

Licensed Airports, Landing Fields and Limited-Use Fields

The Rule and Regulations of the Michigan Aeronautics Commission, adopted and issued in accordance with the legislative acts governing the Department of Aeronautics, require that any airport or landing field must be licensed before it is placed in commercial operation, and minimum requirements for such licensing are set forth in detail. Where there are no commercial activities, and no license is involved, such airports or landing strips are classified as "Emergency Fields" and are separately recorded; a particular field may change its status, year-to-year depending upon continuance of commercial activities and compliance with standards for licensing. From Department records, the following comparison of 1949 with 1959 licensed airports is drawn:

	1949	1959	Change 1949 to 1959
Privately Owned	104	54	-50
Publicly Owned	98	86	-12
	202	140	-62

Examining these changes in greater detail, certain additional information is revealed by the following tabulation:

	Private	Public	Total
Licensed - January 1949	104	98	202
New Airports since 1949	+6	+4	+10
Upgraded from "Emergency"	+1	+4	+5
Downgraded to "Emergency"	-14	-15	-29
Abandoned - 10 year period	-43	-5	-48
Licensed - January 1959	54	86	140

Emergency Fields

Closely related to the smaller licensed airport, and highly important to the individual private flyer, is the emergency field in Michigan. While its official distinction from the licensed airport would convey the impression that such fields are solely for "emergency" use, many provide a base for personal, non-commercial flying, and locally are referred to as "airports."

These fields are regarded as particularly important to the future of general aviation because they-in effect, preserve land upon which a full-fledged airport may be developed economically. Not all sites are satisfactory since many of these emergency fields were developed as expedient measures by owners of individual planes, or by communities in a burst of an enthusiasm generated by some air-minded local citizen. Nevertheless, there should be genuine cause for concern in the disappearance of any field, licensed or otherwise.

Records of the Michigan Department of Aeronautics show the following changes in Emergency Fields in the State from January, 1949 to January, 1959:

	1949	1959	Change 1949 to 1959
Privately Owned	14	36	+22
Publicly Owned	26	33	+7
Total Emergency Fields	40	69	+29

In greater detail, the nature of the changes are revealed in this tabulation:

	Private	Public	Total
Emergency Fields - Jan. 1949	14	26	40
New Fields since 1949	+20	+4	+24
Downgraded from Licensed Airports	+14	+15	+29
Upgraded to Licensed Airports	-1	-4	-5
Abandoned since 1949	-11	-8	-19
Emergency Fields - Jan. 1959	36	33	69

Table 17

GENERAL AVIATION ACTIVITY
Ten Most Active Airports in 1958
on basis of Reported Landings in each category

	Private-Personal	Business-Executive	Flying Services
1.	Pontiac Municipal	Detroit City Airport	Detroit City Airport
2.	Detroit City Airport	Lansing - Capitol City	Mackinaw Island
3.	Flint - Bishop	Grand Rapids-Kent Co.	Beaver Island
4.	Lansing-Capitol City	Detroit-Willow Run	Fox Island
5.	Grand Rapids-Kent Co.	Muskegon County	Northport - Clinton Woolsey
6.	Ann Arbor Municipal	Detroit Metropolitan	Grand Rapids-Kent Co.
7.	Tri City-Freeland	Bay City-Clements	Detroit-Willow Run
8.	Traverse City	Traverse City	Gladwin
9.	Saginaw-Municipal	Kalamazoo	Bay City-Clements
10.	Kalamazoo-Municipal	Flint-Bishop	Flint-Bishop

	Flying Clubs	Aviation Schools	Total Gen'l. Aviation
1.	Tri City-Freeland	Flint-Bishop	Detroit City
2.	Pontiac-Municipal	Jackson-Municipal	Lansing-Capitol City
3.	Bay City-Clements	Lansing	Flint-Bishop
4.	Flint-Bishop	Kalamazoo	Grand Rapids-Kent Co.
5.	Lansing-Capitol City	Tri City	Pontiac-Municipal
6.	Detroit City	Gaylord	Freeland-Tri City
7.	Port Huron-St. Clair County	Mackinaw Co.-St. Ignace	Traverse City
8.	Jackson-Municipal	Port Huron	Jackson
9.	Lapeer-Dupont	Saginaw	Bay City-Clements
10.	Romeo	Pontiac	Detroit-Willow Run

Top 10 Airports reported 67% of Total General Aviation Flights in Michigan.

Source: Survey of General Aviation in Michigan, Transportation Institute, The University of Michigan, 1959.

There is no ground for optimism in the indicated increase in emergency fields. On the contrary, the downgrading of fields formerly qualifying for license, and which alone would account for the total increase, denotes a lack of vigorous interest or use in certain local areas. This is confirmed by the relatively low number, only four, of "new" fields added by public agencies during this period; the activity of private groups or individuals is evidence of an underlying faith in general aviation, but their efforts do not insure the permanence of facilities, nor lend themselves to developments in locations best for long-range interests.

Abandonments and New Facilities

By comparing the detailed listing of Licensed and Emergency facilities prepared periodically by the Michigan Department of Aeronautics, it was possible to determine the specific airports and fields which were dropped or added during the ten years, 1949 to 1959. These facilities were located by counties which, in turn, were grouped into the four classifications appearing in the following table:

Location	Abandonments		New Facilities		Change
	Private	Public	Private	Public	
Detroit Metropolitan Counties	-17	0	+4	0	-13
Other Urban Counties (Kent, Genessee, Saginaw, Ingham, etc.)	-10	0	+6	0	-4
Southern Michigan Agricultural Counties	-14	-2	+8	+4	-4
Northern Michigan Recreational Counties	-13	-11	+8	+4	-12
Total	-54	-13	+26	+8	-33

Loss in Airports and Emergency Fields, 1959 to 1959: 33

The relatively large number of abandonments in the Detroit Metropolitan Area Counties reflects the pressure of real estate demands around a major city. In the face of rising property taxes, from which private airport operators gain no relief, and of tempting offers from real estate developers, the private owner usually has little choice but to sell out despite continuing demand for the smaller airport, conveniently located. The fact that no public facilities were abandoned in any urban county confirms the FAA recommendation that conversion to public ownership is the effective way to preserve these valuable aviation facilities near growing population centers.

It should be noted that the newly provided facilities in the urban counties were also privately owned, but were located on the outer fringes of the metropolitan area where land costs had not yet risen substantially. In these same areas, generally, the local public agencies lack the resources to undertake airport development in addition to other public works for which there is widespread popular demand. The major governmental units in the metropolitan area are preoccupied with major airport development (Kent County, for example) and wish at the moment no added responsibilities for smaller airports.

In these metropolitan areas, facilities for general aviation, which must be more widely dispersed than major airports for air commerce, are disappearing and can be replaced only at prohibitive costs and with substantial dislocations. Much as it may be opposed as a trend toward socialism, there is in this situation a positive indication that action at the state and national level is the only practical way in which the smaller airports essential for growth of general aviation can be provided and preserved.

A similar conclusion can be reached from the markedly different situation denoted by the ten-year developments in the rural areas of Michigan. Here, land costs and pressures for other land-uses are generally not decisive influences; personal enthusiasms on the part of individuals or small groups are, as case studies of communities tend to confirm, much more influential. Because initial costs for minimum facilities are relatively low, it is easy to develop a landing strip; once the early enthusiasm dwindles and sustained interest fails to materialize or the original promoters shift to other fields, the older facilities are not maintained and lapse. The number of abandonments and new fields in these areas indicates the temporary character and lack of substance of so many of the smaller rural aviation facilities; yet the establishment of a widespread system of supporting air fields is vital to the realization of the values of general aviation, particularly business flying.

For the simple truth, though difficult to substantiate on a factual basis, is that the smaller rural airports virtually demand a continuing professional support of a public agency, at least regional and probably state-wide in its aviation scope. Only in this way can the inevitable rise and fall of local and personal interests be bridged to provide continuous support and to avoid an everchanging supply of airfields of marginal utility and critical importance.

As earlier indicated, aviation transcends local interest which has, other than in the area of commercial aviation, all too often failed to produce airports and landing fields suitable to general aviation, the more important segment of aeronautical growth in the next ten to fifteen years. In fact, for the benefit of general aviation, the long-standing policy of the Federal government can be challenged because aviation requires a coordinated progress of aircraft, airway, and airport, which cannot be achieved if the major responsibility for the airport rests with the local units of government or with private individuals or groups.

For progress in airport development, the record of the last ten years in Michigan strongly indicates the need for public airport development at the regional or state level, particularly for general aviation airports in both metropolitan and rural areas.

Effect of Distance to Airport

Among the items of information requested from the individual owners of planes covered by the Transportation Institute Survey of General Aviation were the answers to the following two questions: "How much time does it usually take you to get to your plane?" and "If this time were significantly less, or your plane more conveniently based, would you do more flying?" An analysis of the answers yields a rough indication of the effect of airport location upon flight activity.

With respect to the usual travel time between home or office and airport where plane is based, the following tabulation was developed from survey information:

Time Involved	% Total Reporting
0-5 minutes	15.7%
5-10 "	13.7%
10-15 "	15.9%
15-20 "	21.0%
20-25 "	4.6%
25-30 "	15.2%
30+ "	14.9%

It will be noted that practically 71% of all plane owners were located not more than 25 minutes away from their planes under usual conditions of surface travel.

When those in the various time brackets were queries with respect to the effect of this travel time upon their flying activities, the responses were as follows:

Time Involved	% Indicating Significantly More Activity If Nearer
0- 5 minutes	6.8%
5-10 "	12.3%
10-15 "	30.0%
15-20 "	48.9%
20-25 "	73.4%
25-30 "	77.5%
30+ "	84.1+%

Inspection of these figures indicates a sharp break in the time-significance relationship as the time increases beyond 25 minutes. 81% of those located 25 minutes or more from their planes would probably do more flying if they were nearer, in terms of time, to their base; of the large majority who were within 25 minutes, only 27% - one-third the percentage of the more distant group - indicated significantly more flying if closer.

A first reaction to the indicated increase on the part of those not over five minutes from their planes would be that such fliers were unreasonable or unrealistic. Careful review of the replies, however, reveals that the small percentage indicating probable greater use of their planes with more convenient basing were those in rural areas where flight strips on their own property seem more desirable than a public airport. The criteria of desirability seems more likely a matter of cost rather than convenience, and in all probability those within 5 minutes of their planes could not actually achieve greater convenience time-wise.

While it is recognized that the data does not warrant precise interpretation, because such pertinent factors as quality of airport service and character of highway connections could not be discretely developed in the survey, considerable importance can be attached, it is believed, to the 20-25 minute breaking point. Roughly this is equivalent to a surface distance of approximately 15 miles, in suburban and rural traffic.

As a basis, therefore, for estimating the most effective service area of an airport with respect to business and pleasure flying, this study suggests that a ground travel time of 25 minutes, or an approximate surface travel distance of 15 miles, is reasonable. For commercial aviation services which respond to specialized demands, and for instructional flying, these limits are probably indefinite and much less critical.

Airport Construction Industry

Among the activities which make up aviation's contributions to the economy of the State are those devoted to the construction and improvement of airports, along with hangars and other structures. Since most of the contractors engaged in this work are also in highway and general contracting, statistical information was sought from the Michigan Road Builders Association and from the Michigan Chapter of the Associated General Contractors of America, to which the large majority belong.

Data proved unavailable in any form. As explained by C. J. Carroll, Executive Secretary of the Michigan Road Builders Association, airport work, while of great importance to an individual contractor at particular times, is a very small part of their total business and has never seemed to warrant special attention statistically. It may be observed that Michigan's total airport investment is somewhat less than the highway construction volume in a single year.

The only apparent measure of this aspect of aviation economy is that contained in the annual report of the Michigan Department of Aeronautics, and obtained by totaling the various items listed under "Grants for Construction and Improvement of Airports, Landing Fields, and Facilities." While this figure cannot be broken down to show the amounts going to payroll, purchases, engineering, and other accounts, and does not include construction expenditures which are not channeled through the Department, it does indicate an approximate level. For the fiscal year 1957-58, the total grants and other construction monies was $7,929,623; a conservative estimate would be at least $8 million for that year, the latest for which the official report of the Department was available.

Additionally, the U.S. Air Force, largely through the Corps of Engineers to whom most of the military construction is now delegated, is expending large sums of money for the development of SAC bases and Bomarc missile bases within the State. As was the case with other military information, no specific figures could be secured despite direct inquiry to the Strategic Air Command, the Air Defense Command, and the U.S. Corps of Engineers. Such figures as were released were lump-sum totals which could neither be accurately identified with Michigan, nor definitely assigned to a calendar period. Because of the limited significance of such military aviation figures to Michigan planning, it was decided not to pursue this matter through Congressional assistance.

Airport Employment and Payroll

The management, operation, and maintenance of airports in Michigan requires the employment of 636 full-time (and equivalent) persons who received in wages and salaries a total of $3,152,000 in 1958 according to reports received from various airport managers throughout the state. These figures do not include any Federal or State employees engaged in airport engineering, air traffic control, or in supporting services such as weather. Neither do they include any airline personnel nor employees of any concessions which may operate at airports.

On the basis of visits to numerous Michigan airports in connection with the community-impact surveys in 1959, it was concluded that the number of full-time airport employees had remained virtually unchanged, and that payrolls had increased approximately 2% to roughly $3.2 million.

At many of the smaller community airports, there are no full-time employees and even the manager is on a part-time basis. Maintenance, such as mowing of turf on runways, is accomplished with labor and equipment borrowed from highway maintenance units.

At several of the privately-owned airports, operations are largely family affairs in which the airport owner acts as manager and general handy-man, aided by his wife and other part-time help as it may be needed for special services. Only at the airline airports are organizations maintained on any regularly continuing basis; except for the Detroit Metropolitan Area, even the airline airports operate with surprisingly small groups with 6 to 10 employees as typical.

Michigan Department of Aeronautics

As the operator of the Capital City Airport at Lansing, as well as the principal aviation agency of the State of Michigan, the Department of Aeronautics includes not only airport employees but technical and administrative personnel as well.

For the fiscal year, 1958-59, the Department reported 50 equivalent full-time employees who received in salaries and wages a total of $377,000, as reported by L. C. Andrews, Director of Engineering.

This payroll constituted less than 6% (5.8) of the total income of the Department for that 1958-59 fiscal year, and was approximately 43% of the aviation fuel tax receipts assigned by law to aviation purposes.

For that fiscal year, 1958-59, the funds utilized by the Department in airport development and other aviation services to the State were derived as follows from the annual financial statements:

Source		Amount
Aviation Users		
Aviation Fuel Tax -	$880,684.98	
Registration Fees -	23,541.00	
Sales and Rentals -	160,976.00	
		$1,065,201.98
State General Funds		---
Matching Funds from Local Government		2,491,837.00
Federal-Aid to Airports		2,917,141.00
Miscellaneous Revenues		30,252.00
Total - Fiscal Year 1958-59		$6,504,435.98

This amount, which establishes the order of magnitude of the Department's operations, has been exceeded in only one year, 1957-58, when over $4 million in local government contributions (principally from Wayne County for Detroit Metropolitan Airport) boosted the total to just over $8 million. For such volume, it must be remarked that the Department's staff and payroll are extremely conservative and indicate no extravagant "overhead."

Federal Aviation Agency

The air navigation and traffic control services, along with administrative, technical and special activities of the Federal Aviation Agency employed 638 persons in Michigan who received a total of $4,271,000 in salaries and wages during the fiscal year 1958-59, ending June 30, 1959.

No records are maintained on a state-by-state basis and data was secured only after a search of individual records of employees which is maintained at the FAA Regional Office in Kansas City. Through the courtesy of Mr. L. W. Jurden, Regional Administrator, the payroll data was specially compiled for this study; continuing records are not available.

Other Federal employees - Weather Bureau, Post Office, Civil Aeronautics Board and others having aviation duties in the State - are not included in the FAA data. Efforts to secure information as to numbers and payroll of such employees met with no success despite a series of inquiries through official channels. Uniformly, the response was that no records are compiled that would show such a breakdown. While total Federal employees in Michigan are reported, there is no classification which separates those associated with aviation activities.

Employment Summary

On the basis of the foregoing information and qualifications, it is estimated that airport operations in Michigan utilized directly the services of some 1,350 equivalent full-time persons who received in salaries and wages, $8.1 million in the calendar year 1959.

Airport Funds

Using the sources of funds reported by the Michigan Department of Aeronautics in its annual and biennial reports as a guide, and recognizing that this excludes local funds not channeled through the Department as well as private monies, Michigan aviation has received $35.8 million in the twelve-year period ending with fiscal 1959.

This amount is constituted as follows:

Aviation User Taxes and Fees	$ 6,658,000
State General Funds (Appropriations)	4,468,000
Matching Funds from Local Governments	11,796,000
Federal-Aid for Airports	12,541,000
Miscellaneous	334,000
($35.8 million)	$35,795,000

It should be noted that a substantial share of the miscellaneous funds was received from Canada for the maintenance of airports and emergency landing fields in the Upper Peninsula under a long-standing arrangement for the use of certain fields by Canadian planes. Recent information indicates that this procedure has been terminated.

Federal funds, thus, constitute the largest single source and account for 35% of the total. Matching funds from local governments, counties, and municipalities, run just behind Federal-Aid at 33%. The balance is made up of the payments by the aviation users, principally the aviation fuel tax which accounts for 85% of the user contribution, and from legislative appropriations from State general funds. This item, amounting to approximately $4.5 million in the $35.8 million total, has varied over the 12 years from nothing (as in 1958-59) to more than $1 million in 1956-57 when it made up almost 1/3 of the Department's income.

From data summarized in the Statistical Abstract of the United States, 1959, state and local airport monies in Michigan have averaged 54.5% of the total airport support for projects in the FAA program, as contrasted with 45.5% from the Federal Aid Airport Program.

INVESTMENT IN AVIATION FACILITIES

A measure of the economic importance of aviation in Michigan is the total investment in facilities and equipment. As here employed, the term "investment" means the estimated total capital expenditures for: land for airports; surface improvements and construction for runways, taxiways, aprons, and other areas along with drainage facilities, fencing and the like; hangars and other buildings for aviation use but excluding ticket offices and other sales facilities maintained away from airports by the commercial airlines; and navigation and communication facilities used for air traffic control, and other aids to flying.

From physical inventory records maintained by the Michigan Department of Aeronautics, which utilizes the information to publish the individual maps in the Michigan Airport Directory, and with the application of average construction cost figures used by the Department in estimating the 1958-62 Federal Aid program, it proved feasible to develop the following airport investment data:

1.	For 145 public and private airports including value of land, and estimated capital expenditures	$128,684,000
2.	Federal-Aid Program expenditures, 1947-59, including state and local funds but excluding amounts in Item 1	31,247,000
3.	CAA Projects prior to 1947 but not included in Item 1 or 2	7,900,000
4.	State-Local projects, not otherwise included	1,745,000
5.	State-maintained Emergency Landing Fields	893,000

Total Investment, as of fiscal year ending June 30, 1959, for public and private airports receiving Federal-Aid, State and Local monies $170,479,000

It should be noted that more than $97 million of this $170 million is represented by the three major airports in the Detroit Metropolitan Area - Detroit City Airport, Detroit Metropolitan, and Willow Run. At the last named facility, which was built originally as a wartime facility in connection with production of military aircraft, it is impossible to discount, at this late date, those expenditures which were dictated solely by military considerations and which would not have been made for a civilian airport. As a result, the indicated total may be inflated by some unknown amount, but still can be considered representative of actual expenditures.

Additionally, it was determined through the Transportation Institute Survey of General Aviation that privately owned landing strips, plane storage structures or hangars, and other buildings represented, as of January 1, 1959, a total capital expenditure - not included in previous totals - of $14,133,600.

Thus, the estimated total airport investment in Michigan, through the fiscal year ending June 30, 1959 (and neglecting the discrepancy in fiscal-calendar years because of the general aviation data basis) is: approximately $184,613,000.

Navigational Aids

In addition to the airports, an extensive system of communications and navigational aids has been installed in Michigan by the Federal Aviation Agency. Although no published data is available to show the state-by-state totals of such investments, the Office of the FAA Regional Administrator in Kansas City compiled, in response to letter request, the following information as of October, 1959:

VOR/VORTAC	$ 7,882,700
LMF Ranges	900,000
ILS	1,610,000
"H" Facilities	40,000
Radar	2,593,750
ALS and REIL	312,340
Towers and Centers	4,400,000
Total FAA Investment in Facilities	$17,738,690

Aircraft and Equipment

As a part of the Transportation Institute Survey of General Aviation, questions were asked regarding the investment in aircraft and flight equipment, other than ground facilities. Analysis and expansion of the returns indicates the following:

Class	Investment
Business Flying	$18,380,000
Commercial-Industrial	4,945,000
Instructional	1,182,000
Pleasure-Private	5,249,000
Total	$29,756,000

Because of the arbitrary assignment to the various classes, the several categories are only approximate; instructional flying is probably lower than actual if all planes used for instructional purposes could be separated from the "Pleasure" category. In spite of such uncertainties, the general order of magnitude is indicated, and the substantial role of business flying is again verified.

Figures for the investment by scheduled air carriers in aircraft and flight equipment in Michigan are not available. The total would be quite small because virtually no planes are based at any of the State's airports.

Miscellaneous

It is recognized that a variety of other capital expenditures have been made to support the numerous activities of civil aviation, but exhaustive searches have failed to reveal any reliable basis for determining even approximate amounts.

The commercial airlines, as previously noted, maintain, away from airports, sales and customer service facilities. At the airline airports, numerous operations facilities and equipment are in evidence. And at the major airports, such as Detroit Metropolitan, major investments in terminal facilities are currently being committed. As these expenditures grow in volume, an intensive study may be justified; at present, however, it is believed that for the period ending in 1959 that such data would not remarkably increase the total investment figures.

Similarly, the supplemental services for airlines - limousines, buses, trucks for air-cargo, and rent-a-car installations - represent still another stimulant to investments of as yet undetermined amounts. Flight insurance services, both the operation of counters and machines, are another investment. And to complete this picture, that portion of travel agency facilities devoted to the sale of air travel should also be included. Again, at the present stage in planning studies, it was concluded that the increase in investment totals would still be relatively small.

It is to be emphasized, however, that the existence of airports and aviation services stimulates many activities requiring capital expenditures which cannot now even be approximately estimated, but would all serve to increase the importance of aviation to the Michigan economy.

Summary

Combining the various categories of capital expenditures for airports, aircraft and supporting facilities in Michigan reveals that, in 1959, civil aviation in the State represents an investment of more than $232 million, of which $185 million is in airports, $17 million in navigational aids, and $30 million in general aviation aircraft and equipment.

An interesting comparison with national figures can be drawn from data assembled by the Research Department of the Pennsylvania Railroad and presented in August, 1959, to the Sub-committee of the Committee on Armed Services, House of Representatives, U.S. Congress, which was holding hearings on "Adequacy of Transportation Systems in Support of the National Defense Effort in the Event of Mobilization." Using the total figures as reported and comparing to the Michigan data, the following relationships are evident.

Total U.S. Investment in Civil Aviation	$ 6.9 billion
Total Michigan Investment in Civil Aviation	232 million
% Michigan of National	3.4%
Total U.S. Investment in Civil Airports and Air Navigation Facilities	$ 4.55 billion
Total Michigan Investment	202 million
% Michigan of National	4.4%
Total U.S. Investment in General Aviation	$570 million
Total Michigan Investment	43.9 million
% Michigan of National	7.7%
Population Ratio - Michigan to U.S.	4.6%

On the common population-ratio basis of comparison, Michigan's 3.4% of the total investment in civil aviation lags behind and superficially would indicate a significant deficiency. Closer examination reveals that the $1.8 billion investments of the domestic scheduled airlines distorts the national figures for any state-by-state comparison; the concentration of airline investments to those few states in which operating and maintenance headquarters are located makes individual state figures largely meaningless on a total basis.

Much more significant are the comparisons of civil airport investment and general aviation which are free from such distortion. Michigan's 4.4% of airport investment indicates only a slight lag with the population-ratio of 4.6%, while the 7.7% of general aviation indicates definite expansion in this area.

Although lacking in numerous large air-commerce hubs and the sizable airport investments associated with them, Michigan does rank consistently with its population in its capital expenditures for the development and improvement of smaller airports and landing fields.

The superior position of general aviation in this investment comparison is in part to be attributed to the several corporate fleets based in Michigan. This relationship, certainly, should reinforce the impression of the important role of business flying in the Michigan economy.

It is recognized that many compromises have been made in arriving at the average amounts cited in the above comparisons. Yet, it is reassuring to note Michigan's relative positions and the reason for the one apparent deficiency.

AVIATION MANUFACTURING

In addition to those contributions to the economy of Michigan deriving from aviation, both commercial and general, and its supporting activities, the manufacture of aircraft, engines, aircraft parts, and equipment may also be considered a significant factor in the State's industrial economy. Data to establish this significance is, unfortunately, severely limited and out-of-date according to Dr. C. L. Jamison, Professor-Emeritus of Business Policy in the School of Business Administration, who made the special studies in this area.

The most recent, comprehensive, and authoritative statistics are those of the 1954 Census of Manufactures, U.S. Bureau of the Census, in which the following data is cited:

Aircraft and Parts Industry in Michigan

Number of Establishments	123
Employees	25,088
Payroll	$126,596,000
Value Added by Manufacture	$241,186,000

Less comprehensive figures, only slightly more recent, are cited in the U.S. Department of Commerce, County Business Patterns for the first quarter of 1956, under the same heading of Aircraft and Parts Industry in Michigan:

Number of Establishments	114
Employees	16,467
Total Taxable Payroll	$85,056,000

An attempt to utilize the directory of the Michigan Manufacturers Association proved fruitless as a basis for up-dating information because of incomplete coverage and incompatibility of classifications with those of the Census of Manufacturers. Likewise, an appeal to the Detroit Regional Office of the U.S. Department of Commerce indicated no later sources than those quoted.

Another approach to up-dating was tried through one of the principal aircraft equipment manufacturers based in Michigan. Company records, which would show specific employment and payrolls, along with other data indicating the current economic activity attributable to aviation, proved to be assembled in such manner that none of the desired separations could be readily made. A director of another major company engaged in part in aviation manufacturing, advised that similar difficulties would hamper a successful approach in any but the smallest operations, and that such efforts be dropped.

In their recent study of "The Michigan Economy," Haber, McKean and Taylor commented upon the role of aviation manufacturing: "In the fast-growing aircraft and electronics industries, Michigan has made little headway. The aircraft, aircraft engine, and aircraft equipment (not elsewhere classified) industries in the nation altogether employed over 800,000 people in 1954; but Michigan's employment in those industries was less than 20,000.... Our State - a conspicuous producer of military equipment during World War II and during the Korean period - has come to play a minor role in the defense business."

On the basis of their further studies, Haber, McKean, and Taylor concluded: "Although Michigan has not done as well as other areas in aircraft and missile parts industries, their good growth prospects plus the need for accurate machining to close tolerances for many of the parts required by these industries, suggest that Michigan may be able to secure a largerpart of this business than it has in the past, even though most prime contractors for such business are located in the eastern, wester, and south-western parts of the country."

AVIATION-ALLIED ACTIVITIES

The growth of aviation has generated new demands upon many activities already existing and not exclusively oriented to flying. While some specialized aspects have been developed to serve aviation-generated demand, these activities are largely considered independently of aviation and thus offer many difficulties when attempts are made to relate them statistically out of their context.

Among these allied activities which have grown up around Michigan aviation are: ground transportation services to and from airports (bus, limousine, taxi, rent-a-car, trucking, air-express, and air-freight forwarding); travel agencies serving as "off-line" ticket and reservation offices; aviation insurance, both property and liability, and the so-called "travel" insurance covering passengers and personal baggage; and the personal services such as restaurants, newstands, parking, motel, and other concessions at the major airline airports.

Where these services are operated as a part of a larger enterprise with non-aviation interests, such as the area of insurance, it was found that no ready separation of the available business records could be made to identify aviation statistics applicable to the State. Also, the numerous small operations are not centrally represented and would require a series of state-wide surveys.

Because such analyses and surveys proved, after a series of sampling efforts, to be beyond the resource limits of this study, it was decided to rely upon the individual community-airport visits, described in Part II of this report, to indicate the relative economic contributions of these allied services.

One example should serve to indicate the difficulty of drawing state-wide conclusions from the available data. In response to letters to the aviation insurance organizations active in the State, only two replied with data applicable to this study. One indicated that their air travel insurance was largely issued by "insurance machines" and that some $350,000 in Michigan business was accomplished by 6 employees receiving $24,000 in salaries and wages, and with total taxes paid to the State and to local units of only $43.16 for the calendar year 1958. The other reply indicated two full-time employees, a payroll of $7,800 and taxes of $3,885. Obviously explanations would be desirable, but extended efforts through ordinary correspondence have failed to elicit further information.

It is suggested, therefore, that the aviation-allied services are desirable subjects for special research investigations if a comprehensive picture of their economic role in Michigan aviation is to be drawn.

REFERENCES, PART I

Aero Club of Michigan. Michigan Aviation Directory, 1958.

Adler, R.B. and S.J. Fricker. Summary report on the flow of scheduled air traffic. Massachusetts Institute of Technology, Research Laboratory of Electronics, 1951.

Air Transport Association of America. Air Transport Facts and Figures, 19th Edition, 1958.

American Aviation. Air Traveler's Destination Directory, June 1958.

Barnes, Leslie O. What Aviation Means to Our Cities. Given at the Annual Meeting of the "League of Cities of the Third Class in Pennsylvania," Pennsylvania, 1953.

Cherington, Paul W. The Status and Economic Significance of the Airline Equipment Investment Program. A report prepared for E. R. Quesada, President Eisenhower's Special Assistant for Aviation, June 30, 1958.

Civil Aeronautics Administration. Air Commerce Traffic Pattern, Fiscal Year 1958. Washington: Government Printing Office, 1958.

__________. Airline Airports. Washington: Government Printing Office, 1958.

__________. Airline Passengers. Revised. Washington: Government Printing Office, 1951.

__________. Airport Accounting, Budgeting, and Insurance. Washington: Government Printing Office, 1949.

__________. City to Airport Highways. Washington: Government Printing Office, 1953.

__________. International Air Commerce Traffic Pattern: U.S. Flag Carriers, 1957. Washington: Government Printing Office, 1958.

__________. Jet Age Planning. A progress report as of January, 1958. Washington: Government Printing Office, 1958.

__________. National Airport Plan for 1958. Washington: Government Printing Office, 1958.

__________. U.S. Active Civil Aircraft by State and County. Washington: Government Printing Office, 1957.

__________. Upstairs Neighbors. Washington: Government Printing Office, 1957.

__________, Office of Air Traffic Control. Terminal Locations for Planning Purposes. Washington: Government Printing Office, 1957.

__________, Office of Planning and Development. Federal Airways Air Traffic Activity. Washington: Department of Commerce, 1958.

Civil Aeronautics Board. Aeronautical Statutes and Related Material. Washington: Government Printing Office, 1957.

__________. Jet Age Planning. A progress and development report as of July, 1957. Washington: Government Printing Office, 1957.

__________, Office of Carrier Accounts and Statistics. Quarterly report of air carrier financial statistics, March 1958. Washington, Government Printing Office, 1958.

__________. Monthly Report of Air Carrier Traffic Statistics, May 1958. Washington: Government Printing Office, 1958.

Copeland, Lewis C. Travelers and Arkansas Business, 1948 to 1956.

Curtis Publishing Company, Research Department. The Travel Market of the United States. Fourth National Survey, April 1952-March 1953.

Detroit Metropolitan Aviation Authority. Airports for the Detroit Region. September 1948.

Federal Aviation Agency, Airports Division, Bureau of Facilities. National Airport Plan - 1959. Washington: Government Printing Office, 1959.

__________. Small Airports. Washington: Government Printing Office, 1959.

Geuting, Joseph T., Jr. Airports and Community Air Accessibility. Remarks at the Michigan Aviation Legislative Dinner, sponsored by Aero Club of Michigan, Lansing, April 10, 1957.

Haber, William, et al. What's Ahead for Michigan? First chapter of a book: The Michigan Economy: its potentials and its problems. Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.

Harvard University, Graduate School of Business Administration, Division of Research. The Role of Air Freight in Physical Distribution. Boston: The Alpine Press, 1956.

Harvey, A. D'Arcy. Air Traffic Facts. New York: Institute of the Aeronautical Sciences, 1956.

Kalamazoo Chamber of Commerce, Air Service Committee. Exhibits in Support of the Great Lakes Service Case for the City of Kalamazoo, Michigan. 1957.

Lansing, John B. and Ernest Lilienstein. The Travel Market, 1955. University of Michigan, Survey Research Center, 1957.

Lansing, John B. and Jung-Chao Liu. An analysis of interurban air travel. University of Michigan, Research seminar in Quantitative Economics.

Massachusetts, Commonwealth of. Legislative Research Council. Regional airports and aerial approaches. Boston: Wright & Potter, 1958.

Michigan Board of Aeronautics. Michigan Airports. February, 1944.

Michigan Tourist Council (sponsor). Michigan Tourist Survey, 1957.

Midland, Bay City and Saginaw Chambers of Commerce. Great Lakes Local Service Investigation: Exhibits of the Midland, Bay City, and Saginaw Chambers of Commerce. Proceeding before the CAB, 1957.

Ogburn, William Fielding. The Social Effects of Aviation. Boston: The Riverside Press, Cambridge, 1946.

Ohio Aviation Board. Ohio Aviation Laws.

Pennsylvania Aeronautics Commission. Brief of the Pennsylvania Aeronautics Commission before Examiner John A. Cannon, in the matter of the proceeding known as the Northeastern States Area Investigation, Docket 6436. Before the Civil Aeronautics Board, 1958.

__________. The Pennsylvania Aviation Development Plan. Vol. 1: Airports.

Port of New York Authority, Forecast and Analysis Division, Aviation Department. New York's Air Travelers. Connecticut: The Eno Foundation, 1955.

Smith, Hinchman & Grylls, Inc. and Leigh Fisher & Associates. Proposed Northeast Airport. A report to the Detroit Aviation Commission.

Taaffe, Edward James. The Air Passenger Hinterland of Chicago. Dissertation submitted to the Dept. of Geography, for the degree of Ph.D., Chicago. Illinois: The University of Chicago, 1952.

Tyler, Poyntz (Editor). Airways of America. New York: H.W. Wilson Co., 1956.

United Research, Inc. Economic and Air Trade Study and Master Plan Report for Reynolds Municipal Airport. July, 1959.

U.S. Congress, House of Representatives, Sub-committee of the Committee on Armed Forces. Adequacy of Transportation Systems in Support of the National Defense Effort in Event of Mobilization. First Session under Authority of H.Res. 19. October 10, 1959.

U.S. Department of Labor, Office of Program Review and Analysis. Air Transportation. Industry Manpower Survey, No. 79. November, 1956.

University of Michigan, Survey Research Center. The Travel Market, 1956. Published in 1957.

__________. The Travel Market, 1957. Published in 1958.

Virginia State Corporation Commission, Division of Aeronautics. Aviation in Virginia. 1949.

White House, Office of Aviation Facilities Planning, Systems Engineering Team. Modernizing the National System of Aviation Facilities. Washington: Government Printing Office, 1957.

Wisconsin State Aeronautics Commission. A Decade of Progress in Aviation in Wisconsin, 1946-1956. Progress report published and submitted to Walter J. Kohler, Governor, 1956.

__________. Airport Benefits Survey Report, July 1959.

__________. Air Traffic in Northern Wisconsin, June-July, 1956. Submitted to the Civil Aeronautics Administration, 1957.

SUPPLEMENT TO PART I

The Transportation Institute Survey of General Aviation in Michigan.

An important part of this research study of Michigan's Aviation Needs was the assembly of factual and comprehensive data about general aviation in the State. Almost immediately, it became evident that much of the basic information had never been collected in any statistical forms, and was therefore unavailable in the usual sources of economic data. The only feasible way of gaining such essential information was a survey conducted among the owners and operators of civil aircraft, other than the commercial airlines, in Michigan.

Lacking statistical guides for sampling with confidence, it was quickly concluded that the most effective survey would involve a comprehensive questionnaire addressed to all aircraft owners in the State. Since the total number of aircraft was approximately 3,000, such an inclusive survey presented no problem of overwhelming numbers and could yield a manageable number of returns if typical response were to be achieved. With the precedent of a successful "Michigan Aircraft Owners Opinion Poll" conducted by the Aero Club of Michigan and the Michigan Aviation Foundation in 1957, and with the assured cooperation of the Department of Aeronautics, the questionnaire technique was adopted.

Because detailed information was to be sought in regard to several primary areas - the purpose, extent, and frequency of flights; the costs of such flights and expense of upkeep, and the investment in planes, equipment and ground facilities - as well as a number of related items, an extensive questionnaire was required. With the advice of the Survey Research Center of the University of Michigan, intensive study was devoted to the construction of the questionnaire and to the phrasing of the individual questions. After testing and revising to eliminate vagueness and ambiguity in so far as possible, a master list of questions was adopted.

From this master list, four sets of questions were assembled to yield specific data in each of the four broadly recognized categories of general aviation - "Personal, pleasure or private flying"; "Business, corporate or executive flying"; "Commercial or industrial flying" including charter services; and "Instructional flying" or flying schools. Each category required modifications in several questions to them specifically applicable. The final sets as circulated are included as Forms 1 through 4 in this section of the report.

Supplementary Form 1, which was intended for the individual owner, Form 1-C and accompanying instructions, Form 1-D and Form 1-E, were prepared for the so-called "flying clubs." Although the group flying was "pleasure," as in the case of the individual, the number of these groups (142 in 1958) required a specialized and separate questionnaire. The data derived has been classified under the general heading of "private" since their flying meets this definition.

To provide a mailing list, the Department of Aeronautics made available its records of registration of aircraft in Michigan. The registrations were scanned to establish the obvious classifications; where aircraft, for example, were registered in the name of a corporation, they were assigned to "Business Flying." Since the majority of planes were registered by individuals, further refinement of this mailing list was necessary by direct request via a letter of transmittal of Form 1 - the "Private Flying" questionnaire - addressed to all individual aircraft registrants. The recipients were asked to indicate their proper category, if other than "Pleasure," by returning a request for the correct questionnaire. Of the total of 1,678 individual plane owners so contacted, 129 requested other questionnaires, principally in the "Business" category.

Although answers to the questionnaires were to be anonymous, each form was coded to permit follow-up, if necessary, to promote returns and to indicate the geographic coverage of the response. By referring to the code number, the county of origin of each questionnaire was readily determined, while a check with the master list indicated the particular originator when follow-up was necessary. In general, no identification of individual questionnaires was made.

At the time of mailing the questionnaires, in January 1959, various agencies cooperated to give State-wide publicity to the survey and urge prompt return. The Aero Club of Michigan circulated a bulletin calling attention to the survey: the monthly newsletter of the Department of Aeronautics and its publication, "Michiganian" carried an announcement, and the Michigan Association of Airport Managers was advised and requested to have its members urge cooperation in their immediate area. Additionally, through the

News and Information Service of the University of Michigan, a spot radio announcement concerning the survey was prepared and included on the tapes regularly circulated to local radio stations throughout the State; this announcement was broadcast during the week in which the individual questionnaires were mailed, and made reference to the problem of classifying the type of flying done by individuals.

All of these efforts, along with the sustained personal interest of the flying fraternity, account for the very satisfactory percentage of returns. Within the "deadline period" of four weeks following distribution of the questionnaires, 38% of the total mailed out were returned, most of them within the first two weeks. Since the February 24 date, arbitrarily set when the pattern of returns was established, replies continued to come in irregularly with the latest arriving in November 1959, or over eight months after mailing; a gross return of almost 40% was achieved from the total of 2,366 distributed.

Geographically, the returns were well distributed over the State with the exception of the Upper Peninsula. From this area, total replies were only 18% of the questionnaires distributed; while this response was disappointing, and a somewhat unsatisfactory base for expansion of data in the local area, its small proportion (1.4% of the total aircraft in the State) does not significantly affect the State figures developed from the survey data.

From the various categories of General Aviation, the returns from the "Business Flying" and "Commercial" groups were initially low because several of the larger operators failed to respond.

With the cooperation of the Director of the Department of Aeronautics, the major operators which had failed to respond to the mailed questionnaires were induced to furnish data, largely on personal visits by members of the Survey staff. As a result, 38% return from "Business Flying" was achieved.

Of the four general categories, the poorest response came from the "Instructional" group or the form which only 15 replies were received from 96 questionnaires mailed, or a response of 15%. Many of this group are individuals holding instructor's licenses and operating in an informal, part-time basis; as a consequence some of their activities are reported in the "Pleasure" category because only a small portion of their total flight time was indicated as "training." As in the case of "Business Flying" on the part of individuals, no special assignment was made unless the hours of "pleasure" flying were reported as less than 50% of the total flight hours. Thus, the low returns in this group are believed to have little influence on the total figures for Michigan.

Despite all efforts, including those of the Department of Aeronautics, to encourage a larger response from the "Instructional" and "Commercial" groups, particularly the flying services and aircraft sales organizations, replies remained disappointingly low in comparison to other groups. A final response of 18% was recorded and may account for the failure of the expanded totals of the survey to tally precisely with data which could be utilized as a check.

The principal check on the validity of the expansion of the questionnaire returns to 100%, or "total" basis for Michigan was the aircraft registration. Because the mailing list for the survey was based upon the State aircraft registration records from which the number of aircraft could be directly established, it was considered that the most reliable indication of the representative character would be a comparison of the expanded survey data on number of planes indicated with the actual registration. The survey data expanded showed a total of 2,782 aircraft, or 91.4% of the 2,968 registered. Thus, it was concluded that the figures derived from the survey were within 10% of actual totals, and on the conservative, or non-inflationary side; if anything, they indicate slightly less than the probable actual figures.

Much of the discrepancy can undoubtedly be explained by the relatively low response from the "Flying Services," particularly from certain larger operators who are known to maintain relatively large fleets. In part, too, the data reported by the respondents was not necessarily based upon plane ownership at the time of registration almost a year before the survey. Considering both of these influences, the survey data is believed to be reliable and conservative.

Insofar as possible, bias in the development of the state-wide figures was avoided by reporting the answers for each individual question, classified according to the principal groups, and eliminating the "duds" or faulty answers. Expansion to 100% was thus based on a question-by-question analysis rather than a blanket multiplier derived from total mailing and gross returns.

Because these questionnaires covered such a variety of questions, and totals rather than inter-question relationships were particularly desired, no attempt was made with machine tabulation. Further, the need for current information on responses to indicate follow-up activities demanded detailed personal attention. Accordingly, large tabulating forms corresponding to the questions and their arrangement were set up; data was entered by hand as questionnaires were returned; and running totals were maintained.

The results are presented at appropriate points throughout the final report of the Michigan Aviation Needs Study, and are those for which the source, "Transportation Institute Survey of General Aviation in Michigan - 1959" is cited.

Table I

Summary of Response

Classification	Total Questionnaires Mailed	Total Replies	%
Personal			
Individual	1544	604	39%
Clubs	142	54	38%
Business	448	178	40%
Commercial	136	25	18%
Instructional	96	15	15%
Total	2366	876	38%
Rec'd. After Deadline		75	
Overall Total		951	40%

January, 1959

To: Michigan Aircraft Owners

Your personal cooperation is earnestly sought to aid a "Michigan Aviation Needs" study which we are developing for the Michigan Department of Aeronautics.

Despite the volumes of statistics which have been collected, there is very little available and reliable information compiled for general aviation activities in Michigan. So, we are trying to measure the total extent of private flying in the State and gauge its impact upon our economy in order to gain a sound basis for planning.

Specifically, we are asking—through questionnaires directed to the various segments of general aviation in Michigan—your help in estimating accurately your flying activity during 1958, your annual expenditures on your flying, and your total investment in planes and flight gear. In short, how much and when do you fly, where, and what does it cost?

It will eventually be of direct benefit to you to answer the enclosed questionnaire (for individual owner-flyers) and return it to us promptly in the accompanying pre-addressed, postage-paid envelope.

Do not answer this questionnaire if your plane is used exclusively for business purposes, or for flying club activities. In such case, please check your classification below, enter your address at the bottom of this letter, and return it to us. You will then be supplied the proper form.

We realize that this will take some time and thought, but we hope that you will help us with your careful and prompt replies.

Sincerely,

John C. Kohl

John C. Kohl
Director

A. Executive or Corporate Flying____
B. Aviation School____
C. Flying Club____
D. Flying as an essential part of business (i.e., aerial surveys, aircraft demonstration and sales, charter service, crop dusting, etc.)____
E. Other (please specify)____

____

____

Mailing Address: ______________________________

____

____

January 1959

To: Michigan Flying Clubs

Supplementing the questionnaire which has already been distributed to Michigan's Aircraft Owners regarding their flying as individuals, specialized inquiries are now being directed to other segments of general aviation in the State.

As you undoubtedly know, vast volumes of aviation statistics have been collected, but we can find very little available and reliable information which applies to Michigan's general aviation activities. So, we are trying to measure the total extent of flying, including flying clubs in the State, and thus gauge its impact upon our economy to gain a sound base for planning.

We are asking your help in estimating accurately your flying club's activity in 1958, your total investment in planes, and your expenditures for operation. In short, how much and when do you fly, where, and what do you spend?

Your cooperation is earnestly sought to aid this "Michigan Aviation Needs" study which the University is developing for the Michigan Department of Aeronautics. By your careful and prompt reply to this questionnaire, which will take some time and thought, you will assist materially in this effort.

Sincerely,

John C. Kohl

John C. Kohl
Director

JCK:mlf
Enc.

FLYING CLUB QUESTIONNAIRE

I. How much and when did your club members fly in 1958?

1. How many total hours did your members fly in club aircraft during 1958? __________hours

2. Compared to 1957, was this More_____, Less_____, Same_____, and by what percentage? 10%_____, 25%_____, 50%_____, or _____%

3. In 1959, do you expect to fly More_____, Less_____, Same_____, and by what percentage? 10%_____, 25%_____, 50%_____, or _____%

4. On what days of the week does most of your club flying take place (rank in descending order from "1" for most, and "No" for 'No Flying')?
   Sun._____, Mon._____, Tues._____Wed._____, Thurs._____, Fri._____, Sat._____.

5. In what months of 1958 did club flying take place (rank in descending order from "1" for most, "2" for next most, etc., and "No" for 'No Flying')?
   Jan._____, Feb._____, Mar._____, Apr._____, May_____, June_____, July_____, Aug._____, Sept._____, Oct._____, Nov._____, Dec._____.

II. Where did your club members fly in 1958?

1. What points in Michigan (airports or landing strips) other than your home base were visted most frequently in 1958? Indicate the approximate number of visits.

   ____

   ____

   ____

2. How many flights outside Michigan did your aircraft make in 1958? ___

3. What states did you visit most frequently? ____________________

   ____

   ____

4. What approximate percentage of your club flying was on cross-country flights which involved landings at airports other than your base?
   _____%

III. Why did your club fly in 1958?

1. Please indicate below the primary reasons your club members fly?

Gaining flight experience	___	Percent of flying time	___%
Short pleasure "hops"	___	Percent of flying time	___%
Cross-country flights	___	Percent of flying time	___%
Other ______________________			

IV. How much did your club spend on flying in 1958?

1. How much do you estimate was spent, <u>total in 1958</u>, on your club plane(s) and flying? $_________

2. How much gasoline did you buy? $_________; _________gallons

3. How much oil did you buy? $_________; _________quarts

4. How much was spent on:

Other supplies and flight equipment	$_________
Maintenance and repairs	$_________
Aircraft and flight insurance	$_________
State registration fees and other taxes	$_________

5. How much was paid in airport landing fees, transient tie-down charges and similar items? $_________

6. What was paid for plane storage at your home base?

In hangar $_________, or in the open $_________

V. Club activity information

1. What plane(s) does your flying club own and how long has it owned them?

a. Make_________ Model_________ Year_________ Years Owned_________
b. Make_________ Model_________ Year_________ Years Owned_________
c. Make_________ Model_________ Year_________ Years Owned_________

2. How long has your club been established? _________years

3. How many active members did your club have in 1958 _____, 1955 _____, 1950____ ?

4. How many licensed pilots are there in your club? _________

5. How many licensed flight instructors are there in your club? ________

6. What are your club dues? $________per month, or $________per year.

7. Do club members have to pay fees other than dues (i.e., gasoline charges, special assessments, etc.)? Yes____ No____

8. If Yes, what is the approximate total collected from club members per month for such extra charges? $________per month

VI. What is your investment?

1. Do you own____ or rent_____ club quarters?

2. If owned, what is the total estimated investment in club facilities and equipment, other than planes and flight gear? $______________

3. As of end of 1958, how much do you estimate your total investment to be in your club plane and accessory flight equipment? $___________

4. If you own your own landing strip, how much do you estimate to be the total investment in it? $________

VII. Miscellaneous

1. Where is your flying club located?

________________	________________	________________
Name of Airport	City	County

2. Where is your aircraft based?

Airport__________________ or landing strip__________________
Name Location

3. What suggestions or comments can you make for improving airports and aviation in Michigan?

____

____

____

____

Return to:
Transportation Institute
The University of Michigan
Ann Arbor, Michigan

January 1959

TO: Michigan Aviation Schools

Supplementing the questionnaire which has already been distributed to Michigan's Aircraft Owners regarding their flying as individuals, specialized inquiries are now being directed to other segments of general aviation in the State.

As you undoubtedly know, vast volumes of aviation statistics have been collected, but we can find very little available and reliable information which applies to Michigan's general aviation activities. So we are trying to measure the extent of flying in the State by questioning the various individual avaition activities and, by totaling the information thus received, to gauge the impact upon Michigan's economy as a sound base for planning.

We are asking your help in estimating accurately your flying school's activity in 1958, your total investment in planes and your expenditures for operation. In short, how much time do you devote to instruction, both on the ground and in the air, how much and when do you fly, and how much do you spend in providing this aviation training?

Your cooperation is earnestly sought to aid this "Michigan Aviation Needs" study which the University is developing for the Michigan Department of Aeronautics. By your careful and prompt reply to this questionnaire, which will take some time and thought, you will assist materially in this effort.

Sincerely,

John C Kohl

John C. Kohl
Director

MICHIGAN AVIATION NEEDS STUDY

Survey of Aviation Schools January 1959

I. How Much and When Did You Fly in 1958?

1. How many hours were your school aircraft flown in 1958? ____ hours (This figure should be total of all planes.)

2. What percentage of total flying time was devoted to "in-flight" instruction? ____100%, ____75%, ____50%, or ____%

3. Are your training planes used for flying other than that directly involved in flight instruction? ____Yes, ____No

   If "Yes," what percentage of the total hours flown was for such use? ____10%, ____25%, ____50%, or ____%

4. On what days of the week does most of your instruction ("In-flight") occur? (Rank in descending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No flying.') ____Mon., ____Tues., ____Wed., ____Thurs., ____Fri., ____Sat., ____Sun.

5. In what months of 1958 did most of your instruction ("In-flight") take place? (Rank in descending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No flying.') ____Jan., ____Feb., ____Mar., ____Apr., ____May, ____June, ____July, ____Aug., ____Sept., ____Oct., ____Nov., ____Dec.

6. If your planes were used on cross-country training flights, with landings at other airports, please indicate the approximate number of such flights in 1958? ________
   (Number)

7. At what airports did you land? (Indicate the approximate number of landings at each.)

   ____

   ____

   ____

   ____

II. How Much Did Your School Spend on Flying in 1958?

1. How much do you estimate was spent, total in 1958, on your school planes and flying them? $______________

2. How much gasoline did you buy? $______________; _____ gallons

3. How much oil did you buy? $______________; _____ quarts

4. How much was spent on:
   Maintenance and Repairs $______________
   Other Supplies and Flight Equipment $______________
   Aircraft and Flight Insurance $______________
   State Registration Fees and Other Taxes $______________

5. How much was paid in airport landing fees, transient tie-down charges, and similar items? $______________

6. What was paid for plane storage at your home base? In hangar $______________, or in the open $______________

7. Approximately what percentage of the above expenses were incurred for instructional flights? ____100%, ____90%, ____75%, ____50%, or ____%

8. Approximately what was your total payroll (wages and salaries to yourself and to employees of your school) in 1958? $______________

9. Approximately what percentage of your payroll could be charged to instructional activities? ____100%, ____90%, ____75%, ____50%, or ____%

III. Aviation School Activity Information

1. Which of the following is your school licensed for?
   ____Ground School, ____Primary Flying School, ____Commercial Flying School

2. How many hours per week, on the average, is instruction given in your school?
   "In-flight" instruction ____ hours
   Ground instruction ____ hours

3. How many students did your school instruct in:

	1958	1955	1950
Ground	____	____	____
Flight	____	____	____

4. In 1959, do you expect to instruct: ____More, ____Less, ____Same students than in 1958, and by what percentage? ____10%, ____25%, ____50%, or ____%

5. What is your standard instruction fee?

   Ground school; $____________ per hour, or $____________ per lesson

   Flight school; $____________ per hour, or $____________ per lesson

6. What was the total amount paid by your students for aviation instruction during 1958? $______________

IV. Planes and People

1. What plane(s) does your flying school use?

   Make_____________, Model____________, Year______, Years owned______

   Make_____________, Model____________, Year______, Years owned______

   Make_____________, Model____________, Year______, Years owned______

2. How many people are employed by your school? (Indicate the number in each category.)

   _____Manager; _____Full Time, _____Part Time, _____% of time
   _____Instructors; _____Full Time, _____Part Time, _____% of time
   _____Mechanics; _____Full Time, _____Part Time, _____% of time
   _____Others; _____Full Time, _____Part Time, _____% of time

3. What are your affiliations with the aviation school? (Check all that apply.) ____Owner, ____Manager, ____Licensed Flight Instructor, ____Other (please specify)____

V. What Is Your Investment?

1. As of the end of 1958, what do you estimate to be your total investment in your aviation school (including plane, flight equipment, accessories, hangars, etc.)? $______________

2. If you own your own landing strip, what do you estimate to be your total investment in it? $____________

VI. Miscellaneous

1. Where is your school located, and how long has it been established?

_________________________, _________________________; ______years
Airport County

2. Do you offer other aviation services in addition to schooling?
____Yes, ____No. If "Yes," please indicate the type of service.

_____ Air Charter (taxi) Service
_____ Air Cargo Service
_____ Aerial Surveying
_____ Aircraft Sales and Service
_____ Crop Dusting
_____ Other (please specify below)

____

3. What suggestions or comments can you make for improving airports and aviation in Michigan?

____

____

____

____

Return to:

Transportation Institute
The University of Michigan
Ann Arbor, Michigan

February 9, 1959

TO: Michigan Business Aircraft Owners.

Supplementing the questionnaire which has already been distributed to Michigan's Aircraft Owners regarding their flying as individuals, specialized inquiries are now being directed to other segments of general aviation in the State.

As you undoubtedly know, vast volumes of aviation statistics have been collected, but we can find very little available and reliable information which applies to Michigan's general aviation activities. So, we are trying to measure the extent of flying in the State by questioning the various individual aviation activities and, by totaling the information thus received, to gauge the impact upon Michigan's economy as a sound base for planning.

We are asking your help in estimating accurately your company's flying activity in 1958, your total investment in planes and your expenditures for operation. In short, how much and when did you fly, where and why did you fly, and how much did you spend?

Your cooperation is earnestly sought to aid this "Michigan Aviation Needs" study which the University is developing for the Michigan Department of Aeronautics. By your careful and prompt reply to this questionnaire, which will take some time and thought, you will assist materially in this effort.

Sincerely yours,

John C. Kohl

John C. Kohl
Director

MICHIGAN AVIATION NEEDS STUDY

Survey of Michigan Business Flying — February 1959

I. How much and when did you fly in 1958?

1. How many hours was your company aircraft flown in 1958? ________ hours.

2. Compared to 1957, was this More____, Less____, Same____, and by what percentage? 10%____, 25%____, 50%____, or____%.

3. In 1959, do you expect to fly More____, Less____, Same____, and by what percentage? 10%____, 25%____, 50%____, or____%.

4. On what days of the week do you usually fly (rank in decending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No Flying')?
Sun.____, Mon.____, Tues.____, Wed.____, Thurs.____, Fri.____, Sat.____.

5. In what months of 1958 did you fly (rank in descending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No Flying')?
Jan.____, Feb.____, Mar.____, Apr.____, May____, June____, July____, Aug.____, Sept.____, Oct.____, Nov.____, Dec.____.

II. Where did you fly in 1958?

1. What points in Michigan (airports or landing strips) other than your home base did your company aircraft visit on business flights in 1958? If more than once, indicate the approximate number of visits.

____

____

____

2. What states did your company aircraft visit on business flights in 1958? (If more than once, indicate the approximate number of visits.)

____

____

____

3. Approximately what percentage of your total flying hours were devoted to company travel?

________% or ________hrs.

III. How much did you spend on flying in 1958?

1. How much do you estimate that you spent, total in 1958, on your plane and flying it? $__________. (If you claimed income tax deductions for business use in 1958, what were your total deductible expenses? $__________.)

2. How much gasoline did you buy? $__________; __________ gals.

3. How much oil did you buy? $__________; __________ qts.

4. How much did you spend on:

Other supplies and flight equipment	$__________.
Maintenance and repairs	$__________.
Aircraft and flight insurance	$__________.
State registration and other taxes	$__________.

5. How much did you pay in airport landing fees, transient tie-down charges and similar items? $__________.

6. What did you pay for plane storage at your base? In hangar $__________, or in the open $__________. (During 1958 only)

7. How many persons does your company employ in the aviation aspect of your business, and what was the total amount of wages paid to these employees in 1958? (i.e., pilots, mechanics, travel managers, etc.)
__________, $__________.
(Number)

IV. Why did you fly in 1958?

1. What plane(s) do you fly?

Make ________,	Model ________,	Year _____,	Years Owned ________.
" ________,	" ________,	" _____,	" " ________.
" ________,	" ________,	" _____,	" " ________.

2. Please indicate how your plane(s) was primarily used for business travel:

Sales trips	______,	_____%	of flying time.
Professional service	______,	_____%	" " ".
Maintenance and repair service	______,	_____%	" " ".
Executive	______,	_____%	" " ".
Other (please specify)__________	______,	_____%	" " ".

3. Is your plane also used for non-business or personal flying?
Yes________, No________. If "Yes", indicate how plane was used:

Gaining flight experience	______, ______%	of flying time
Short pleasure "hops"	______, ______%	" " "
Vacation trips	______, ______%	" " "
Other	______, ______%	" " "

V. What is your company's investment?

1. As of the end of 1958, what do you estimate your total investment to be in your plane, flight equipment, and accessories? $__________.

2. If you own your own landing strip and/or hangar, how much do you estimate that you have invested? $____________.

VI. Business activity information.

1. What is the approximate average number of flights taken by personnel in your company plane per month? __________.
(Number)

2. Do you use your plane to carry any company materials, products cargo, etc.? Yes____, No____. If "Yes," what is the average total load carried per month? Lbs.________.

3. What arrangements for surface transportation connections do you make at your destinations?
____________________Public vehicles
____________________Company car
____________________Rent-A-Car service
____________________Other__________________(please specify)

VII. Miscellaneous.

1. Where is your business located?

____
(Post Office) (County)

2. Where is your aircraft based? ______________ or ______________.
(Airport) (Landing Field)

3. How much time does it usually take you to get from your office to your plane? ____________________.

4. If this time were significantly less, or your plane more conveniently based, would you do more flying? Yes____, No____, Don't Know____.

5. Do you offer any aviation services? (i.e., air charter, air cargo, etc.) Yes____, No____. If "Yes," please indicate the type of service.

____

6. What suggestions or comments can you make for improving airports and aviation in Michigan, as it relates to executive or company flying?

____

____

Return to:
Transportation Institute
The University of Michigan
Ann Arbor, Michigan

February 9, 1959

TO: Michigan Aviation Service Owner-Operators

Supplementing the questionnaire which has already been distributed to Michigan's Aircraft Owners regarding their flying as individuals, specialized inquiries are now being directed to other segments of general aviation in the State.

As you undoubtedly know, vast volumes of aviation statistics have been collected, but we can find very little available and reliable information which applies to Michigan's general aviation activities. So, we are trying to measure the extent of flying in the State by questioning the various individual aviation activities and, by totaling the information thus received, to gauge the impact upon Michigan's economy as a sound base for planning.

We are asking your help in estimating accurately your aviation service's flying activity in 1958, your total investment in planes and your expenditures for operation. In short, how much and when did you fly, where and why did you fly, and how much did you spend?

Your cooperation is earnestly sought to aid this "Michigan Aviation Needs" study which the University is developing for the Michigan Department of Aeronautics. By your careful and prompt reply to this questionnaire, which will take some time and thought, you will assist materially in this effort.

Sincerely yours,

John C. Kohl

John C. Kohl
Director

MICHIGAN AVIATION NEEDS STUDY

Survey of Michigan Flying Service Activity February 1959

I. How much and when did you fly in 1958?

1. How many hours, total, did you fly in 1958 for business and personal reasons? ________hrs.

2. Approximately what percentage of your total flying hours was devoted to flying service travel? _____% or _____hrs.

3. Compared to 1957, was this More____, Less____, or Same____ and by what percentage? 10%____, 25%____, 50%____, or ____%.

4. In 1959, do you expect to fly More____, Less____, or Same____ and by what percentage? 10%____, 25%____, 50%____, or _____%.

5. On what days of the week do you usually fly? (Rank in descending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No Flying.')
Mon.____, Tues.____, Wed.____, Thurs.____, Fri.____, Sat.____, Sun.____.

6. In what months of 1958 did you fly? (Rank in descending order from "1" for most, "2" for next most, etc.; indicate "No" for 'No Flying'.)
Jan.____, Feb.____, Mar.____, Apr.____, May____, June____, July____, Aug.____, Sept.____, Oct.____, Nov.____, Dec.____.

II. Where did you fly in 1958?

1. What points in Michigan (airports or landing strips) did you visit on business flights in 1958? (If more than once, indicate the approximate number of visits.)

____

____

____

2. What states did you visit on business flights in 1958? (If more than once, indicate the approximate number of visits.)

____

____

____

3. Approximately what percentage of your business flying hours were in cross-country flights? ________% or ________hrs.

III. Why did you fly in 1958?

1. Please indicate how your plane(s) was primarily used for business travel:

Air charter service	______	, ______%	of flying time
Air cargo service	______	, ______%	" " "
Aircraft sales	______	, ______%	" " "
Maintenance and repair service	______	, ______%	" " "
Other ______________________ (please specify)		, ______%	" " "

2. Are your planes also used for non-business or personal flying? Yes_____, No_____. If "Yes," indicate how your plane was used:

Gaining flight experience	______	, ______%	of flying time
Short pleasure "hops"	______	, ______%	" " "
Vacation trips	______	, ______%	" " "
Other ______________________ (please specify)		, ______%	" " "

IV. How much did your flying service spend in 1958?

1. How much do you estimate was spent, <u>total in 1958</u>, on your business planes and flying them? $__________.

2. How much gasoline did you buy? $__________ ; __________gals.

3. How much oil did you buy? $__________ ; __________qts.

4. How much did you spend on:

Other supplies and flight equipment	$______________.
Maintenance and repairs	$______________.
Aircraft and flight insurance	$______________.
State registration and other taxes	$______________.

5. How much did you pay in airport landing fees, transient tie-down charges and similar items? $__________.

6. What did you pay for plane storage at your home base? In hangar $__________, or in the open $__________.

7. What was your total flying service payroll (wages and salaries to yourself and to employees) in 1958? $__________.

V. Planes and people.

1. What plane(s) does your flying service use?

Make ____________, Model ____________, Year _____, Years owned ___.
" ____________, " ____________, " _____, " " ___.
" ____________, " ____________, " _____, " " ___.

2. How many people are employed by your flying service? (Indicate the number in each category.)

____Manager (owner); ___Full time, ____Part time (_____% of time).
____Pilots ; ___ " " , ____ " " (_____% " ").
____Mechanics ; ___ " " , ____ " " (_____% " ").
____Other ; ___ " " , ____ " " (_____% " ").

VI. What is your investment?

1. As of the end of 1958, what do you estimate your total investment to be in your plane, flight equipment, and accessories? $____________.

2. What is your investment in ground facilities?

Land $____________.
Landing strip or runways $____________.
Buildings (hangar or service buildings) $____________.
Or total $____________.

VII. Flying service activity information.

1. If air charter service is offered, what was the number of flights made and passengers carried in:

	1958	1955	1950
Flights	_____	_____	_____
Passengers	_____	_____	_____

2. What was the approximate average length of charter flight taken in: 1958 _________ (miles), in 1955 _________ (miles), and in 1950 _________ (miles)?

3. What arrangements for surface transportation connections do charter passengers usually make at their destinations?
_____Public vehicle, _____Company car, _____Rent-A-Car service,
Other ______________________________ (please specify).

4. If air cargo or express service is offered, approximately what was the total payload carried in: 1958 _________ (pounds), 1955 _________ (pounds), and 1950 _________ (pounds)?

5. Approximately what was the gross income derived from the above services in 1958? $__________.

6. Do you offer any additional aviation services (i.e., aerial surveying, crop dusting, etc.)? Yes____, No____.

   If "Yes," please indicate the type of service.

   ____

   ____

   ____

VIII. Miscellaneous.

1. Where is your flying service located, and how long has it been established?

   _____________________________________; _____years.
   (Post Office) (County)

2. Where is your aircraft based?

   ____________________ or ____________________
   (Airport) (Landing Field)

3. What suggestions or comments can you make for improving airports or aviation in Michigan?

   ____

   ____

   ____

Return to:
Transportation Institute
The University of Michigan
Ann Arbor, Michigan

02821-3-F

THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION INSTITUTE

Final Report

A Background Planning Study of Michigan's Aviation Needs

Part II. A Field Survey of Aviation and Airports in Selected Michigan Communities

JOHN C. KOHL

Under Contract With:

Michigan Department of Aeronautics
Capitol City Airport
Lansing, Michigan

Administered by:

August 1960

THE UNIVERSITY OF MICHIGAN RESEARCH INSTITUTE • ANN ARBOR

65-4137

THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
Department of Civil Engineering
Transportation Institute

Final Report

A BACKGROUND PLANNING STUDY OF MICHIGAN'S AVIATION NEEDS

Part II. A Field Survey of Aviation and Airports in Selected Michigan Communities

John C. Kohl

UMRI Project 02821

under contract with:

MICHIGAN DEPARTMENT OF AERONAUTICS
CAPITOL CITY AIRPORT
LANSING, MICHIGAN

administered by:

THE UNIVERSITY OF MICHIGAN RESEARCH INSTITUTE ANN ARBOR

August 1960

HIGHLIGHTS FROM THE FIELD

Airport at Baldwin is directly responsible for an annual business expenditure of more than $375,000 - over 10% of the total retail sales in the county.

Air travelers account for more than $500,000 annually in Battle Creek hotels.

50% of the car rentals are to airline passengers at Battle Creek; such cars are used one to three days and are driven 50 to 100 miles with a typical bill of $30.

A Battle Creek industry spending $50,000 annually on air travel, both in company planes and commercial airlines, reports that over 99% of all of its out-of-town trips are by air.

Of the seven new industries locating in Coldwater in the past three years, two were definitely attracted by the improved airport which was a deciding factor. Both are users of corporate aircraft.

At Grand Rapids, business and commercial aviation (non-airline) brought in 46,000 passengers in nearly 40,000 itinerant movements in 1958, as compared with 88,000 airline passengers in the same period.

92% of the passengers arriving in business aircraft at Grand Rapids had destinations within five miles of the airport.

88% of all airline passengers at Grand Rapids originate within 25 miles of the airport.

Airline passengers visit Grand Rapids for an average of three-day periods, while non-airline passengers remain less than a day (75% less than four hours).

Airline passengers develop $4800 to $5000 weekly business in Grand Rapids hotels.

Travel agencies gross more than $1 million annually in air ticket sales which account for as much as 65% of their total business.

One industrial concern purchases approximately $30,000 of airline transportation yearly for its personnel and accomplishes 75% of its total travel via commercial airlines.

80% of the car rentals in Grand Rapids are to air travelers, and account for nearly $8000 business weekly.

One of the largest manufacturing companies in Iron Mountain could not continue business in that community without the airport and the nationwide contacts it affords; it practically "lives on planes," according to one of its executives.

A dairy products firm in the Ludington area ships 3000 pounds of cheese weekly by air to New York City to gain a premium price.

At Ludington, 60% of air traffic is for business purposes and 40% for personal reasons, largely weekend commuting from Chicago, Indiana, and Missouri points to summer homes in the area.

At Marquette, in contrast to lower Michigan, it is estimated that 80% of incoming air passengers, both on airline and executive flights, remain one night or longer. About 65% of the airline passengers are on business trips, and the others are traveling for various personal reasons.

Business travel by Marquette area industries is now 75% by air, both company plane and airline, and is increasing. The typical distance by company plane is 500 miles.

Most pleasure flying at Marquette now takes place through the Marquette Area Flying Club with most of the activity on weekends from April to October. "Very little flying" is planned from November through March because of weather conditions.

Two Niles' manufacturing companies average one business flight per day on trips generally extending not more than 300 miles, and one company attributes fully one-third of its volume to business secured through contacts made by its executive aircraft.

At Reed City, traffic is 75% business flights and has increased 500% since Miller Field was paved and lighted.

Tecumseh Airport reports 90% of its traffic as business flights and estimates that such planes bring in 300 visitors per month. The large majority of these visitors leave again on the same day.

The Traverse City Municipal Airport carries an estimated value of $5 million and generates an annual payroll in excess of $600,000, and brings in an estimated $1.1 million of business from the 27,000 air travelers annually.

A month-long check of visiting aircraft at Traverse City revealed that 221 arrivals came from 62 different points of which 37 were in Michigan and 25 in 11 other states. 204 of the 221 flights originated within a 300-mile radius.

At Traverse City, as in most other Michigan communities, it was found that 75% of business travel was by air. About 50% of the business visitors return the same day, while the other 50% remain for one night or longer.

Air freight is playing an increasing role in Traverse City industries. As much as 5% of total shipments are now moving by air (up from 2-3%). One firm reports that use of air freight has permitted a reduction in inventory of certain special items, used in small quantity but critical, from 1½ years to 60 days with a corresponding release of tied-up capital.

Air travelers account for as much as 85% of the local car rental business which yields the Traverse City Airport some $2600 in concession income annually.

By concentrating air travel from Saginaw, Bay City, and Midland at the Tri-City Regional Airport, its traffic ranks fourth (virtually tied for third with Lansing) in the State, and ranks third in commercial air cargo.

80-85% of the total annual movements at Tri-City Airport are itinerant, not including airline movements, and indicate its emphasis on air transportation rather than local flying.

The public attention to commercial air transportation at Tri-City Airport has made difficult the support of the individual municipal airports, particularly in Saginaw, which serve private aircraft largely owned by smaller business firms. 75% of the activity at Clements Airport in Bay City, and "virtually all" of the activity at Saginaw Municipal Airport were claimed to be in connection with local business and commercial interests. At Barstow Airport in Midland, by contrast, 90% of the flights are "local" and for pleasure.

Of the 1700-1800 guests registering weekly in the Tri-City area hotels, 15% are air travelers who stay for two days or less.

Final Notes

In general, it must be remarked that the individual communities visited revealed wide differences in the extent and detail of their records. Some airport activities were recorded in great detail and could support the observations made by local individuals interviewed; other records were found to be casual, inconsistent, and non-existent so that many figures cited above and in the body of the report cannot be verified because they are a matter of opinion. There is great need for enforcement of existing regulations regarding airport records and for establishment of uniform procedures for reporting and compiling them if a body of useful planning data is to be available.

Finally, it must be observed that aviation progress, or the lack of it, in any community seems largely to have depended upon the personal enthusiasm and efforts of some aviation-minded individual in the community. So long as aviation was largely a sport, or pleasure venture, these local enthusiasms served well; now that aviation has become so intimately a part of business transportation, and the local airport a part of a nationwide transportation system, it seems that facility development can no longer be left to local initiative, no matter how desirable that might be philosophically, but must become the responsibility of a more geographically extensive, impersonal organization.

The wide differences in public understanding, interest and support which were found in these community visits underline the need for a comprehensive evaluation of the whole system of airport development in the State, as well as nationally. A conclusion, contrary to existing policy of primary local responsibility for airport development, may well be reached.

John C. Kohl
Project Director

TABLE OF CONTENTS

INTRODUCTION

In the state-wide studies of aviation and the economy of Michigan, it was obvious that there were serious gaps in the available information and that there was no immediate prospect of establishing procedures for the orderly and regular collection of such data. Further, from the state-wide viewpoint, much of the importance of aviation to a local community could not be translated by the layman unaccustomed to statistical analysis. The direct assembly of local data in terms of community activity would, it was felt, do much to offset the anticipated shortcomings of the initial phase of this study described in Part I.

Accordingly, as a supplement to the statistical studies, a series of visits to selected communities in the State were planned to yield a picture of the role of aviation and airports in the local economy. These selections were intended to be typical Michigan communities which would demonstrate the range and variety of impacts of aviation and airports; they were not intended to be statistical samples which could be expanded to state-wide totals.

When available, information was recorded in statistical terms but opinions of community leaders were also recorded. While of questionable value if a truly objective purpose was to be achieved, these opinions are nevertheless highly indicative of the degree of impact; strongly expressed opinion, particularly when repeated by several persons within a community, indicates a strong reaction whether it be favorable or unfavorable, while the mildly expressed or neutral opinion denotes a lack of impact and even apathy toward aviation in the community.

The results, therefore, of this portion of the study must be regarded as qualitative, rather than quantitative. Such data as may be cited is not necessarily consistent and hence should not be combined to give full statistical basis to any conclusions. Their value lies in their abilities to stimulate constructive thinking about aviation and airports in the local community, and to assist in the formulation of policies in other communities and at the state level.

SELECTION PROCESS

In view of the large geographical extent of the State of Michigan with the obvious range and variety of communities, and with regard for the resources of the study, it was tentatively decided that the number of communities to be examined should not exceed 18. Since there were in 1959 some 182 airports and landing fields outside of the Detroit Metropolitan Area, which was excluded from this study by virtue of the independent study being conducted there, the problems of selection of the typical Michigan communities served by aviation loomed large.

To provide a basis for initial selection, airport facilities were first studied. Only those communities having licensed airports within immediate range were considered; even so, approximately 120 possibilities existed outside of the Detroit area. For further support of the "typical" classification suitable to the purposes of aviation planning, these 120 communities were carefully studied with regard to the following factors:

- Airport facilities
- Geographical situation and population
- Economic characteristics
- Ground transportation service
- Special features

Information on airport facilities was compiled from records of the Michigan Department of Aeronautics, from the official Michigan Airport Directory, and from Federal Aviation Agency reports. The physical development of the airport, the number of based aircraft, general aviation operations, and the availability of airline service were all factors included in the consideration.

The geographical situation was largely determined by study of maps. The location of the airport in the state-wide pattern, and the relationship of the community to surrounding communities were given careful consideration. As nearly as possible, every area of the State was to have representation with due regard for the factor of population distribution.

Because the study was made in 1959, just prior to the 1960 Census when 1950 figures were sadly out-of-date, population estimates developed by the Michigan Department of Health were utilized. While some precision was lacking, this was no handicap for the population figures were being employed as broad rather than narrow guides for selection. A range from small to large communities was desired, but no finely drawn lines of size were contemplated.

For the economic characteristics, such as the community-type, (industrial, marketing, institutional, etc.), labor-force, sales, bank deposits, and other indicators, use was made of the Economic Data Sheets prepared on a county and regional basis by Michigan Economic Development Department. The staff members of the Research Division of that department were most helpful in assembling, furnishing, and commenting upon this data and the role of aviation, or lack of it, in particular areas. Additional economic data was drawn from sales tax returns released by the Michigan Department of Revenue.

Ground transportation services were analyzed in terms of carriers, connections, and schedules. For such information, the sources were the various transportation guides: Russell's Official Motor Coach Guide, the National Highway and Airways Carriers'

Directory, the Official Railway Guide; and commercial airlines service was obtained from the Official Airlines Guide.

On the basis of the collected data, a series of trial lists of potential communities were made up. By cross-checking the principal items, the obvious duplications were eliminated, and a single listing of 25 communities was drawn. This list was then reviewed with the planning engineer of the Department of Aeronautics for advice on the airport aspects of each community.

Finally, the 18 communities, as listed in Table I and located on the map in Figure I, were selected for detailed studies by field visits. Their transportation resources are summarized in Table II.

In reality, Bay City, Midland, and Saginaw were, for purposes of this study, considered a regional community centered about the Tri-City Airport at Freeland. This facility, planned to serve these communities, is a unique examples which warranted such consideration; otherwise, visits to these cities could not have been justified consistently with the selection of the other communities in the final listing.

FIELD VISITS

To facilitate the accumulation of the local information in the 18 selected communities, field visits were carefully planned and scheduled during July, August, and September, 1959. In each community, contacts were sought with those individuals believed in the best position to supply aviation information to the interviewers taking part in the survey.

Originally, it had been planned to have the interviews conducted by established field teams of the University's Bureau of Business Research. Unavoidable delays in the authorization of the project, however, created such scheduling problems that it was ultimately necessary to use inexperienced members of the Transportation Institute staff.

As a means of overcoming this lack of experience and keeping interviews within manageable bounds, a series of questions and check lists were worked out with the counsel of the Bureau of Business Research, long-experienced in such community surveys. These initial lists were used by those assigned to the interviews in several trials with Ann Arbor officials; the procedure and results were carefully reviewed to establish standards for the actual field work.

In the Appendix to this part of the final report, the check lists finally adopted are reproduced. Even these, as well as the techniques employed, were refined and modified in the light of experience gained as the interviews were accomplished in a particular community.

It was determined, for example, that the airport manager and the executive secretary of the local chamber of commerce were the key figures in most communities. Accordingly, whenever possible, letters were sent out in advance of the dates of visits to explain the purpose of the survey, to alert the community as to the scope of information desired, and to insure that the proper individuals would be available.

Cooperation, following these letters, was excellent. In some communities, the airport manager arranged to bring the various officials together for a general discussion with the interviewer; in others, a series of appointments was arranged; and in no case was there any refusal to supply information. Interviewers reported, without exception, that their reception was enthusiastic.

Despite this cooperation, it was impossible to gain systematic and factual answers to all of the questions so that any accurate and comprehensive picture of community aviation could be finely drawn. It was the experience of the interviewers in most communities that the factual data required to answer many questions had never been collected, nor had it occurred to the community that it might be of interest or value. In several instances, the interviewer's visit apparently stirred up enough interest that investigations of several questions was undertaken with information subsequently reported by letter.

Immediately following a field visit, the interviewer assembled the notes and other pertinent information gathered during his visit, and prepared a community file. From these files, the summary data has been prepared to form the individual community aviation impact reports which are set forth in alphabetical order for each of the 15 independent airport communities, and the Tri-City regional group of three cities.

Table I

COMMUNITIES SELECTED FOR AVIATION IMPACT STUDIES

Community	County	Location	1959 Population	Economic Charac.	Other Factors
Alma	Gratiot	Central	8,300	Industrial	Home of Alma College
Alpena	Alpena	Northeast	15,000	Industrial	Air Nat'l. Guard Training Camp
Bad Axe	Huron	Thumb	3,000	Agricultural	Also resort area
Baldwin	Lake	West	800	Resort	---
Battle Creek	Calhoun	South	49,000	Balanced	Hdq.U.S. Civil Defense Agency
Bay City*	Bay	East	53,000	Balanced	*Part of Tri-City Zone
Coldwater	Branch	South	8,600	Rural-Balanced	---
Gaylord	Otsego	North Central	2,300	Resort	---
Grand Rapids	Kent	West	350,000	Metrop. Area	---
Iron Mountain	Dickinson	Upper Peninsula	14,000**	Industrial	Also resort area
Ludington	Mason	Lake Michigan	9,500	Industrial	Also resort area
Marquette	Marquette	Upper Peninsula	17,000	Balanced	Northern Michigan College, Marquette Prison
Midland*	Midland	East	27,000	Balanced	*Part of Tri-City Zone
Niles	Berrien	Southwest	13,100	Balanced	Adjoins South Bend, Indiana
Reed City	Osceola	West	2,200	Ind.-Resort	---
Saginaw*	Saginaw	East	97,000	Balanced	*Part of Tri-City Zone
Tecumseh	Lenawee	Southeast	7,000	Rural-Ind.	---
Traverse City	Grand Traverse	Northwest	17,000	Balanced	Summer resort center

*Tri-City Zone includes Bay City, Saginaw, and Midland as served by the Tri-City Airport at Freeland.
**Includes Adjacent Kingsford.

Table II

TRANSPORTATION SERVICES TO THE SELECTED COMMUNITIES

Community	Scheduled Airline	Rail-Pass. Main	Rail-Pass. Branch	On Major Trunkline Highway
Alma	No	No	No	Yes
Alpena	No	No	No	Yes
Bad Axe	No	No	No	No
Baldwin	No	No	Yes	Yes
Battle Creek	Yes	Yes	No	Yes
Bay City*	Yes	No	Yes	Yes
Coldwater	No	No	No	Yes
Gaylord	No	No	Yes	Yes
Grand Rapids	Yes	Yes	No	Yes
Iron Mountain	Yes	No	Yes	Yes
Ludington	No	No	Yes	Yes
Marquette	Yes	No	No	Yes
Midland*	Yes	No	No	Yes
Niles	No	Yes	No	Yes
Reed City	No	No	No	Yes
Saginaw*	Yes	No	Yes	Yes
Tecumseh	No	No	No	No
Traverse City	Yes	No	Yes	Yes

* Part of Tri-City Zone

COMMUNITY REPORTS

In accordance with the procedure just outlined, a large and varied amount of information about local airport and aviation activities was collected in each of the selected communities. The field interviewers prepared individual summary reports of their conversations in which answers to the questions on the various checklists and additional information was recorded.

A number of individuals interviewed were extremely frank in their answers and requested that their names not be revealed. Also, in many cases, specific figures were cited with the requests that precise identification to particular individuals or companies be avoided. To maintain such confidences, then, these community reports have been prepared from the field data without exact references to the sources of information; it was all obtained by interviews within the community unless it is otherwise noted.

These reports are arranged alphabetically by community name rather than by dates of field visits, size of the community or other arbitrary classification. The one exception is the grouping of the communities of Bay City, Midland, and Saginaw under the Tri-City Airport heading, since this airport has a definite regional basis.

Alma (Alma Municipal Airport)

Alma is primarily a rural-industrial community of approximately 8500 population (over 12,000 with adjoining St. Louis, Michigan) and is the principal city, though not the county seat, of Gratiot County. Its major industries are: Leonard Refineries (in the process of merging with Standard Oil of Ohio, though exact status of the merger is uncertain pending litigation), Alma and New Moon Trailer Companies, Michigan Chemical Company, and Roth Industries in the aviation parts field. It is also the home of Alma College, a privately supported liberal arts college with an enrollment of some 800 students and staff.

As the map, Figure 1, shows, Alma is near the center of Michigan's Lower Peninsula, some 50 miles north of Lansing and 40 miles west of Saginaw. It is served by the Ann Arbor, and the Chesapeake and Ohio Railroads, neither offering passenger service; bus service is provided by Greyhound, with direct service to Lansing and the north along U.S. 27, and by the locally-owned Mercury Bus Line connecting to Midland and Saginaw. Several major trucking lines directly serve Alma and St. Louis.

The airport is municipally owned by the City of Alma, and its operation is conducted by the Yellow Cab Company of Alma under a lease agreement. Its principal runway provides a 50 by 2500-foot bituminous surface with additional gravel overrun to a total length of 2700 feet. There are six hangars of varying construction. The field is lighted and is attended from 6 A.M. until midnight. It is licensed by the Michigan Department of Aeronautics as a landing field, and is classed as a secondary airport for general aviation under the former CAA classification.

The airport is not used by the scheduled commercial airlines, neither trunknor local service. The nearest airline services are at Capitol City Airport, Lansing, and Tri-City Airport at Freeland, near Saginaw; both airports are approximately one hour's driving time distant from Alma.

For general aviation, there are a recorded 25 active, based aircraft; only two were reported as multi-engine, while all of the others were single engine, four-place or less. The majority are reportedly owned for business purposes, and the principal activity at the airport is in the so-called "executive flying" category. Some charter and personal flying, but very little instructional activity, is indicated.

Records of airport activity in terms of flights were unavailable. Apparently, no regular effort is made to maintain the register, although the rules and regulations of the Michigan Department of Aeronautics stipulate that all landings and take-offs be currently recorded in such a register at every licensed airport and landing field. Since no landing fees or tie-down charges are imposed upon transient aircraft, there is no particular incentive to keep an accurate record in the absence of any enforcement of the State regulation.

The airport operator does receive rentals for hangar space, and revenues from the sale of aviation fuel, oil and miscellaneous supplies. In addition, the City of Alma contributes a subsidy in the amount of $175 per month.

In return for this subsidy, as well as on its investment in the airport, the City of Alma has no specific measures of benefits received. According to its officials, they have a "busy little airport" but neither the number of visitors nor the amount of money they spend in the community has ever been determined.

The airport is "thought to contribute to the retaining of industry in that local industries are better served by having such a facility available." And the airport is one of the selling points in Alma's industrial development program, although it was commented that they "are aware of no particular industry that has been attracted by the availability of the airport."

Tourist and recreational activities definitely are not a factor in airport activity because Gratiot County is not a resort area and has no attractions which would generate such traffic. This fact largely accounts for the relatively minor traffic in transient pleasure aircraft, and the emphasis on business flying.

Demands for runways longer than 2700 feet as provided by the Alma Municipal Airport have arisen among industrial users, and caused an engineering study of airport requirements in the form of a master plan. These engineering recommendations included plans for another runway of 3500 feet at a total estimated cost of some $350,000 including land acquisitions.

A review of these recommendations by a Citizens Airport Advisory Committee developed serious questions about the advisability of such added expenditures on the present site, and suggested exploration of a county airport authority to develop a modern airport at a more satisfactory location. Further studies are to be made, and it may be hoped that more specific attention to community benefits will be given than anyone has done to date.

In the words of one of the community leaders interviewed: "The present owners of aircraft are fully aware of the need for increased airport facilities in our community. There is a bit of education required to cause the people in general to be in accord." Until more facts than are presently available can be developed, that education will be a frustrating task, because the community at large seems apathetic toward aviation.

Alpena (Phelps-Collins Airport)

Alpena, the principal commercial and industrial community of northeastern Michigan and county seat of Alpena County, is also the center of a growing agricultural area (berries and livestock). On Lake Huron, and convenient to numerous inland lakes and state forest lands, it is in tourist and resort country, though Alpena itself is not considered a resort community but is classified "Industrial."

Its population of more than 15,000 establishes it as the largest community north of Bay City on the Lake Huron side of Michigan. All economic indicators show consistent growth of 15% to 20% since 1946-47, and capital expenditures on industrial facilities support predictions of continuing growth.

Major industries are cement manufacturing, limestone quarrying and processing, concrete machinery, hard bond and paper production, and automotive products. Markets are national and international.

Ground transportation is principally by highway via U.S. 23 - a major state trunkline - along the Lake Huron shore for north-south movements; M-32 extending westward connects Alpena with Gaylord where it meets U.S. 27, now under reconstruction as Interstate Route 75 as a major outlet to the south through central Michigan. More than 200 miles, or four to five hours driving time, from

Michigan's major urban centers, Alpena is somewhat isolated.

Eastern Greyhound Lines provide two daily bus schedules to and from Detroit and Mackinaw City, while Smith Bus Line, locally owned, provides single runs to Gaylord and Indian River. One interstate and one intrastate common carrier truck line provide freight service. Mail, including airmail, is received by truck from Detroit.

The Detroit and Mackinac Railroad provides only carload freight service via its connections at Bay City and Cheboygan. Water transportation for heavy cargo-cement and limestone is a major resource.

Alpena, although included in the air service recommendations of the CAB examiner in the Great Lakes Service Case, has as yet no scheduled commercial airline service. The nearest airline airport is at Pellston, approximately two hours driving time away; Tri-City Airport at Freeland, near Bay City, is roughly three hours distant. Because of these unfavorable ground travel times, Alpena Flying Service operates as an intra-state carrier to transport air passengers to Detroit where trunkline service may be obtained more adequately and conveniently.

The Phelps-Collings Airport, located about eight miles west of Alpena, is owned and operated by the Alpena County Road Commission, though it was constructed by the Corps of Engineers during World War II. Because of its military design and construction, the airport is much more of an installation than would be expected for a community of the size of Alpena. The airport is licensed by the Michigan Department of Aeronautics and bears the

"Intercontinental" service classification by the old CAA on the basis of its 8000-foot and two 5000-foot runways. In 1959, 15 active civil aircraft were based at the fields. Because of its military background and excellent runways, the airport is used as a regional summer training center for the Air National Guard which maintains extensive base facilities along one side of the field.

In support of a brief submitted by the City of Alpena and the Alpena Chamber of Commerce in the Great Lakes Service Case, records of flight activity for the period July 1 to December 31, 1956, were analyzed in detail. During that six-month period, there were 802 landings of civil aircraft of which some 350 were classed as personal pleasure or instructional flights. Since that time, there has been a steady, though not spectacular, increase in landings and take-offs; it is estimated that 90% of incoming transient traffic is made up of business flights.

Only random samples have been recorded of numbers of passengers arriving with these flights; on the basis of such limited observations, the multi-engine business aircraft - which make up at least 40% of the civil traffic - are bringing in around 1600 people per year not including the pilots of the planes who may also be a part of the business group as a business-man pilot. Unfortunately, no locally reliable information could be found as to length of stay or the amount of money spent in the area by these visitors.

Assuming that the average stay is two days per visitor - not an unreasonable estimate considering the national interests of many Alpena industries with general offices in Detroit and more distant cities - and that his expenditure for room, meals and miscellaneous items averages $25 per day (a conservative figure based upon current studies), these air passengers contributed in round numbers $80,000 per year to the Alpena economy.

This sum, it must be emphasized, is a direct cash contribution. In addition, these businessmen involved with Alpena industry contribute vitally to the economic well-being of the companies with whom they are doing business, as employers, salesmen, or customers. Without the airport, and the business flying it makes possible, it was generally observed that Alpena could not long retain several of its industries.

Some of these business flights are related to agricultural interests of the area. During the strawberry season, which occurs as one of the latest of the berry-producing areas, there is increasing use of planes to deliver special shipments so as to insure fresh arrival and a premium price. And, as livestock activity increases, livestock exchange people are flying in, though no statistics have been collected.

Recreationally, there is some evidence of developing traffic on weekends. Last year, according to observations by the airport manager, about six flights per weekend brought in hunters during the season.

One factor contributing to the obvious local interest in the airport is the operation of a flying service by the airport manager. His planes maintain virtually a regular schedule between Alpena and Detroit to connect with the commercial airlines, and to bring in the Detroit newspapers. Additionally, he flies to numerous points on charter operations for Alpena business and industry groups.

A seeming handicap to more rapid increase in the use of the airport by civil aircraft is the presence of the Air National Guard at the field. In the summer months as many as 5000 guard personnel train for two-week periods; their jet operations are believed to deter many visits by civil aircraft whose pilots do not want to become involved with military traffic. Also, differing ideas as to the nature and extent of physical improvements at the airport have led to some undesirable administrative friction between the military command and the county road commission-management of the airport; while the Air National Guard activities contribute a substantial amount to the local economy and undoubtedly add to the community's awareness of aviation, they do present special problems.

And the community seems well aware of its airport and aviation. The interest in obtaining commercial airline service is widespread and the initial recommendations of the CAB Examiner were generally well-received; there is some impatience with the continuing delay in a final decision which would allow airline service. In the meantime, the airport is popular because of its vital role in industrial and business travel.

Bad Axe (Huron County Memorial Airport)

Bad Axe is a city of over 3000 population and is the county seat and principal community of Huron County which forms the northern tip of Michigan's Thumb. The area is predominantly agricultural, although the Lake Huron and Saginaw Bay shorelines provide a recreation-vacation attraction of widespread interest.

Located slightly more than 100 miles directly north of Detroit, Bad Axe is served for freight only by branch lines of the Grand Trunk Western, and the Chesapeake and Ohio Railroads. Greyhound buses provide $3\frac{1}{2}$-hour passenger service to Detroit via State Trunkline M-53, while Indian Trails buses connect with Saginaw and Flint with a $2\frac{1}{2}$-hour running time. Several truck lines also provide surface transportation.

The Huron County Airport is licensed by Michigan Department of Aeronautics and carries a "Secondary" classification under the old CAA schedule. One of its three runways is bituminous-surfaced and lighted; and has an effective length of 2350 feet. The other two runways are turfed and are 2500 and 2000 feet long respectively. Three hangar buildings, one of which includes a shop, and an administrative building have been provided. Fifteen active civil aircraft, including one multi-engine, are based at the field.

Three other air facilities, including a seaplane base, are maintained in the county. The nearest, at Harbor Beach, about twenty miles to the east, is a small private field. Five active aircraft are based at these field, and at "flying-farmer" landing strips in the county.

The airport at Bad Axe is owned by Huron County and is operated by a manager appointed by the Supervisors, but who is also the operator of Huron Flying Service. A part of the manager's salary is paid from County funds, while the balance is derived from aviation services - hangar rentals, sale of fuel and supplies, charter flights, and instruction. Maintenance and snow removal operations are conducted by the Huron County Road Commission which, apparently, is reimbursed for the cost of any services by the County Supervisors from general funds. In 1958, the most recent year for which full information was available, Huron County expended just under $15,000 of which roughly $10,000 was for operations and maintenance and $5,000 for capital improvements.

Such expenditures of public funds, even though modest by modern standards, indicate general interest and support of aviation by the community. While no records are maintained, it was observed that expenditures in the community by visitors arriving by air ranged from $10 to $50 with the principal amount "going" for aviation fuel - sales in 1958 ran over 18,000 gallons as compared with 1,500 in 1957, and 1959 will show a further increase. No estimate of the total amount of money air visitors contribute to the community could be gained.

Traffic at the airport has steadily increased since a change in management from the Huron Aviation Club to the Huron Flying Service was effected in 1958. It is estimated that there were 1000 landings during the year but comparisons are lacking because there has been no continuous or complete record of traffic. Most visits were for one day or less.

Of these flights approximately one-third are on summer week-ends with passengers heading for resorts and cottages in the Port Austin area. This traffic is holding steady, but it is the local feeling that more business and executive planes are using the air-port in connection with many industries in the area. Planes owned by General Motors, Hercules Powder Company, and Wyandotte Chemicals

Company - all nationally known firms - have been frequent visitors. Buyers and salesmen in agricultural fields are also flying in with their own planes. About one landing every week is a military plane.

Locally, the flying service was engaged for approximately 100 passenger flights during the year; these were principally to connect with the scheduled airlines at Detroit, or at Tri-City Airport. Some 25 cargo flights were also chartered, principally to the Detroit airports. And, in the summer months, the flying service provides a daily run from Detroit to Bad Axe, across Saginaw Bay to East Tawas, to deliver the airplane edition of Detroit newspapers to vacationers.

Despite the community support and interest in such services, there is no feeling that Bad Axe should be provided with airline service. Except for the convenience of a few individuals, little would be gained because local business and industry could not support such service; neither the business or vacation activities of the area depend upon the airline type of service.

Up to the present time, the existence of the Huron County airport is believed to have been no serious factor in industrial consideration of Huron County locations. It is rumored, however, that land in the vicinity of the airport has been purchased for an industrial expansion project; at least, some factor influences the price to rise beyond the obvious value of the properties and prevented the economical acquisition for airport purposes.

As in other communities, the lack of even the required records made impossible any specific estimates of the airport impact. Here, there was obvious good feeling that the facility was a benefit, or at least a means of preventing the loss of industry from the area which is inconveniently reached by any other means of transportation. In general, Bad Axe felt that its airport is adequate to its needs and is willing to support it at its present level; anything else, the airport manager is expected to produce as a result of his commercial flights.

Baldwin (Municipal Airport)

The Village of Baldwin, the smallest community visited in this survey, has a population of slightly over 800 and is the largest community as well as the county seat of Lake County. In the Manistee National Forest, the area is predominantly "vacation country" with numerous camps, resorts, and private cottages serving outdoor sportsmen. It is classed as a "resort" or "recreational" community.

Ground transportation is provided by the Chesapeake & Ohio Railways; it offers passenger service to and from Grand Rapids approximately 75 miles to the south; the Saginaw-Ludington branch also serves Baldwin for freight. North Star Bus Lines provide service to Grand Rapids and points north to Traverse City. Interstate and intrastate trucking is provided over Michigan trunklines U.S. 10 east and west, and M-37 north and south.

The nearest airports with commercial air service are at Muskegon and Grand Rapids, at least 1½ hours driving time away. If recommendations of the Great Lakes Service Case materialize, local service could be established at Ludington, approximately

40 miles distant, and at Reed City (20 miles). Baldwin, itself, because of its limited airport facilities has not been seriously considered for air service.

The Baldwin Municipal Airport, owned and operated by the Village, is licensed by the Michigan Department of Aeronautics, and classified by the FAA as a limited-use field. It is provided with three turf runways, the longest being 3100 feet, which are maintained well and serve planes as large as DC-3's under favorable conditions. Navigation aids include UNICOM and a lighting system which can be turned on with sufficient advance notice. There is one hangar in which one of the State's Conservation Department planes has been based. The airport is less than two miles from the center of the village and there is no other airport within 20 miles.

Built originally as a WPA project using Civilian Conservation Corps labor during the depression '30's, the airport has in recent years been improved by the Village. Some $12,000 has been expended in capital improvements, of which $5,000 was from private gifts while the balance represented state and local monies under matching-fund agreements. In 1959, approximately $2,000 was spent on improvements, maintenance, and operations with some $750 in gross revenue from aviation fuel sales and hangar rental.

Management of the airport is vested in a village committee of three men; the airport manager serves as a part-time, volunteer worker without pay. Aviation fuel sales are handled by the local Rotary Club under an arrangement which is seemingly informal and not at all clear. There was general feeling that somewhat greater revenues could be developed, but that expenses for a salaried manager would more than outweigh the increased returns.

Without full-time management, it was not surprising that there was almost a complete lack of statistical information about airport use and aviation in the community. Serious interest in the airport, however, runs unusually high; to supply such data and comments as might be helpful, the airport manager quickly arranged a meeting of the mayor, the probate judge, the president of the Chamber of Commerce, and a resort manager with the University field party. An animated discussion revealed many local attitudes.

All were agreed that the airport was a vital factor in maintaining the economy of Baldwin because of the advantages of accessibility to an otherwise inconveniently located resort area. The following information was cited.

The number of cottages and summer homes in Lake County has more than doubled since the airport was improved. While no direct relationships can be established with airport usage, increasing numbers of families remain at these summer homes with weekend commuting by private plane.

A corporation-owned lodge, maintained by a nationally prominent manufacturing company, is almost entirely serviced by executive aircraft utilizing the Baldwin airport. Some 2500-3000 persons stay at this lodge, for an average of three days each, during the course of the year; virtually all are flown in by company planes which account for an estimated 25% of all traffic at the airport. Executive conferences, sales meetings, and employee-family vacations accounted for an expenditure of at least $375,000 in the community in 1959, or roughly 10% of the total retail sales in the county.

The lodge manager expressed the opinion that, without the airport, his company would not maintain the lodge at Baldwin. Air travel by company-owned planes (business aircraft) not only achieved a saving in transportation costs, but more important, conserved the time of its personnel to such an extent that a convenient airport was considered essential to the location of the lodge.

Unfortunately, beyond such opinions, no statistics are available to document the enthusiastic and energetic interests of Baldwin's community leaders in aviation.

Battle Creek (W. K. Kellogg Field)

Battle Creek is a city of more than 49,000 population and the principal community of Calhoun County with a population of some 138,000 according to preliminary figures of the 1960 Census. Famous as the center for packaging of foods, particularly Kellogg's and Post's cereals, it has a wide variety of manufacturing, commercial, and agricultural activities which establish it as a community of "balanced" economic character. In addition, the national headquarters of the U.S. Office of Civil and Defense Mobilization with over 800 employees is located here.

The community has long been the home of the nationally known Battle Creek Health Center which has offered special diagnostic services and dietary programs. More recently, it has been developing a preventive medicine, or "health service," program for industry.

Transportation facilities are extensive. Passenger and freight service to Chicago and the West, and to Detroit, Lansing, and the East is offered by the New York Central, and Grand Trunk Western Railroads. Served by the new Interstate Highway No. 94, rapidly nearing completion in Michigan, Battle Creek is being provided with a major highway facility to Detroit and Chicago; state trunkline routes provide good connections in all directions; three bus lines - Greyhound, Indian Trails, and Shortway - and 33 truck lines provide highway transportation service.

Air transportation service is provided at Battle Creek by North Central Airlines which connects with other carriers at Detroit and Chicago. Three charter services - Kellog Hangar Service, Battle Creek Flying Services, and Midwest Aviation - are available for freight and passenger movements.

W. K. Kellogg Regional Airfield is a licensed airport of the "Intercontinental" (CAA) classification, capable of handling all but the very largest jet aircraft. Representing an estimated investment of $10,000,000, the field is completely equipped with a modern terminal building and control tower (new 1958), hangars and service buildings, and extensive air navigation and landing aids. Its longest runway is 7000 feet; three others are in the 4800-foot category and all are paved with bituminous or concrete surfaces. Located three miles west of the city, the airport is readily accessible and within 15 minutes travel time from the central business district.

Other airports are located at Marshall, 15 miles, and Kalamazoo, 35 miles. Airline service is also available at Kalamazoo, served by North Central and Lake Central Airlines. The nearest air trunk carrier service is Capital at Lansing, some 60 miles or 75 to 90 minutes travel-time away.

Kellogg Airfield is owned and operated by the City of Battle Creek under the supervision of a full-time, salaried airport manager and staff. Comprehensive, well-kept records are maintained; with the tower, aircraft operations are readily observed and recorded by FAA staff, and the municipal staff records other aviation activities.

According to municipal accounts for the airfield, total operating expenses for fiscal 58 ('59 figures were unavailable at the time) were $116,500, including salaries, maintenance, and operations, and depreciation charges. Income totaled $112,900 in the same period, with principal amount ($88,500) from building rentals, and from a service contract with the Air National Guard which maintains a base. The net operating deficit is made up from the City's general fund, and is considered well worth the expenditure which was less than $3600 - an amount which, it is believed, will shortly be eliminated again by the self-supporting operations of the field.

More than 65,000 landing and take-off operations were reported by the traffic control tower for 1958. About 40% were purely local operations, but the remaining 60%, or nearly 40,000 operations (an average of more than 100 daily) were transient flights. Nearly half of these, or 19,991, were general aviation aircraft which accounted for more than the airline and military totals combined. Two out of every three of these operations was a business flight, and planes from 37 major U.S. corporations were recorded as visitors at the airport.

The three commercial flying services at the airport reported their operations in some detail. Their combined data indicates an investment of $215,000 in planes and equipment, or nearly $22,000 per plane, they employ a total of 19 including 11 pilots (8 part-time) and a total payroll of approximately $45,000 annually, (influenced by the part-time employment factor). Some 3500 hours of flying time was accumulated during the year with April, May, and June as the busiest months, and November through March as the lowest period of activity.

The average length of charter flight from Battle Creek was reported as 180 miles, with Chicago, Detroit, Cleveland, Indianapolis, and Dayton as the most frequent destinations; within the state, Coldwater, Three Rivers, Allegan, Flint, Detroit, and Jackson were the most frequently visited airports. It was commented that the pattern of flights had remained "about the same for five years," with no indications of any changing trend. No record of the total number of passengers was available, although one operation reported about 500 per year; charter freight movement was reported at 20,000 pounds in 1958, which seems insignificant in comparison with the 420,000 pounds reported by the commercial airlines, but nonetheless important.

In connection with air freight movement, however, it must be noted that much of the reported commercial air cargo actually moved into or out of Battle Creek via truck to Chicago or Detroit for loading into planes. The amount of cargo available at any one time, the plane schedule and available capacity all are variables which make precise statements about air freight most difficult. What is important is that the shipper and receiver are satisfied with the speed of the service, not with the total length of flight. Where special service requirements cannot be met by the commercial airlines because of the truck-air combinations, the charter flight, such as here illustrated, provides substantial time-savings.

It is interesting to note that, in spite of the recorded 31.7% increase in air cargo over the previous year, many of the industries interviewed indicated little regular use of air cargo. Except for the florists, who maintain regular arrangements for the movement of cut flowers, only one firm reported a substantial and regularly increasing volume of air shipments; the others claimed the use of air for "emergencies only" because of the expense involved.

Companies owning planes were, not surprisingly, air-minded. One reported that 99% of all out-of-town travel by air for its employees with two company-plane flights and one commercial airline flight per week. Company planes are used because the operations include a chain of 20 units scattered throughout the U.S. at points which cannot be conveniently reached by direct airline connections. Over $50,000 was spent by this concern for flying alone during the past year, yet an official denied that the airport was a major consideration in their plant locations.

Data from one Battle Creek corporation owning and operating aircraft for business purposes was remarkably detailed. Because it seems to fit the fragmentary comments of other corporate aircraft owners, it is reported separately from consolidated figures and information obtained in the state-wide survey. During 1958, a total of 611 flying hours were accumulated at a cost of $81.85 per flying hour for a total expense of just over $50,000; 1959 usage was approximately the same as 1958. 60% of the flying time was for trips in connection with sales; 20% was for "executive" personnel; and the remaining 20% was for customer service including emergency repairs. Chicago was the destination of the largest number of flights, and New York was the most distant point visited; within Michigan, Detroit City Airport, Willow Run, and Pontiac were most frequently visited. Its corporate aircraft activity is considered essential to its successful business operations.

Major Battle Creek industries not owning company planes, reported 75-85% of their out-of-town personnel movements by air with some 25% of their visitors (salesmen and other businessmen) flying in. One company is booking about 50 flights per month while another (with less than 300 employees) is making about 15 flights per month; both reported about a 50% increase in such flights since the opening of the new terminal in 1958.

Several industrial traffic managers comments to the effect that Battle Creek's airport seemed less important because of the excellent railroad and highway facilities. In the absence of such ground transportation, the airport would assume much greater importance in their minds. Even today, though, Kellogg Field is a definite advantage.

Confirming this point of view is the information supplied by the Office of Civil and Defense Mobilization which requisitioned

1568 tickets at a total cost of $136,000 for air travel during the fiscal year 1959. Some 90% of all travel between Battle Creek and Washington, D.C., was by air and a substantial percentage moved by air to other destinations. An analysis of OCDM travel did not, however, justify investment in private planes and pilots assigned to the Agency. The presence of the airport was a deciding factor, along with U.S.-owned buildings, in locating the agency with its 800 employees in Battle Creek.

A check with the principal hotels revealed much more awareness of air travel than had been anticipated, and a number of items of information unobtainable elsewhere were reported. Of the total number of guests registering in the hotels, 10% in the smaller and up to 25% in the larger units arrived by plane; in all, approximately 200 guests per week were air travelers to and from Battle Creek. Their stays ranged from one to three nights and averaged 2½ days with a typical expenditure of $20 per day for room and meals; thus air travelers represented $10,000 a week in hotel business in Battle Creek, more than $500,000 annually.

Motels, where virtually all guests arrive by car, could furnish no useful information. Aside from one establishment near the airport where airline personnel are regularly accommodated, no use of motels by air travelers - commercial airline, or private plane - was indicated.

Another contribution to local activity is the air traveler's use of rental automobiles. While there is no accurate estimate of the total number of rentals, it was reported that approximately 50% are to airline passengers who travel 50 to 100 miles in their one to three days' use of the rented cars. (This period of use corresponds with the typical story at the Battle Creek hotels.) A typical bill for rental is $30, based upon day and mileage rates. Demand from air passengers is heaviest in the winter months when business travel reaches a peak via the commercial airlines.

Another aviation activity which was reported in considerably more detail than usual was that of the Battle Creek Flying Club. Made up of 19 pilot members, and owning two planes of 1947-48 vintage, the club logged 377 hours of flying time during 1958 with about 25% of the time devoted to cross-country flights to points largely within 150-200 miles of Battle Creek. Total expenses amounted to slightly more than $3500, or slightly more than $9 per flying hour which compares closely with the $8.75 figure derived in the statewide survey reported in Part I.

Other specific information was not developed by further questioning. Although business use of the airport is active and growing, no new industry had been attracted to Battle Creek because of the airport facilities. And air travel still has to compete with highways for intrastate trips; many businessmen interviewed indicated a preference for driving to other Michigan metropolitan areas where airports were not conveniently located for their ultimate destination. Generally, it was concluded that the community was aware of its Kellogg Field and was supporting it without any major promotional efforts.

Coldwater (Branch County Memorial Airport)

Coldwater, a community of 12,000, is the county seat of Branch County (population 40,000) in the extreme southern tier of

Michigan counties. The nearest city of larger size is Battle Creek, some 45 miles away; Detroit is more than 100 miles, and Chicago 150 miles via U.S. Highway 112. With such relative isolation, Coldwater presents a diversified and reasonably balanced economy without any single, dominant establishment.

Ground transportation is principally by highway; Greyhound, Indian Trails, Short Way Lines provide bus service, while some 22 truck lines serve the community. Only 15 miles north of the Angola Interchange of the Indiana Turnpike, Coldwater is strategically located for East-West highway movements; with continued improvements of U.S. 27 and 127 as part of the Michigan major highway network, its connections to the rest of the state. Rail transportation for freight only is provided by branch lines of the New York Central System.

No commercial airlines serve Coldwater. The nearest airports are at Battle Creek and Jackson where North Central Airlines provide local service. Trunk air carrier service is available at South Bend, approximately 80 miles, or two hours travel-time distant, or at Detroit about 105 miles and 3½ hours away. A charter service is operated by the airport manager for passenger flights. A freight pickup is operated out of Battle Creek.

The Branch County Memorial Airport, owned and operated by Branch County, represents an investment of $190,000 in land, improvements, and buildings. It is licensed as an airport by the Michigan Department of Aeronautics and is classified by the FAA as a commercial facility for general aviation services usually performed by single-engine aircraft of less than four places.

The longest runway is 3500 feet and is bituminous-surfaced; lighting for night operation is provided but other navigation aids are lacking. Active based aircraft total 26, an increase of 10 in the past three years. There is no other airport in the county, although several farmers utilize their own landing strips.

Since the airport was improved in 1956, seven new industries have located in Coldwater; two of these definitely indicated the airport as a deciding factor in choice of location. Land in the immediate vicinity has increased in value five-fold in contrast to stable price levels for other land in the area.

Sharp contrasts exist in airport activity; during the week, principally on Tuesday, Wednesday, and Thursday, most itinerant flights are business while personal planes make up virtually all of the weekend flights. No accurate records of airport activity were available, but it was estimated that local corporate aircraft averaged two flights per week and a like number of out-of-town business aircraft called at the airport. Most visitors arrive and leave the same day as flights are apparently short.

In the charter service, the most frequent destinations out of Coldwater are Detroit, Chicago, and Battle Creek to make connections with the commercial airlines.

An increasing use of planes locally for agricultural purposes was noted though statistics were not available. Almost all corn in the area was reportedly sown by plane last year, and crop spraying or dusting from the air is much more common. Carrying out the agricultural interest, some $700 was realized from rental of land between runways for planting of low-growing crops.

The airport is under the jurisdiction of a commission appointed by the Branch County Board of Supervisors, and is, as previously noted, managed on a part-time basis by the owner of the local flying service. The commission is trying to widen public support for the airport, but thus far feels that the general public is not aware of the facilities nor of their importance to the community. One member likened the airport to the "railroad depot of earlier years when the town recognized its importance, and many more people should realize that the airport has taken its place."

Gaylord (Otsego County Airport)

Gaylord, a city of 2300 and county seat of Otsego County, is located in the middle of northern Lower Michigan and is primarily a community supported by its recreational environment. The county is the center of a forest management program supervised by the Michigan Department of Conservation and is beginning to revive its earlier activity in the production of wood products, principally lumber and pulpwood. Nevertheless, about 75% of the area is open to public use; with numerous lakes and streams, this public availability emphasizes the recreational potential. It is estimated that summer weekends bring as many as 5000 visitors to the Gaylord area.

Ground transportation includes the New York Central Railroad's line between Detroit and Mackinaw City with freight and limited daily passenger service; during the summer months, this passenger service is augmented on weekends to serve vacation traffic. The predominant transportation, as in most Michigan communities, is highway; with U.S. 27 now being converted to an Interstate highway, Gaylord is provided with excellent road connections north and south. Greyhound and Smith Bus Co. provide bus service, while three commercial carriers supply trucking service.

No scheduled airline serves Gaylord. The nearest commercial airport is at Pellston, 45 miles or 70 minutes to the north where Capital Airlines provides year-round service at a minimum level, and a considerably increase summer service when vacation travel demand is high.

The Otsego County Airport is owned and operated by the County of Otsego under the direction of the Board of Supervisors. It has been improved during 1959 by the provision of a 3500-foot, bituminous-surfaced runway in addition to a 3700-foot turf runway. It is licensed as an airport by the Michigan Department of Aeronautics, and is classified as a "Commercial" facility by FAA. Eleven aircraft are based at the airport, and a Department of Conservation plane is frequently based at the field for extended periods during forest dusting operations.

There are no other airports in the county and the nearest fields are some 28 to 35 miles away at Grayling, East Jordan, and Boyne City. Nine private landing strips in the County, one at Au Sable Ranch Resort; because of uncertain conditions, however, they are not usable much of the time and there are few landings.

Management of the airport is conducted by a part-time manager who also conducts a flying service and gives flight instruction. In return for management services, the airport manager is given the free use of the hangars and field; maintenance operations are conducted by the Otsego County Road Commission and paid for out of county general funds appropriated by the Board of Supervisors.

Financial records are maintained in the County Clerk's office, but no clear picture of expenditures could be derived because the accounts for county parks and the airport are not subdivided. The 1959 improvements, however, were identified as costing $20,600, and the total investment in the airport was estimated on the order of $100,000 including land. Recent acquisitions to protect the airport with the proper clear zone established the value of the land at $100 per acre, or $60,000 for the 600 acres now owned.

Because of the current improvements in the runways which are equipped with lights for 24-hour operation, traffic at the airport has increased substantially but has not had sufficient time to establish a firm trend and indication of a new "normal" level of activity. Extensive records in 1956 indicated 3405 landings during that year with 2160 local flights, and 1245 transient planes of which 875 were single-engine aircraft. The sod runways prevented their use by heavier planes during the winter and spring months; with the paved runway, "airport use by larger planes has definitely increased."

The primary use of the airport is by private planes on pleasure flights. Many northbound planes from Ohio, Illinois, and Indiana stop to refuel because of Gaylord's strategic location, and spend an average of $10 per person for aviation fuel and other services. Much of this transient traffic, which amounted to 125 aircraft in July 1959, arrived on weekends, muchof it at night because of the beacon and well-lighted paved runway. UNICOM provides an adequate communication which is also helpful in bringing these planes in.

Arrival of the larger executive aircraft has been particularly significant since the new runway was put into service. Business flights into Gaylord have already become regular by one company having local interests, and executive flights are now frequent in connection with meetings or vacations at Hidden Valley Resort Club. One major industrial corporation has acquired a resort lodge in the area and brings its planes in on the average of once a week.

Visitors arriving by plane now stay in the area three to four days, mostly for long weekends, and spend \$25 to \$30 per day. Just how many arrive by air and the influence of the airport upon the increase in the Gaylord tourist business has not been established. Since airport improvements were announced, however, the resort industry has demonstrated solid growth; in the last year, all available lake frontage has been sold, and there has been "a big increase" in sale of hunting lands, particularly to industrial companies for hunting lodges. Sales tax collections have increased 23% over 1958, but no definite amount can be ascribed to the airport improvement.

Another factor is the increasing number of "permanent tourists" who have acquired homes in the area, and in their "winterizing" these homes for use in late fall (hunting) and winter (skiing). In the summer months, numerous families stay while the husband flies in from Detroit and other cities for long weekends. No accurate or complete record of such developments has been developed.

A major benefit from the improved airport is expected to be an increase in the winter sports activity. Last year, there were five ski resorts, in addition to Hidden Valley Club, in the Gaylord area and an estimated 50 visitors arrived by plane each weekend when skiing was good. The airport received about 15 phone calls per day inquiring about snow conditions and landing conditions at the field. On a typical winter weekend, six to ten planes were tied down by ski visitors.

In addition, there is interest in weekend charter service with "ski specials" arranged with the airlines. One resort operator, it is understood, has been investigating the potential and estimates that such a service from Detroit alone would bring in a full plane load every weekend; this would mean some $4000 to $5000 in local business each winter weekend when there is normally a sharp drop.

Charter service for passengers is reported as highly seasonal but averages about 10 flights per month to points within 200 miles and an occasional trip to Cleveland. A local manufacturer is shipping about 3500 pounds of air cargo this year, with about 50% to Cleveland, via chartered plane. This service earned $9,000 in gross revenue and required the services of one full-time and one part-time employee.

In addition, 20 students received both ground and flight instruction at the airport during the year. Some seaplane instruction was undertaken on the nearby lakes, but is declining in popularity because of the restricted services available to such planes landing in the state. The principal seaplane interest is on the part of several local residents who own seven planes equipped with floats and travel to cabins in Canada which are accessible only by air.

Local enthusiasm for the airport has been increasing because of the attention aroused by the new pavement. At the dedication ceremonies in August 1959, the airport was visited by a large number of out-of-town planes, including corporate aircraft making "courtesy calls," and the event was featured in the Detroit papers. That publicity is a part of an industrial development program designed to attract new industry; the airport is considered as one of the principal attractions and is expected, locally, to be a key factor in gaining new industry. As yet, its effect cannot be measured.

Grand Rapids (Kent County Airport)

Grand Rapids is the third largest (according to 1960 Census preliminary figures) metropolitan area in Michigan, ranking closely behind Flint, and Detroit. Its area population is on the order of 350,000, of which 250,000 is in the urban areas. As a metropolitan area, its economy shows a number of facets and is difficult to characterize for transportation planning purposes.

Widely known as "The Furniture City," dispersion of furniture manufacturing to other areas and the advent of other types of firms caused the U.S. Department of Labor to state in its Area Manpower Guidebook - 1957 that, "The Grand Rapids are probably has the most diversified industrial economy in Michigan." All but one of the 20 major industry groups designated by the U.S. Department of Commerce are represented in Grand Rapids by manufacturing establishments employing 20 or more people each.

Additionally, it is the wholesale trading center for all of western Michigan and second only to Detroit in number of employees, payroll and sales volume. Retail trade is also a major activity with Grand Rapids ranking third in the state for total retail sales volume. Both wholesale and retail trade activities are major factors in producing transportation demand and a consciousness of transportation service.

With several major hotels, affording almost 1500 rooms in downtown Grand Rapids within walking distance of its Civic Auditorium and Exhibition Hall, the city has achieved prominence as a convention center. In 1957, 162 conventions of regional, state, and national scope attracted 73,000 persons with some 20% coming from outside Michigan.

Historically, all of these economic factors have attracted transportation facilities and services, though Grand Rapids is located on no mainline of any service. Four railroads - Chesapeake & Ohio, Grand Trunk, Pennsylvania, and New York Central - provide freight service and limited passenger service to Detroit and Chicago. Five bus lines, including Greyhound, provide both long distance and intrastate service to the principal cities of Michigan and to Chicago.

As a highway hub, in keeping with its role as a trading center, Grand Rapids is furnished with some eight state trunklines and with two links in the U.S. Interstate highway system. Two major truck lines - Interstate System and Associated Truck Lines - maintain their headquarters and terminals, and are part of the 41 carriers providing highway transportation to the Grand Rapids Metropolitan Area.

Three commercial airlines serve the area through the Kent County Airport. Capital, as a trunkline carrier, connects Grand Rapids with some 76 cities, principally via Detroit to the east and south and via Chicago to the west and southwest; a branch serves a limited number of northern Michigan points. North Central and Lake Central Airlines, both local service carriers, provide connections to north and west across Lake Michigan, and to the south, as well as supplementing Detroit and Chicago services by Capital. Over 30 flights daily are scheduled and an average of 240 passengers per day were enplaned to make Kent County Airport the second busiest commercial airport in Michigan.

As a matter of interest, it is claimed that the Grand Rapids-Detroit air service is one of the oldest, if not actually the oldest, regularly scheduled operation in the U.S.

Air express and cargo services are provided by the scheduled passenger airlines and by Flying Tiger, Ind. which is also certificated to serve Grand Rapids. Most of the time, because loads do not justify a through flight, cargo via Flying Tigers is trucked to and from Chicago; a faster schedule can be achieved than by waiting for a minimum plane load, or diversion of a partially loaded plane enroute elsewhere.

The Kent County Airport is located about four miles from the Grand Rapids central business district, approximately 15 minutes driving time away. With five runways, all surfaced or paved (longest - 5700 feet) is licensed by the Michigan Department of

Aeronautics, and is classified as a "Express" type airport under the old CAA ratings. The field is fully lighted, equipped with extensive navigation aids, and is controlled by a tower maintained and operated by the FAA. It represents an investment of at least $8,000,000 although records, incomplete prior to 1951, do not permit an accurate total.

Some 80 aircraft are based at Kent County airport; 15 are multi-engine, and the majority are owned by industries or by flying services for executive and commercial use. Another 20 active aircraft are registered in the area and are based at four other fields in the county; all are within a radius of 15 miles and, except for Spartan Municipal Airport, are of emergency or limited-use classification, used principally by small personal planes. The Sparta Municipal Airport, with a 2200-foot, "black top" runway and UNICOM facilities, provides facilities for light and medium executive aircraft on the north side of Grand Rapids. Both the number of planes and variety of airports are indications of the air-mindedness of the area.

Because of growing air traffic, especially in the general aviation category, the Kent County Airport Board of Control retained consulting services to advise on airport expansion. The report of this consultant, Leigh Fisher and Associates, together with studies in support of the brief filed with the CAB in August 1958 in behalf of the interested parties in the Great Lakes Service Case, has produced an overwhelming mass of aviation data for the Grand Rapids area.

When the consultant recommended that the County undertake a completely new airport development at Cascade, approximately 10 miles southeast of the city, extensive public interest was developed because of needed favorable rating by the taxpayers of Kent County. The public disoussion of the new airport has probably made the "man in the street" more aware of aviation in the community of Grand Rapids than in any other Michigan community at the present time. The result was a far greater willingness to talk when interviewed by the University field survey, and a far greater number of interviews than in any other community visited.

In 1958, the latest year for which complete figures were available, Kent County Airport handled a total of 87,656 movements, over 35% above the previous year and in the face of a decline or leveling-off generally in air carrier operations. Some 88,000 passengers were enplaned, while another 46,000 passengers arrived in business and charter aircraft in almost 40,000 itinerant movements.

A special staff study by the airport personnel developed origin-destination data for passenger enplaning at the Kent County Airport in December 1957, and again in April 1959. This was supplemented by a review of airline tickets issued by local travel agents. Analysis of this information revealed:

> 56% of total enplaning passengers were bound for destinations within 300 miles, and only 8.0% for points over 1000 miles from Grand Rapids. The 300-600 mile, and 600-1000 mile ranges absorbed roughly 21% and 15% of the total, respectively.

Over 90% of the short-haul passengers originated within Grand Rapids. This indicates that very few passengers will drive more than a few miles for a short haul flight; an exception apparently is Lansing, which also has scheduled airline service, but generates traffic at Grand Rapids because of schedule frequency at the latter point.

Of all passengers enplaning, nearly 57% were destined for only five cities with Chicago as the leading destination. New York, Detroit, Milwaukee, and Cleveland followed; only New York is beyond the short-haul radius of 300 miles. The other 43% were distributed among 138 cities.

A radius of 25 miles around the airport would include all but a minor fraction of the potential airline passengers out of Grand Rapids. 88% originated within 25 miles of the airport.

Correlating ground travel distance with airline haul, the percentage traveling more than 25 miles showed a significant increase for trips of more than 300 miles, and a much lower proportion on the short trips.

The number of passengers arriving in business, charter, and personal planes is approximately equal to the short-haul airline traffic and well exceeds the other distance categories.

92% of these non-airline passengers had local destinations within five miles of the airport.

Other data indicates that the typical airline passenger arriving in Grand Rapids remains in the city for an average of three days, while the stay of non-airline arrival is less than one day. There was no direct estimate of the total amount, or the amount per per day, spent by these visitors.

From the hotels, it was learned that approximately 6% of their weekly guests are considered air travelers, and that their average hotel bill is $18 to $20 per day. Their total contribution to the hotel business had not been estimated, although it could be roughly calculated at $4800 to $5000 per week on the basis of the partially established facts.

Air travel purchased through the local travel agencies in 1958 represented a gross of slightly more than $1 million and made up 55-65% of the total travel bureau business. It supported 13 agency personnel, in addition to airline staff.

Air passengers account for 80% of the total number of rental automobiles in Grand Rapids and contribute a gross of approximately $8000 per week on the basis of 200 rentals.

Industrial users of aviation indicated a wide range of service demands. Certain larger firms with nationwide business contacts, surprisingly, had not yet developed a justification for executive aircraft and depended entirely upon commercial airlines; the extent of use for business travel was widely variable - one firm indicated airline use to New York and driving to most other points, while another estimated that 75% of its total personnel movement, at roughly $30,000, was by air last year. Incoming business visitors, however, were estimated to use airlines or company planes for 95% of the calls, in one case, to "general" in another, and a low is 33% in a third instance. Air express and air cargo were used occasionally for the emergency shipment, but the service was not regarded as sufficiently advantageous for regular use; less than 1% of their traffic was estimated to move by air.

In industries owning aircraft, the attitude toward use of planes was much more positive. Air travel was regarded not merely as a "convenience" but as an essential aspect of the business. One firm, associated with the aviation industry, moves executives and technical personnel in its own planes on flights averaging 250 miles, and utilizes commercial airlines for longer flights when destinations can be directly reached. Parts on "hot" jobs will also be flown in company aircraft. Most of the industries using business aircraft are of small size and engaged in specialties in which skill and prompt service are major factors in success; they seek locations near the airport and at most, within aradius of 10 miles.

Adequate airport and air service are essential factors in Grand Rapids' commercial and industrial growth. While good rail and motor freight service are basic, the airport may be a decisive influence in attracting new industry; in Grand Rapids, the airport was responsible for one favorable location decision on the part of a very large U.S. corporation, and was influential in retaining amother which expanded its operations when airport improvements were committed.

In 1957, a far-reaching policy decision by the Kent County Airport Board in Control, concurred in by the Kent County Board of Supervisors, established landing fees for business and corporate aircraft to assist in the support of the airport and to afford revenues for much-needed improvements. Careful study of all other sources of revenue - rentals of space, concessions, and other services - was also undertaken with a view toward revising schedules to achieve, as nearly as possible, a self-sustaining airport operation exclusive of major capital improvements. It is anticipated that the same policy will be in force at the New Cascades airport when open to use because there have been few unfavorable reactions to date; adjustments are still being made and are not yet sufficiently complete to indicate the precise balance of increased revenues and regular operating expenditures.

The Grand Rapids area is well aware of its airport and is demonstrating its support by voting bond issues for the new facility and accepting the charges for service to permit self-sustaining operations. Emphasis in general seems to be on the commercial airline service, although there is evidence of sustained appreciation of the role of general aviation.

Iron Mountain (Ford Airport)

Iron Mountain, together with the adjoining community of Kingsford, an urban population of some 14,000 to constitute the largest concentration of people in Dickinson County. It is primarily an industrial community with several heavy manufacturing and mining operations, but it is also in the Upper Peninsula woods-and-lake country with numerous recreational attractions; its ski facilities have established it widely as a winter sports center. Iron Mountain is also the county seat of Dickinson County and the trading center for a wide area of northern Wisconsin as well as Michigan.

Ground transportation is supplied by both rail and highway facilities. Rail passenger service exists to Milwaukee and Chicago, while Greyhound buses connect these cities, and with Duluth as well as the Upper Peninsula cities of Menominee, Escanaba, and Marquette. Three common carriers provide trucking service via U.S. highways 2, 8, and 141; overnight schedules are maintained to Milwaukee and Chicago.

Air transportation is supplied by North Central Airlines, a local service airline, which connects the northern Michigan cities of Houghton and Marquette with Green Bay via Iron Mountain. From Green Bay, flights are routed south to Milwaukee and Chicago, west to Minneapolis and east to southern Michigan points with termination at Detroit. Air express, and air cargo when capacity is available, are handled in the passenger planes. Service has provided an average of five flights per day in summer months with some decrease in winter as traffic fluctuates.

August 1959 was cited as a "typical" month for airline activity; records showed a total of 485 passengers departing (enplaning) and 510 arriving, or an average of slightly more than three passengers per departing flight. Traffic in 1959 averaged 13 enplaned passengers daily. 2665 pounds of air express and 5533 pounds of air cargo were handled in and out during the month. Passengers had increased about 25% over the corresponding month of 1958, but express and cargo were approximately the same; yearly totals of passengers show a current average of 13 enplaning daily - a very slight increase over recent years.

The airport was originally built by the Ford Motor Company to serve its Kingsford plant. When that operation was discontinued, the airport was turned over to the Dickinson County Board of Supervisors which, in turn, has assigned the management to Joseph Fontana, owner of Fontana Flying Service. In return for management services, the airport manager receives free use of the field. The airport is licensed by the Michigan Department of Aeronautics and is classified, under old CAA standards, as a "Feeder" airport for local service airlines. It has two paved runways, with maximum length of 3800 feet; it is lighted for after-dark landings and has UNICOM. A total investment of $180,000 was reported.

Other than one emergency landing strip at Ralph, some 35 miles north and east in the backcountry, there is no other landing facility in the area. The nearest airports are at Crystal Falls some 35 miles northwest, and at Escanaba, 40 miles to the east.

Industries in the area are the principal users of the airport, both as patrons of North Central Airlines and of the local flying service, and as operators of their own planes. Nine active aircraft, including several multi-engine, are based at the airport to provide executive and charter flights.

One company engaged in general construction within a 500-mile radius maintains a plane and employs a full-time pilot. He averages about four flights per week, but total expenditure was unreported. Commercial airlines are used only about twice a month when the company plane is not available for the particular trip and airlines will serve the destination conveniently. The investment in aircraft and equipment is estimated at $35,000 to $40,000.

Another company is a branch operation of a national concern which maintains its headquarters in a city some 500 miles distant. It operates several planes, although none are based at Iron Mountain; it estimates, however, that it spends over $10,000 on flying in the Iron Mountain area. Approximately 50% of this company's total personnel travel is by air and averages one flight per week for a typical trip of 500 miles - the distance to headquarters. Other flights are by commercial airlines with an annual expenditure of $5000 for tickets. "A minor but important percentage" of its total in-bound freight is shipped in by air freight (between 8,000 and 10,000 pounds last year) and a definite need is felt for more adequate air cargo service. The airport was not a factor in the location of this activity which is governed by the existence of mineral deposits rather than the adjunct services; if the necessary services do not exist, the company will endeavor to supply them.

Two other companies indicated, however, that their continued activity in Iron Mountain depended heavily upon the airport and availability of airline service. One uses the airlines exclusively for both passenger and cargo movements, while the other also uses charter service, or leased plane and pilot. No specific estimates of travel or expenditures for air travel could be obtained, but one comment was made to the effect at least one person was in the air every day and that "this company lives in the planes." Rush shipments in small amounts are regularly made; when larger amounts are to be shipped, they frequently must be trucked to Milwaukee to gain prompt air movement because plane capacity at Iron Mountain is often too restricted.

In general aviation, the airport averages about 40 movements per day in the summer months and less than half as many during the winter. Roughly 95% of the flights are for business purposes except for weekends when some pleasure flights arrive for fishing, hunting, and skiing. Last winter about two planes per weekend flew in for skiing; Minneapolis and Chicago are the principal points of origin.

About 50% of the planes take on gas; last year, some $16,000 was grossed from the sale of aviation fuel, with the typical plane spending $15.

Interviews with motels and hotels in the area revealed wide differences in opinion on the airport as a generator of business. One attributes 40% of his business to air travelers who rent cars on arrival, remain three to four days, and spend about $15 a day on room and meals at his lodge; another caters to ski parties who arrive by charter plane - 12 groups flew in from points as far distant as Cleveland last winter, and one group of 38 on a charter flight one weekend was "weathered out." At the hotel, 25 to 30 guests per week are air travelers, but a "substantial number of fliers" are patrons of the dining room even though they don't stay in the hotel. No reliable estimates of dollar volume of business generated by the airport were even attempted.

In the car rental field, it was estimated that air travelers, either on North Central or in company planes, rented an average of 18 vehicles per month for an average period of two days and 125 miles each. At typical rates, this amounts to roughly $5500 annually.

An estimate by the Chamber of Commerce indicated that the typical air traveler remained in the area for three days and spent at least $15 per day; on vacation during the summer, this amount was more nearly $36 per day. Unfortunately, no reasonable estimate of numbers of air visitors could be established to provide total amounts contributed to the community.

It was the observation of the survey team that a recent fire in a hangar-shop building had caused considerable damage, and had so involved the airport manager that much less information was divulged than might be available otherwise. Typically, though, very little was a matter of record and could only be supplied by personal contact and conversation.

Ludington (Mason County Airport)

Ludington is an industrial-resort community of some 9500 population on the Lake Michigan shore approximately 50 miles north of Muskegon. It is the county seat of Mason County which has a population of almost 22,000. Branch plants of several major corporations, including Dow Chemical Co. and Harbison-Walker Refractories, and numerous small specialty concerns make up the industrial community while approximately 100 resorts within a 25-mile radius, including inland lakes and Lake Michigan beaches, constitute an appreciable summer vacation attraction.

The community is the interchange point between the Chesapeake & Ohio Railroad's line across Michigan from Port Huron and the Lake Michigan car ferries to Milwaukee and other Wisconsin ports. It is also the interchange for the continuation of U.S. 10 across Lake Michigan via auto ferry to Manitowoc, Wisconsin. It is two miles west of U.S. 31 which provides a north-south highway link along the Lake Michigan shore.

Rail service for freight only is provided by the Chesapeake & Ohio Railway, while Greyhound Lines provide bus service, principally via Muskegon to Grand Rapids. There is no commercial airline service - nearest airport with service is at Muskegon, 50 miles or 60 minutes away.

The airport is owned and operated by Mason County through a committee of its Board of Supervisors, and an airport manager who is paid, in part, by the county. One runway was paved and opened to traffic on June 30, 1959, in the hope that the ability to handle heavier planes would increase traffic as well as support a bid for local airline service; the paved runway is 2500 feet long with a 900-foot turf overrun. It is not yet lighted, but UNICOM is provided. It is licensed by the Michigan Department of Aeronautics, and is rated as a "Commercial" airport for general aviation by the FAA. The estimated investment in the airport is $200,000.

According to FAA records, nine single-engine aircraft are actively based at the Mason County Airport. Two of these are operated by a flying service which provides charter flights and instruction on a part-time basis. Airport activity records are meticulouslymaintained and reveal a slow growth in movements, although the newly-paved runway is expected to stimulate traffic when word of the improvement is spread. No other airport is located within 25 miles.

Airport use has been highly seasonal, despite the business flying, with the peak month in August and 75% of the annual volume occurring in the five months, June through October. In January and February 1959, there were only 35 movements, of which only 17 were cross-country or transient flights. With the paved runway and effective snow removal, it is expected that this seasonal slump will be materially offset. Lack of lights has also been a handicap on short winter days. By contrast, July movements reached a peak of 285 landings and takeoffs.

Most passengers in these private planes arrive for weekends and stay for four days. Typically, these arrivals are visiting their families who are permanent summer residents in the resort areas. On a normal summer weekend, six to ten planes will be tied down. About 40% of the total traffic is estimated as in connection with such vacation use by commuting heads-of-families, chiefly from Illinois, Indiana, and Missouri.

Business trips, which constitute roughly 60% of the transient traffic on cross-country departures of home-based aircraft, are typically one-day visits. Very rarely do these passengers stay overnight. It is anticipated that the paved airport will increase these visits by companies owning heavier planes. Dow, for example, with DC-3's has indicated more regular flights on visits to its Ludington plant. In all of 1959, 78 twin-engine planes landed, while in July 1959, the first month of service for the new runway, 22 such aircraft landed. Most business flights originate in Detroit, Chicago, Grand Rapids, or Lansing.

With the exception of one company which attributes 75% of its business to air travel, local industries regard the airport as a desirable convenience rather than an essential utility. Executive flights do save time, but total transportation costs are about the same as ground transportation combined with commercial airlines when used; one firm indicated a higher cost when capital charges on its investment in planes were included. No charge, it is to be noted, was made for executive time lost in slower travel.

Ludington joined withthe community of Manistee to support a bid for commercial airline service to that area of western Michigan. The two communities indicated their willingness to establish a regional airport, or to cooperate in improvement of one of the existing fields at either community if service were to be authorized. In the Great Lakes Service Case recommendations, Ludington was indicated as a new local-service stop but legal delays seem to postpone indefinitely the actual establishment of such service.

In the meantime, the local travel agency tickets air passengers via Capital Airlines out of Muskegon, the nearest airline stop some 60 minutes or more in driving time away. Most frequent destinations booked are the major outstate hubs - Chicago, New York, and Los Angeles. Detroit receives very little traffic because of ground travel-air haul relationship; if driving an hour or more to Muskegon, the typical traveler feels that he might as well continue to Detroit by car. Service locally would overcome that disadvantage.

Lack of airline service also holds down air freight value. A small amount of emergency shipments are handled by company planes, although no volume figures were available. One dairy products company regularly ships 3000 pounds of cheese weekly to the New York City area and utilizes a truck line from Ludington to Detroit where transfer is made to scheduled air cargo planes; in this way, overnight delivery is maintained. Unless local-service planes could assure space at Ludington, there would be no great advantage in flying it out from the local airport.

A general assessment of the local impact of the airport was that, "the general public is certainly more air-minded today - most people realize the airport is here and take it for granted."

Marquette (Marquette County Airport)

Marquette is the largest city (population 19,000) and the principal center of the Upper Peninsula. As the county seat of Marquette County, home of Northern Michigan College, and the Northern Michigan State Penitentiary, as well as numerous industrial and commercial activities, it is classified as a "Balanced" community. Like other Upper Peninsula areas, it also has some resort traffic. The nearby cities of Negaunee and Ishpeming provide an urban population of 34,000 people in the county.

Transportation for freight is well developed because of the long activity in mining, lumbering, and manufacturing. Four railroads serve the community to provide direct connections to Chicago, and to the west via Duluth and Minneapolis; lake transportation for bulk cargoes is handled through the excellent harbor. Six certificated carriers provide trucking service. Rail passenger service has virtually disappeared from the area, and only limited schedules of intercity bus service are provided by Greyhound. For most transportation, the highways, principally U.S. 41, provide the basic resource.

Air transportation is afforded by North Central Airlines, which maintains schedules south via Green Bay to Lower Michigan, Milwaukee, and Chicago, and east-west between the Soo and Minneapolis. There is no fixed-base operator, and charter services must be arranged out-of-town.

The Marquette County Airport was opened in July 15, 1957, as a brand-new facility replacing the temporary commercial operations at the K. I. Sawyer Air Force Facility at Sands, some 15 miles south of Marquette. The field is licensed as an airport by the Michigan Department of Aeronautics and is classified as an "Air Commerce" airport, "express" class on the basis of its 5000-foot primary runway. Both this runway and a 3000-foot secondary runway are paved, and only the primary runway is lighted. Navigation aids include UNICOM; an instrument landing system has been recommended. Excellent ground transportation to Marquette, Ishpeming, and Negaunee is provided by the four-lane U.S. 41; a paved parking area of 88 cars is proving, however, inadequate.

Aside from the USAF facility at Sands, just mentioned, there are no other airports or emergency fields within 40 miles of the Marquette County Airport. Eleven planes were based at the field; six were single-engine, more than four-place, and one was multi-engine. One light plane was owned by the Marquette Area Flying Club while the majority were business aircraft. Two hangars are available, in addition to a terminal building. Total investment is on the order of $300,000.

The airport is owned by Marquette County and operated by the County Road Commission with the full-time service of a salaried airport manager. Through rentals, landing fees, and sale of fuel and services, it is planned to offset costs of operation and maintenance. Income activities, such as a restaurant, are encouraged at the airport. In 1959, revenues to the airport approached $18,000, and about equaled expenditures for salaries, light, heat, power, and insurance; maintenance has not begun to be a factor because of the recent construction. The policy, nevertheless, is asserted to be one of self-sufficiency as far as possible, with exception of capital improvements.

North Central Airlines maintained an average daily departure schedule of seven flights and enplaned 20 originating passengers daily for a total of just under 7500 in 1959. About 65% of these passengers are on business trips, and 35% for pleasure or other purposes. Marquette generates about 60% of the air carrier traffic, while Ishpeming and Negaunee develop most of the remaining 40%, or roughly in proportion to their populations.

For itinerant flights, however, Marquette accounts for at least 70% of the origin-destinations and reflects the predominant business interest in general aviation. It is estimated that 80% of the incoming air passengers, both on air carrier and executive aircraft, stay one night or longer; this is in contrast to lower Michigan communities where the business aircraft passengers stay for less than one day. The difference is largely due to Marquette's relatively remote location, some 300 air-miles or more from principal business centers such as Detroit and Chicago.

The majority of the industries using the airport are mining and construction companies. Last year, 273 different company planes landed at the airport once or more times. Detailed records of airport activity are being maintained and show that these company planes are transporting one passenger for every two carried in or out of Marquette by North Central Airlines.

Interviews with industries owning business aircraft revealed that approximately 75% of personnel movement is by air and increasing. One company regularly makes three flights per week for a typical 500-mile distance, while the others indicated two to three hours flying per week with most of it in summer months; during bad winter weather, they depend upon the commercial airlines. No percentage of air travel by airlines could be obtained, though it was remarked in two cases that "about six times" per year would cover such flights. All considered the airport a distinct asset but not a critical factor in their business operations.

Aside from the activities of the Marquette Area Flying Club, very little pleasure or sports flying takes place. The flying club indicated some 233 hours of flight time in 1958 and hoped to increase it by at least 25% in 1959; their activities had been curtailed during a major overhaul of their plane which was out-of-service nearly five months. Their most active periods are weekends in October and April, with the summer months all busy. Very little flying is planned for November through March because of weather.

It was estimated that approximately two flights per week come into Marquette for hunting and fishing during the season, and some three to four flights during the winter skiing. Some promotion might build up this traffic, particularly by commercial airlines, it was suggested.

Niles (Jerry Tyler Memorial Airport)

Niles is a community of relatively balanced economic character in the extreme southwestern part of Michigan and in the South Bend, Indiana, area of influence since it is only 10 miles distant. It is a city of some 13,000 surrounded by a rich agricultural area, within a radius of 15 to 25 miles, by several communities of 7000 to 18,000 population in addition to the South Bend Metropolitan Area of 250,000. Niles, therefore, tends to lose its identity as a distinctly separate community because it is neither dominant nor isolated as is the case with the other sample communities in this survey.

From the standpoint of transportation, Niles is strategically located. Six state and U.S. highways join here to provide good roads in all directions, and only five miles to the south is a toll-gate on the Indiana Turnpike. Three buslines, including Greyhound and Indian Trails afford intercity service while 30 highway carriers supply trucking service. On the mainline of the Michigan Central railroad, and convenient to the east-west rail lines at South Bend, ample railroad passenger and freight is maintained.

Although no commercial airlines serve Niles directly, both trunkline and local services are available at South Bend only ten miles away. A flying service at the Tyler Airport supplies charter passenger and freight flights.

The Jerry Tyler Memorial Airport, located only 1.5 miles from the center of the city, is owned by the City of Niles and managed by the operator of Niles Airways, a flight service based at the field. The two runways, one 3200 and the other 3300 feet in length, are paved and lighted; UNICOM is in service. Licensed by the Michigan Department of Aeronautics as an airport, the field bears a recommended FAA classification as an "executive" airport for general aviation, and a former CAA rating as a "feeder" type. An office building and six hangers and shop buildings provide administration, service, and storage facilities. The complete installation represents an investment of some $255,000 of record, and is locally claimed to have a value of $2 million, although this figure could not be verified.

Three other airports are located at distances of 10 to 27 miles; the nearest is at South Bend, as previously noted. Only the South Bend airport has scheduled airline service, but local service has been recommended at Benton Harbor-St. Joseph, 24 miles northwest of Niles, by the examiner's report in the Great Lakes Service Case.

Despite this competition, 25 planes - five of them multi-engine - are based at Tyler Airport. Eight are owned by flying services and the majority of the others are business aircraft. Traffic averages 20 movements a day and is predominantly business and charter, military and pleasure use are negligible. Activity is pretty much year-round and has been showing steady growth since the runways were paved in 1950; except for extreme weather conditions, there is little seasonal fluctuation.

Two of Niles' major manufacturing companies maintain business aircraft and average 30 flights per month out of Tyler airport. Typically, these are one day trips within a radius of 300 miles. No estimate of the amount of expense involved, nor of any savings through such air transportation could be obtained. No industry indicated that the presence of airport was any critical advantage in their operations, but one manufacturer attributed one-third of his sales volume to contacts made by flights from the airport. While the airport was cited as a deciding factor in an early plant location, no new industries have recently been attracted because of other detrimental factors.

Records, particularly financial, of the airports could not be clearly established. The airport manager receives no salary and is compensated from a portion of the hangar rentals which gross some $900 a month; some 48,000 gallons of aviation fuel were sold last year but disposition of the net income could not be established. Apparently, thereis a realignment of airport accounting in process which will clear up these confusions; a request for $2000 from city funds for extra maintenance and improvements prompted the reorganization.

Generally, it was felt that the citizens of Niles are aware of the airport. Some 2000 visited the facility when it was visited by the Dawn Patrol, and over 300 turned out for a breakfast promoting aviation. Nevertheless, it was felt that the community's aviation interests were largely those of business concerned with rapid and convenient air transportation, and an airport close to their plants.

Reed City (Miller Field)

Reed City is an industrial town of 2200 population located in the resort, or vacation, country of west-central Michigan, and is the county seat of Osceola County, population 13,500. It is the headquarters of Miller Industries, aluminum extruders and fabricators, which maintains an international market, and more recently has attracted several small enterprises. The area is also developing oil and gas whichhas brought in exploration and drilling groups.

At the junction of U.S. 10 and 131, Reed City is well supplied with highway service. Three bus lines, including Greyhound, and seven truck lines connect with all points. The Northern Michigan branch of the Pennsylvania Railroad, and the Port Huron-Ludington line of the Chesapeake & Ohio, afford adequate rail freight service.

The airport, Miller Field, was built in 1954 by James T. Miller, president of Miller Industries, as a base for his business aircraft. He has continued to manage and improve the field as an adjunct to his business and has invested approximately $250,000 in aviation facilities including an auditorium building seating 1200.

The runways, one 5000 feet long, are paved and lighted, and the field is equipped with UNICOM. Although licensed by the Michigan Department of Aeronautics, Miller Field is not classified as a public airport by the FAA; yet its standards are the equal of many airports serving cities of 50,000 to 1000,000 population.

Admittedly operated as a hobby by Mr. Miller to serve his personal and business interests in aviation, none of the usual standards of record keeping or public accounting apply. As a result, no comparisons of his expenditures of some $55,000 - over $36,000 in salaries and $10,000 in insurance on pilots, planes and airport - can legitimately be drawn with publicly operated facilities.

Activity at Miller Field is estimated at 200 movements per month with at least 150 involved with business flights. Since airport improvements - paving, lighting and communication - were completed, activities have increased roughly 500% and are generally stable throughout the year. Personal flying builds up movements somewhat on weekends; only bad storms curtail flying temporarily for the field is well-equipped to handle snow and other adverse conditions.

Because of the superior facilities, Miller Field attracts traffic from other airports within a 20-25 mile radius. Planes, too heavy for the turf runways at Baldwin, utilize Reed City on flights bringing business groups to Whirlpool Lodge; similarly, multi-engine planes load traffic for Bid Rapids, 13 miles to the south, at Reed City. Miller Field is the center of operations for a radius of 20 miles.

Industry in this 20-mile area relied upon the airport for its business flying. Sales and service personnel are most frequent passengers, and many small parts - tools, dies, and replacement items - are moved both in and out by air. A complete installation of aluminum extruded parts for a new hotel in Venezuela was shipped as air cargo; it was trucked from Reed City to Detroit and then flown to Caracas - with such service, industries remote from markets are enabled to compete.

Skiing, hunting, and fishing are popular sports in the area and induce some personal flying. The increase in resort or recreational activities in the Reed City area has not produced a noticeable increase in use of airport by personal planes. Those arriving in personal planes have been observed to remain in the area for periods up to one week, and their average expenditure is estimated at only $10 per day. Their total contribution to the community could not be determined.

The economic well-being of Reed City is definitely recognized as being tied in with its airport; its industries depend upon it and would not long remain if it were to be closed. Local residents are continually reminded of the airport because they frequently visit the modern auditorium located in the terminal building; while their visit may have nothing to do with aviation, they are at least exposed to the airport facilities. Such indirect public relations are suggested as a good idea for overcoming public apathy in other communities.

Tecumseh (Tecumseh Airport)

Tecumseh is an industrial community of 7000 population in eastern Lenawee County, and just outside the Southeastern Michigan Metropolitan Area centering on Detroit. Its principal industry, Tecumseh Products, Inc., manufactures refrigeration controls and other devices for a national market and employs some 3,800 persons; other industries, though small, are diversified specialty manufacturing and service organizations.

Because of the excellent highway connections of the area, neither industrial employment nor trade is localized. Within one hour's driving time of both Detroit and Toledo, Tecumseh realizes certain advantages of both urban areas and yet retains the less congested aspect of a rural community. Ground transportation by bus, truck or private car is extensive and more than adequate.

Rail transportation is somewhat limited because Tecumseh is located on a declining branch of the New York Central, and is devoted exclusively to carload freight.

No commercial airlines directly serve Tecumseh, but Willow Run Airport is less than 25 miles distant, Detroit Metropolitan 40 miles, and Toledo Express approximately 35 miles away, to provide a variety of schedules and services all within one hour's driving time. Charter service is available at the Tecumseh Airport.

Tecumseh Airport is privately owned by the Meyers Aircraft Company but is open to public use; it is licensed by the Michigan Department of Aeronautics as an airport and bears a "secondary" classification of the old CAA. It is not included, however, in the current FAA National Airport Plan. It provides a 2600-foot paved and lighted north-south runway, and a 2150-foot turf runway east-west. No communication facilities or navigation aids are installed, and lights are turned on only upon request after 10:00 P.M. Two hangars and shop buildings afford storage and service facilities. The investment is listed as $65,017.25 by Meyers Aircraft Company and operating expenses, exclusive of manager's salary, average about $3500 a year.

In addition to the three airline airports mentioned above, there are some eight other airports and emergency landing fields within a 25-mile radius. Tecumseh Products Co. maintains a private field for use by its own planes, which became too large for Tecumseh Airport. The nearest public airport is the Adrian Municipal Field, some 12 miles southwest of Tecumseh by highway. No shortage of fields exists in the area, though upgrading of facilities is apparently needed to meet the increasing standards of operation.

Sixteen planes were reported as based at Tecumseh Airport, and because of the shortage of hangar space, six Tecumseh plane-owners are currently basing their aircraft at Adrian. Tecumseh Products, as noted, built its own airport when its needs exceeded the facilities at Tecumseh Airport and the private owners were unable to expand the field and buildings.

It is estimated that 90% of the traffic at the airport is made up of business flights. They bring in about 300 passengers per month. Some local flying is generated by two flying clubs, and a flying service which engages in instructional flying. No records of number of flights or flying hours were available.

Tecumseh Products, operating two planes from its own airport, spends $25,000-$30,000 annually on its flying which totals around 1000 hours. Some 20-25 flights per month are made by these planes with destinations usually in Ohio and Wisconsin, but occasionally to any part of the country. Its executives also make three to four commercial flights per month, and would use more airline service if a terminal were more conveniently located. Most of the company travel is by air and is increasing.

Some 15 to 20 business visitors fly in to call at Tecumseh Products and the greatest percentage arrive in executive aircraft, either their own company's or Tecumseh Products'. Those that travel by commercial airline usually travel from the airport to Tecumseh in rented cars but, again, the inconvenience of the airline airports encourages private flights direct to the plant.

Some crop dusting and spraying is done in the area, but planes do not use local airports. Principally, Skyways Dusting out of Brooks Field At Marshall is in evidence.

There is a growing opinion in Tecumseh that the private airport management, because of its inability to finance needed expansion, is holding back industrial development. A modern airport is considered a valuable factor in attracting new industry, and it is claimed that a publicly-owned and operated field would be more attractive than the present, inadequate private operation. Municipal moves to buy or lease Tecumseh Airport and plan for its expansion are seriously encouraged by local businessmen.

Traverse City (Municipal Airport)

Traverse City, with a population of 17,000, is the largest city of northwestern Michigan and the trade and industrial center of a five-county area surrounding Grand Traverse Bay. Lake Michigan, inland lakes and woods create a major vacation-land; Northwester Michigan College and Traverse City State Hospital with its affiliated training facilities constitute a substantial educational and institutional aspect to the community; extensive orchards of cherry trees make the area a leading agricultural producer of fruit. Considering all if its many resources, Traverse City is one of the most diversified communities in Michigan as well as one of balanced economic characteristics.

Located at the base of Grand Traverse Bay, Traverse City is roughly 150 miles north of Grand Rapids, 250 miles northwest of Detroit and 300 miles northeast of Chicago. Thus, its accessibility by various means of transportation is essential to its general prosperity. Many citizens indicated a concern, stemming from one or more of their specialized business interests, for continuing efficiency and economy in transportation facilities; more than in any other community visited was this awareness of the role of transportation expressed.

Several state trunklines, including U.S. 31, serve the area and are gradually being upgraded in accordance with the State Highway Department's program of trunkline improvement. Two bus lines - Greyhound and North Star - along with nine truck lines provide highway common carrier service. The Chesapeake & Ohio Railway offers a minimum daily passenger service, and rail freight service to Grand Rapids.

The Traverse City Municipal Airport is owned and operated by the City of Traverse City under the direction of a full-time airport manager responsible to the City Manager. A U.S. Coast Guard Air Station is maintained at the airport and utilizes its runways. The airport is licensed by the Michigan Department of Aeronautics and is classified by the former CAA standards as an "Express" airport on the basis of its 5000-foot, paved and lighted runways. It is equipped with L/F and VOR radio facilities; two hangars and a terminal building provide storage, service and office facilities (Coast Guard facilities are on U.S. property across the field). The field, improvements, and facilities carry an estimated value of $5,000,000.

Seven planes are based at the Municipal Airport. Four of the planes are owned by flying services, which offer charter and instructional flights, and by local business; the other planes are personally owned for pleasure flying.

Traverse City offers the only paved and lighted airport within 40 miles; the nearest suchfacility is at Cadillac. There are, however, five emergency landing fields and airports within a 25-mile radius; the nearest is Interlochen, about 15 miles south and west. Their use is principally during the summer season by personal planes, in contrast to the year-round commercial airline and business user of the Traverse City Airport.

Capital Airlines, during the summer season, has ten daily flights scheduled with direct service to both Detroit and Chicago, as well as local stops between Grand Rapids and the Soo via

Pellston (Mackinaw). Extra sections are necessary when vacation travel is high, particularly on weekends. Airport records indicate 13,000 inbound airline passengers during 1959, or an average of 36 per day. This average, however, is not realistic because of the seasonal variations.

Civil itinerant flight, totaling some 9000 during the year, brought in another 14,000 passengers. These 27,000 arrivals, according to the results of a study by A. H. Stults on the airport, make up 49,500 visitor-days in Traverse City and an annual expenditure in the community of $1,188,000 for rooms, meals, ground transportation and other purchases. Tracing the taxes generated by these expenditures revealed, in the Stults study, that the Traverse City general fund gained nearly $9,500 and the school district almost $38,000. Without speedy air transportation, it is reasoned that fewer people would have visited Traverse City, and those that did would be able to remain a shorter time with the consequence that such travelers' expenditures would be drastically less. For this reason, the airport is credited with bringing "new money" to the community.

Winter traffic has largely been confined to business travel according to the manager of the Park Place Hotel. Studies of their trade indicate that about 8%, or 1 out of 12, of the guests fly in during the year, but that during the summer season most guests are motor tourists. The return to the hotel because of air travelers could not be estimated.

Business travel in private planes is increasing, but is still thought to constitute a minor part of the traffic. Local businesses making active use of the airport average only one flight every ten days, an activity far lower than recorded at most other airports visited. About 75% of business visitors to local industry fly in - a figure typical of reports in other Michigan communities - either on airline or business planes. About 50% of these remain for one night or more, while the other 50% leave the same day. Generally ground transportation for Traverse City destinations is taxicab, while rented cars are used for out-of-town.

The car rental agencies reported that air travelers accounted for 80-85% of their total business, and that about 105 cars per week are rented for an average 2½-3 days and 100 miles of travel per car. Concession arrangements with the airport yielded about $2,600 to the airport fund in 1958.

Air freight is playing an increasing role in the operations of several firms; one firm producing a specialty product indicated 5% of its total shipments are now moving by air express and air freight (selection is made on basis of comparable time schedule to particular destination and lowest cost). By judicious use of air transportation, this firm has been able to reduce inventories on certain items from 1½ years to 60 days. Direct flights and a minimum of transfers are also prime considerations.

Local travel agency figures reveal that over 6,000 tickets were sold for airline trips last year, and developed a gross of more than $47,000 in 1958. About 50% of the total business is represented in airline tickets. It is claimed that this aspect of air travel is not highly seasonal; Chicago is the leading destination with Detroit second, but a "substantial number" are booked to more distant points.

It is this travel to destinations beyond Chicago and Detroit that has led local opposition to the proposed transfer of airline service from Capital - a trunkline carrier serving directly the principal cities of eastern and southern U.S. - to North Central or Lake Central which are local service carriers terminating at the nearest major hubs. Recommendations of the CAB in the Great Lakes Service Case, and more recently in Capital merger negotiations do not support Traverse City claims.

Another study by A. H. Stults, the airport manager, bears out the claims of extensive ties of Traverse City interests. An origin check on the 221 civil itinerant aircraft landing at the Municipal Airport during October 1958 indicated 62 different points from which the flights originated; of these, 37 were in Michigan and 25 in 11 other states, as far as Texas. Of the total, 33 flights crossed Lake Michigan - an obvious barrier and delay to ground transportation - and 201 originated from points 150 miles or more from Traverse City; 204, however, were within 300 miles to bear out other data which indicates that typical limit on general aviation trips.

Several of those interviewed expressed the opinion that the typical local citizen is little aware of the impact of the airport on the community and, when he thinks of it at all, is likely to regard it as a tax burden. Management of the airport, as a matter of city policy, is directed to make the airport operations, exclusive of major capital improvements, as nearly self-sustaining as possible; earned revenues in 1957 and 1958 exceeded expenditures on the order of $10,000, and a similar surplus was achieved in 1959 so that the users of the airport are supporting it, not the general taxpayers.

Additionally, the airport and supporting activities deriving revenues from airport users contributes nearly $600,000 in annual payrolls, and $95,000 annually in local purchases to the Traverse City economy. The airport actually is the fourth largest generator of payrolls in the community.

Finally, it must be remarked that Traverse City, along with Grand Rapids, afforded the most detailed and extensive information of any communities visited, and the seeming community support no doubt derives from the flow of factual information which the airport agency produces. Such public relations consciousness is recommended to every local airport management.

Tri-City Region (Saginaw, Bay City, Midland and Tri-City Airport)

The Tri-City Region is the only example of the pooling of resources of several Michigan communities - Saginaw, Bay City, Midland - to establish an airport for a unified commercial airline service and capable of handling the largest corporate aircraft. The combined population of the three counties served is 345,000 of which 178,000, or 54%, are in the urban areas of Midland, Bay City, and Saginaw proper. While heavy industry is evident in all three cities, commercial, agriculture, and institutional activities tend to provide a balanced economy for the combined area. Some resort business is also carried on, principally in Bay County bordering Saginaw Bay.

Ground transportation in the area is extensive with numerous rail lines of the Chesapeake & Ohio, New York Central, and Grand Trunk Western Railroads providing freight service and very limited passenger service. Major highways lace the area; Interstate 75 connects all three cities to points north to the Soo, and south past Detroit to the major east-west roadways. Five bus lines, including Greyhound, and 40 truck lines provide highway carrier service. Water transportation is available at both Bay City and Saginaw for Great Lakes and St. Lawrence Seaway movements. The Tri-City Region is well-supplied with surface transportation facilities.

Commercial air transportation is centered at the Tri-City Airport located at Freeland, some 40 minutes travel time from the central business districts of Saginaw and Bay City, and 30 minutes from Midland; highway distances are roughly equal at 10 to 12 miles. General aviation aircraft, however, not only use the Tri-City Airport but also may utilize, if they are not too large, the three municipal airports at each of the three cities, and one private field at Saginaw. There is also a secondary airport at Chesaning in Saginaw County to round out a total of six airports in the three-county region. A seaplane base is maintained at Bay City is a supplementary service.

These facilities, however, are not operated by any single agency. Barstow Airport is owned and operated by the City of Midland; James Clements Airport is municipally owned and operated by the City of Bay City; Saginaw Municipal Airport is owned and operated by the City of Saginaw, while Muhlenbeck Field at

Saginaw is privately owned and operated. The Chesaning airport is privately owned and operated. The Chesaning airport is another municipal facility. Except for the Tri-City Airport, owned and operated by a special commission representing the sponsoring cities, there is no formal coordination of activities among these six airports.

For that reason, assembly of information has been difficult. The very range of sources and the variety of records and their lack have proved to be more troublesome than anticipated. A composite regional picture, then, can be drawn only in fragments.

With regard to commercial airline traffic, Capital Airlines serves Tri-City Airport with eight daily flights affording direct service to Detroit, Chicago, Washington, and New York. In the fiscal year ending June 30, 1959, a total of 34,288 originating passengers were carried out of Tri-City Airport to rank it fourth busiest in Michigan, and virtually equal to Lansing, the third ranking passenger airport. Air cargo in total volume of 278.8 tons during the same year was the third heaviest movement in Michigan. Traffic growth has been consistent with the general trend, and is continuing.

The nearest airport offering commercial airline service is Bishop Airport at Flint. Because of schedule differences and the existing excellent highway connections, there is some tendency for Saginaw travelers to fly Capital Airlines from Flint rather than from Tri-City. Just how extensive this diversion may be could not readily be determined, but it is believed to be a factor which works both ways - Flint people travel to Tri-Cities for service, too, although they are more likely to go to Detroit for flights using airlines other than Capital.

There has been fear in the Tri-Cities area that local service might be substituted for the existing trunkline service if the proposed Capital-United merger takes place. The loss of trunkline service, it is strongly believed locally, would severely decrease patronage at the Tri-City Airport and transfer passengers to Flint if that city continues to be served with direct flights to major hubs.

General aviation use is more difficult to ascertain because, without a tower, not all movements have been recorded. Nevertheless, the total annual movements are over 21,000 with 80-85% representing civil itinerant flights. 17 active aircraft are based at Tri-City - four are multi-engine planes owned by Dow Chemical Co. and 13 are single-engine craft variously owned by companies, flying services and individuals. Demand for hangar space exceeds capacity which has not recently been increased.

At Saginaw Municipal Airport, 13 active aircraft are reportedly based and all are single-engine planes; while at Muehlenbeck Airport, there are seven additional light planes based for a total of 20 in Saginaw. The Saginaw Municipal Airport has three runways, the two longest being 3300 feet and surfaced with shale and gravel; there are no lights or other navigational aids. During summer months, traffic averages 30-35 arrivals per week and drops off to 10-15 in winter; almost all are business or executive aircraft with Detroit as their primary origin.

The administration of the City of Saginaw has wanted to close the Municipal Airport and transfer its operations entirely to Tri-City Airport, in which it has a 50% financial stake. This has been opposed by local industry utilizing the airport on the grounds that the Municipal Airport is much more conveniently located for their use; also, some claim that commercial airline operations and light plane flights are not compatible at Tri-City Airport. After an increase in airport charges and a resulting increase in net revenues which have been yielding a small "profit" ($984 last year), any plans for immediate abandonment of the airport have apparently been shelved. A "wait and see" attitude is now in effect.

One consequence of this expedient policy has been the discouragement of light personal planes at the Municipal Airport. The number of based planes decreased from 20 to 13 after hangar rentals were increased in amounts from $20 to $35 per month. Only the business aircraft and the more active personal, or flying club planes remain. All categories of income - rentals, gas sales and other services - reportedly increased after the hangar fees were raised. While the actual locations of the seven planes withdrawn could not be established, it is understood that some transferred to Muehlenbeck Field on the west side of Saginaw, while others are now based at private flight strips in the rural areas.

In contrast to the feeling in Saginaw that a local airport is perhaps unnecessary and that Tri-City can adequately serve the entire aviation needs, the Bay City attitude was found to be aggressively in support of continued operation and improvement of

James C. Clements Airport. According to local data, there are 37 based aircraft (although FAA figures show only 22 active aircraft based in Bay County) with at least 18 owned exclusively for business purposes. 75% of the total activity at the Clements Airport is considered to be in connection with Bay City business and commercial interests.

According to local claims, time-distance-cost factors place Tri-City Airport at a disadvantage for executive aircraft. Clements Airport is within ten minutes and 75 cents cab fare of most local plants, while it is 60 minutes and a minimum of $6.50 from Tri-City Airport. These differences are reported as actual experience because Tri-City, equipped with lights, must be used after dark when business aircraft cannot land at Clements Airport. A second reason in favor of the local airport, repeating an opinion heard in Saginaw, was that pilots flying the smaller business planes do not like to use the same facilities as the larger company and commercial planes - that commercial and private flying should logically be done at different airports.

Another factor favorable to continuance of the local airport is its attraction for new industry. Industrial development activities place great stress on the availability of an airport for business flying; it is now an essential consideration in the location of the smaller companies which are the more numerous and likely prospective "new industries." With convenient airport facilities and company planes, their limited supply of executive talent can make greater productive use of their time, and distance disadvantages of any particular location can be more than offset.

Habitant Furniture Company and Peet Packing Company are both cited as Bay City industries which have grown because of their executive flying.

While James Clements Airport apparently has won over many in the community who had looked upon it as a drain on municipal funds, the city does not have a formal program of improvements to keep pace with the demands. A complete lighting system and some extension of the existing runways, together with paving the longest runway (now 3200 feet) are the chief capital items. In its current National Airport Plan, the FAA indicates the Bay City facility as a needed "Executive-type" airport and confirms the local evaluation of needed improvements. The community-at-large, however, continues to support Tri-City Airport.

This interest in the airline airport is evidenced by the comments of the hotel managers in the two cities. Of the 1700-1800 guests per week, some 15% are air travelers using the scheduled airlines and either limousine service or rented cars for their ground transportation. Roughly 95% of their guests are businessmen, except for convention traffic, and are "in" Mondays through Thursdays for typical stays of two days or less; with air travel, their visits are shorter but more frequent. Estimates of guests flying in via company planes using the local airports (Saginaw Municipal and Clements) could not be obtained, though the number was believed insignificant. (This confirms airport observations that virtually all of this transient traffic remains less than one day and that the passengers do not remain overnight.)

At Midland, Jack Barstow Field is also municipally owned and operated but shows a greater interest in personal flying than any other airport visited. Of 25 active aircraft based at Barstow Field, only one is company-owned; most of the planes belong to flying clubs with two established and a third in the process of formation. This is explained by the concentration of highly paid technical and younger age-range personnel who are employed at Midland by the Dow Chemical Company, and who take naturally to flying as a sport.

One such club has ten members of whom three are licensed pilots and the others are learning to fly and gaining flight experience. It owns two 1947 model planes which are used an estimated 200 hours annually with 90% of the flights purely "local." Virtually all of their flying takes place on weekends during June, July, and August, although some of the members would fly in the winter months if they could be assured of snow-clear runways. Expenditures for 1958 totaled just over $1600, or roughly $8.00 per flying hour, which is in line with the state-wide experience of flying clubs.

The majority of transient visitors to the airport are business flights with most of them generated by Dow Chemical Company. Most of these arrivals leave the same day and only 50% make any purchases at the airport ($10 is a typical amount, largely for gas, from those who do spend). Records of total volume of traffic were not available; it was commented that "only about half of them register."

Another unusual aspect of the Midland situation is the role of the Dow family and the Dow Foundation. Land for the airport was donated to the City of Midland, and additional land for the expansion of the airport has since been acquired. Many of the airport improvements have been contributed and have given rise to speculation that the Dow Company might support a major upgrading of Barstow Airport so that it could base its planes, now at Tri-City, in Midland. With the new expressway joining Midland and Freeland, adjacent to Tri-City Airport, it is difficult to recognize any advantage to Dow in such a move.

Such speculation indicates the division of support between the local and the regional airport. While all seemingly are agreed that no one of the three cities could enjoy separately commercial airline service now available at Tri-City Airport, they are reluctant to expand the business flying at the regional airport for fear of loss of their local fields which are believed to be community assets. In 1959, for example, the Tri-City Airport Commission failed to agree on funds for the construction of hangars needed to house business aircraft; Saginaw and Midland, it was understood, supported the appropriation but Bay City did not approve and the hangars were not built. It was commented that working arrangements and relations between Tri-City Airport and the three individual cities "are very good, except when it comes to money."

Apparently, no one locally in the area has voiced the idea that all of the local airports might, together with Tri-City, be regionally managed with development balanced as the various aviation interests of the communities might be justified. One industrialist in Saginaw commented: "The Tri-City Airport has tremendous possibilities and is an important link in solidifying the three cities and putting the Tri-City area in its proper perspective in the industrial picture." Further, "It has been my feeling, and this feeling is shared by others in business in the Saginaw Metropolitan Area, that the one big drawback to private aircraft is uncertainty over the future of the Municipal Airport. Growth in port facilities and private flying should certainly equal or exceed the growth in the community as a whole, but I doubt that the Municipal Airport can keep pace with things as they are."

To change "things as they are" for the better, it is suggested that the regional outlook be extended to all facilities in the area, and not solely to the airport serving the commercial airlines.

APPENDIX - PART II

Check lists used in interviewing community leaders to determine background for evaluating local aviation impact are reproduced on the following pages for reference. The extent to which these lists could be utilized in any given community depended in large measure upon the energy and interest of the particular individuals reached; questions unanswered by one were carried over to other contacts in order that as complete a picture as possible might be drawn. These lists of questions were used by the interviewers, not as rigid guides, but rather as reminders of the scope of information desired and as devices for encouraging conversation.

Appendix - Part II
Check List No. 1

Airport Manager

What does the airport mean to your community in dollars and cents, and in intangibles?

1. Statistics relating to incoming airline passengers or private-plane passengers:
   a. Average length of stay - Where stayed
   b. Primary area of origin
   c. Average expenditures for services used - Typical purchases
   d. Purpose of trips (Business, pleasures, resort or recreation)

2. What are the most important passenger destinations? (Measured by frequency)

3. Has airport improvement increased the use of the airport?

4. Has airport improvement increased the revenues of the businesses in the community in any way?
   a. How much, relatively?

5. Does distance from the airport affect business?
   a. How?
   b. To what extent?

6. Have adequate airport facilities been mentioned as a consideration in the determination of a plant to locate in your community?

7. What industries make active use of the airport?
   a. How many take-off's and landings?
   b. What types of industries predominate in the use?

8. What sports activities are important in your area?
   a. Winter or summer, or both?
   b. Are these activities important to the community's economy?
   c. Is flying an important means of transportation to the sportsmen?
      1. How measured?

9. Has any increase in resort or recreational activities caused an increase in personal flying? or vice versa?

10. How many vacationers and tourists arrived at, and departed from, your airport in 1958? 1959 - to date?

11. Are planes used for the transport of agricultural supplies and products?
    a. Types and amounts of products
    b. What reliance is placed on planes for this function relative to other types of transportation?
        1. Is it more economical?

12. Do the farmers use the airport or their own open fields?
    a. Number of take-offs and landings.

13. How much use is made of planes for spraying, dusting, fertilizing, seeding, etc.?
    a. Are these operations important relative to the entire farming operation?

14. What effect does the airport have on adjacent land use and highway development?

15. Number of take-offs and landings; day, month, week?
    a. What type; business, private?
    b. What military?

16. Compared to preceding years? (Number of take-offs and landings)

17. Is traffic weekend, seasonal, etc?

18. Is weather a factor in number of flying and non-flying days?

19. Date of opening of airport.

20. Do you have an airport master plan?
    a. Is site permanent?

21. Airport Manager's salary.

22. Other occupation or business of airport manager.

23. How is airport managed? 1) Leased to private owner; 2) separate department; 3) under commissioner or committee; 4) division of a department; 5) other?

24. Runway construction: (See airport facility record)
    a. Date
    b. Cost
    c. Resurfacing and maintenance

25. Location of airport:
    a. Driving time to center of city
    b. Highway type and access (U.S., State, etc.)
    c. Condition of route (surface, traffic, etc.)
    d. Surface public transportation connections (cab, limousine)
    e. Distance to nearest airport

26. What is your attitude toward the community airport?

Name of Airport: ______________________

Date: ______________

Class: ______________

SOURCES OF CAPITAL OUTLAY AND AMOUNT OF EACH

U.S. Gov't. Grant	WPA	State Grant	Local Funds	Gift	Other	TOTAL

EXPENDITURES

Salaries	Maintenance	Light, Heat & Power	Insurance	Capital Outlay	Misc.	TOTAL

REVENUES

Source	Base Rate	TOTAL
Hangar Rental		
Gas & Oil		
Building Rent		
Landing Fees		
Concessions		
Miscellaneous		

Appendix - Part II
Check List 2

Chamber of Commerce Executive and Public Officials

1. What is the stability of commerce (business) in community?
   a. Is this stability contributed to by airport facilities and services?
   b. Static or growing?

2. Does a large amount of out-of-town buying and shipping take place?
   a. Where?
   b. Is this a potential air traffic generator?
   c. Other generators in area?

3. How many new establishments were created since airport was opened/or improved?
   a. Is this related to airport improvement?

4. Land Values:
   a. What is the effect of airport on adjacent land values?
   b. Generally, what is the effect of airport facilities on land values of the area?

5. Would airline service or improved facilities increase business trade?
   a. What type of business would benefit as a result?
   b. Would this add to community's economy (labor, money circulation, etc.)?

6. What does private and airline (if any) travel add to the community's, or the area's, economy?

7. Have adequate airport facilities been mentioned as a consideration in the determination of a plant to locate in your community?

8. How important is distance from the airport upon the site of a new plant?

9. Does the airplane have any effect on the decentralization of industry?
   a. Is this very important in your situation?

10. Would company rather build own landing strip?
    a. Is this a matter of either distance or money, or both?

11. What industries shipped finished products by air cargo?
    a. What is the relative importance of air cargo to the entire cargo transport picture?

12. Number of summer homes built, purchased, or improved since airport was opened? Or, facilities improved?

13. Average length of stay of tourists in your area? (days)

14. Average estimated daily expenditure of vacationists and tourists?

15. How many tourists fly to your area, personal or airline?

16. Has any increase in resort activities caused an increase in personal flying? or vice-versa?

17. What is an optimum distance from the airport?

18. Does use of plane directly improve customer service?
    a. What are the indirect benefits of airplane use?

19. How much does business depend on air cargo for supply of goods?
    a. What type and how many businesses?
    b. Does this tend to reduce inventories?

20. What is the market area?
    a. Does use of plane extend market area?
    b. How much?
    c. What businesses are affected?

21. How many new industries since airport was opened, or substantially improved?

22. Does company plane make your operation more efficient through greater speed of movement, better impressions on prospective customers, etc.?

23. Does use of company plane give you a competitive advantage?
    a. Does use of plane by your competitors put you at a disadvantage?
    b. Do you find, with all competitors using planes, that the competition for the product is more intense?

24. Was the airplane instrumental in making new contacts, because of speed of personal communications, etc.?

25. How much money was saved on total transportation costs (attributable to use of company plane)?

26. How much money was saved as a result of a reduced sales force?

27. How do aviation or airport facilities affect sales through transportation of salesmen, buyers, and executives?

28. Has plane travel made your sales force more efficient with respect to time in travel, time in actual field work, more intensive coverage of area, reduction of men, etc?

29. Do you rely heavily on air transport for emergency supply of needed parts? (For repairs, etc.)
    a. How often has this type of situation arisen?

30. Does fast supply of parts by air transport tend to reduce inventories?
    a. What type of parts?
    b. Are other forms of transportation used for similar purposes? If so, what is the relative importance of each type?

31. How many flights per month?

32. Is the plane more useful to certain type of farming than to others?
    a. If so, what types and to what extent?

33. Does use of planes by government and state agricultural agencies enhance liaison between agencies and farmers?

34. Are planes important to the servicing of the extractive industry?
    a. Is the operation end more accessible to the administrative end (flights per month)?
    b. Are planes used for bringing in supplies, emergency maintenance repair, etc.?
    c. Are planes used for air cargo? How much?
    d. Are planes used for maintaining the population of mining towns?

35. To what extent are planes depended upon for discovery purposes, mapping, aerial surveying, photography, etc.?
    a. Are these contracted services?

36. Does your city have a master plan?
    a. Is the airport considered in the master plan?

37. What type of community promotion exists for an over-all plan for airport development?

38. Do you consider a regional or multi-city airport more desirable from the standpoint of financing, servicing the community, etc., than a single city airport?

39. How and by whom are airports financed locally?

40. What is your attitude toward the community airport?

41. Zoning of land adjacent to airport?

<u>Aircraft Suppliers</u>

Name
No. of employees, payroll
Gross income
Type of products
General destination of company planes

42. Have <u>you</u> had occasion to use or support airport?

43. What other local leaders should be approached for information?

Appendix - Part II
Check List No. 3

Industry Executive

1. Do you have a company plane?
   a. How many?
   b. If no, why not?
   c. How many people are employed?

2. Do you fly commercially?
   a. If no, why not?
   b. How much would you fly?

3. How many flights per week, month, or year?
   a. Company plane or commercial airlines?
   b. Average length of flight?

4. What percentage of total personnel movement is by air?
   a. How much was spent on flying personnel last year?
   b. Can you determine a trend? What kind?

5. How many people come in to see you on business matters?
   a. How many of these fly in?
   b. Do you fly any of these people in your company plane?
   c. What is your average length of stay?
   d. What is their means of surface transportation?
      1. Rent-a-car
      2. Company car, etc.

6. How much freight (tonnage) did you ship out by air last year?
   a. What percentage is air freight of the total out-freight picture?
   b. Can you determine a trend in air freight?
   c. How is freight forwarded between airport and plant?

7. How much freight did you fly in last year?
   a. What percentage is air freight of the total in-freight picture?
   b. Is there a trend?

8. How much was spent on movement of goods by air?

9. How much was spent last year (total) on flying by your company?

10. Is the airport an important consideration in the location of your plant?

Appendix - Part II
Check List No. 4

Travel Agency

What does the airport mean to your community in dollars and cents, and in intangibles?

1. Number of fares and passengers originating from the community?
   a. Number of passengers originating from adjacent towns via your airport.
   b. Is traffic seasonal?

2. What are the most important passenger destinations? (measured by frequency)

3. What is the average length of trip?
   a. What is the average cost of the ticket?

4. Number of employees in the travel agency?
   a. Gross income derived from air travel ticket sales.
   b. Percent of business devoted to air travel.

5. Has airplane travel increased the size of college enrollment by bringing in the outstate students?

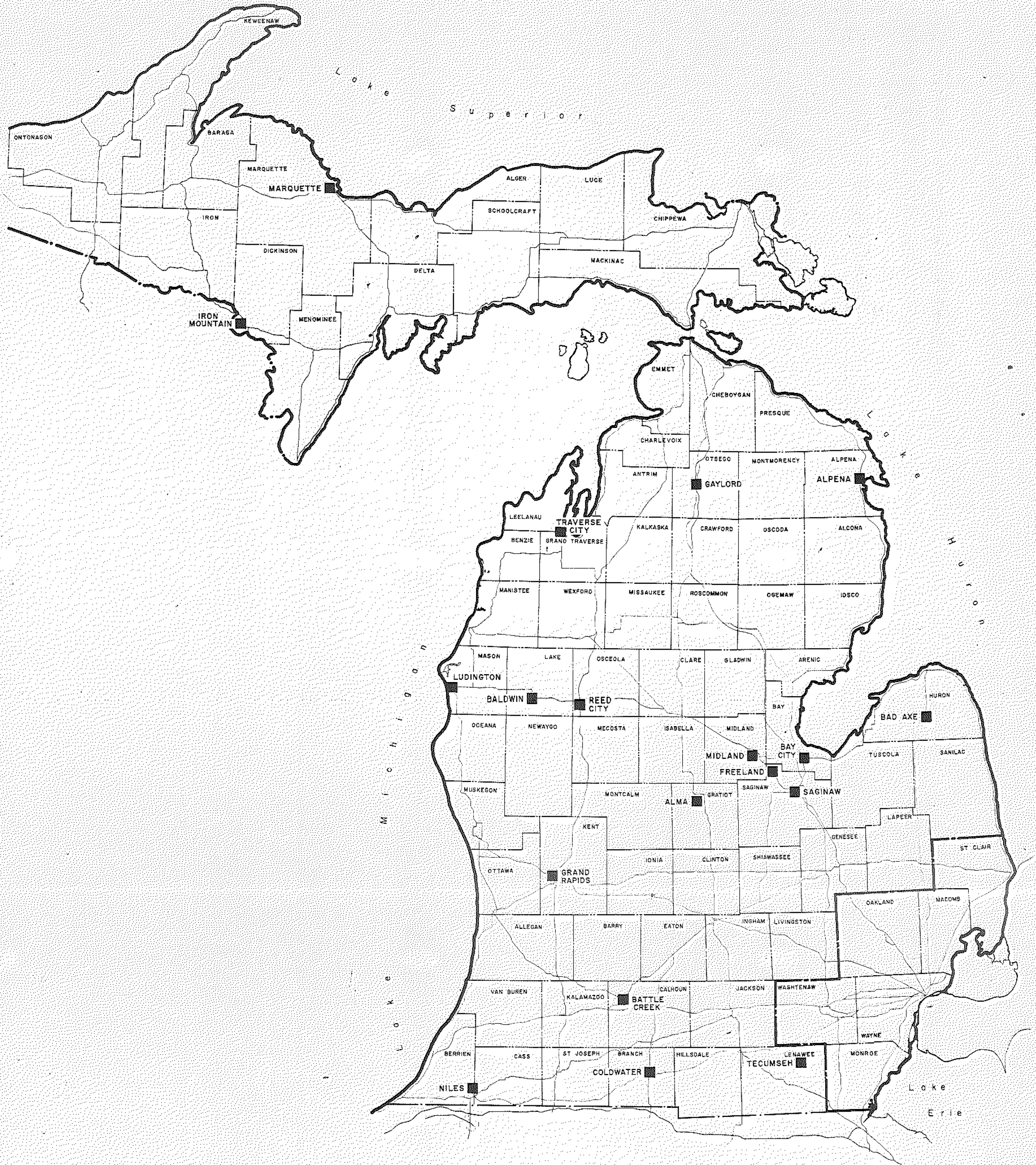


FIG. I

COMMUNITIES SELECTED FOR FIELD STUDIES OF AVIATION IMPACT

02821-2-F

THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION INSTITUTE

Final Report

A Background Planning Study of Michigan's Aviation Needs

Part III. Growth and Technological Change in Aviation

Section I. Technological Trends in Aircraft, Air Traffic and Traffic Control.

Under Contract With:

Michigan Department of Aeronautics
Capitol City Airport
Lansing, Michigan

Administered by:

August 1960

THE UNIVERSITY OF MICHIGAN RESEARCH INSTITUTE • ANN ARBOR

65-4141

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Harold F. Allen
Department of Aeronautical and Astronautical Engineering

UMRI Project 02821

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LANSING, MICHIGAN

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THE UNIVERSITY OF MICHIGAN RESEARCH INSTITUTE   ANN ARBOR

August 1960

FOREWORD

Considered assessment of growth is an essential part of the background of planning. In an area of rapidly changing technology, such as transportation - particularly air transportation - today, this assessment properly includes the study of probably developments in technology and their realization in new equipment, techniques and standards of service. These, in turn, exert significant influences upon the extent and nature of the growth of transportation services. At the present time in aviation, these relationships are of critical importance.

Part III of the comprehensive study of the planning background for Michigan's aviation needs is an evaluation of the influence of technological change in aviation and an estimation of growth in Michigan's air transportation. For convenience in assembly and presentation, this part has been developed in two separate sections.

Section I is devoted to the consideration of technological trends in aircraft, air traffic and traffic control, and to certain conclusions regarding their influence upon aviation planning for Michigan. Because this subject involved specialized knowledge, its development was assigned to the University of Michigan's Department of Aeronautical and Astronautical Engineering; Dr. Harold F. Allen, research engineer and lecturer in the field, assumed responsibility for the preparation of this section of the report.

While the report is presented with full official confidence in the professional competence and integrity of the author, the conclusions are Dr. Allen's and do not bear any institutional authority. It should be added, as a measure of appreciation, that Dr. Allen possesses not only the scientific qualifications for this study, but also, as a licensed pilot and an aviation officer in the U.S. Naval Reserve with rank of captain, a practical viewpoint of inestimable value in such research.

In the presentation of technological considerations, Dr. Allen deliberately adopted an approach which assumed that the reader had little or no specialized knowledge of aviation. To those who have studied in the field, some of the material may seem unduly elementary; to the layman, without such information, the inclusion of simple detail is essential and is considered to add to the general value of the study.

Section 2, which is separately bound, deals with the growth of aviation, nationally and locally, and presents in broad terms an estimate of the future insofar as it seems practical to speculate. This section was prepared by the staff of the Transportation Institute, which is continuously concerned with the study of demands for transportation services rather than the detailed technological bases. While it was independently developed, close attention has been paid to Dr. Allen's phase of the study and careful consideration given to his conclusions.

Both sections are therefore essential to an understanding of the background for the establishment of a rational aviation planning policy for the State of Michigan. Neither alone, nor together, are they intended as a blueprint or rigid guide for any arbitrary plan of airport design and location.

While "scientific" in the sense that rational analysis and statistical relationships have been applied to the information collected, it must be emphasized that the future will be influenced by forces which cannot be entirely anticipated nor precisely measured in advance. Inherently then, the conclusions of this Part III of the report are the result of the collective judgment of the research staff which has attempted to maintain a professional, objective and unbiased view. They are not intended, nor should they be considered as absolute, unqualified predictions.

John C. Kohl
Project Director

TABLE OF CONTENTS

Introductory Notes

The information presented herein is for the purpose of assisting the Michigan Department of Aeronautics in planning for the future. However, in most cases, the information is quite general, and applicable not only to one state, but to the entire country. Types of aircraft, for example, will be no different in Michigan than in other states, while air traffic control, meteorological services, etc., must be provided by agencies which are nationwide, or even international in scope. Frequent references are made to possible Michigan applications, and the generality of the report does not detract from its specific usefulness within the state. Much of the material was obtained from reference 1, and to avoid continuous repetition, this will not be referred to in the report. Some of the material results from personal experience, and is not referenced. Other major sources of material are listed at appropriate points in the report.

For purposes of this report, it is assumed that international conditions will not change significantly during the next ten or twelve years, that there will be no full-scale war and no complete mobilization. However, it is assumed that continuing international tensions will necessitate maintenance of defense expenditures at a high level, providing a continuing base for the civilian economy.

Since 1946, the American economy has been in a state of expansion. Gross National Product, a measure of the total market value of national output, rose about 4% per year from 1947 to 1957, and there seems little doubt that expansion will continue at a similar rate. Since 1950, population has increased by nearly three million per year, and under a prosperous economy, population growth should continue at a rapid rate.

It is assumed that the steady expansion of output and increase of population will create an extremely favorable environment for further growth in air transportation. Total inter-city travel has grown faster than both population and Gross National Product, with growth limited to private automobiles and to the airlines. In 1956, air travel comprised only 3.3% of total inter-city travel and 35.9% of common carrier inter-city travel, so there is still plenty of room for expansion of all forms of air commerce.

It is assumed that the increased demand for air travel will continue to exert pressure on the manufacturers to develop new types of aircraft, and all the accessory equipment and services which they will require. On the basis of past experience, aircraft types have been considered in the light of the technical possibilities for new development within the next ten years. Plans prepared by the Federal Aviation Agency for air traffic control are fairly specific for the next few years, though less definite beyond 1963. These plans are discussed in general terms only, as they apply to the country as a whole.

Except for forecasts of increases in domestic and international airline passenger volume, which are taken from published surveys carried out nationally, the report is qualitative rather than quantitative. The types of aircraft which can be developed within the next ten-year interval can be fairly accurately foreseen, although it is not possible, without far more general surveys than have been undertaken, to estimate the numbers of different aircraft which will be flying at any given date, or indeed, whether such aircraft will exist at all. The fact that it is technologically possible to produce a certain type of aircraft does not imply that it will actually be developed. A need for the type must first be established before its production can be undertaken. Even if a need exists, preoccupation of industry with other types, or lack of facilities or capital may inhibit development until the need has disappeared or been satisfied, perhaps less efficiently, by other means. The report frequently points out the desirability or the technical possibility of developing certain types of aircraft, equipment, or services, but it is often impossible to predict the appearance of the type in significant quantities.

Consequently, the report can be used to estimate technological trends, and types of facilities or services which may be needed, but additional surveys will be required in order to determine quantitative requirements.

Summary

The major portion of the air transport fleet will continue to comprise largely conventional propeller-driven, fixed-wing aircraft, similar to those now in use. There will be a major shift away from the reciprocating engine and toward the turbine type of power plant. Significant numbers of jet aircraft will be used, mainly in the larger sizes (100 or more passengers) and in medium to long haul service. Supersonic transports will not be economically feasible within the next ten years. Transport helicopters or VTOL transports may be used to some extent in heavily subsidized short haul services.

The types of aircraft used for private and business flying are less likely to change in the next ten years than transport aircraft. Piston engines will continue to predominate, as there are few small turbines being developed. Larger private aircraft, and aircraft used for business purposes are more likely to be powered by turbine power plants. Helicopters will not be used in large numbers due to their high first cost and expense of operation, although they will be used for certain special services which only copters can provide. In general, there is not likely to be any great increase in private flying, although flying for business purposes is increasing, and will probably continue to increase.

There is slight possibility that VTOL aircraft or "flying jeep" types, or lighter than air craft will form a significant part of air traffic. There will be considerable military traffic,

but the amount or trend cannot be estimated except by defense agencies.

The seaplane and the STOL aircraft both have considerable potentialities, but an evaluation of their possible future use is difficult, as seaplanes are currently not used to any great extent in Michigan and STOL aircraft are not available at this time. The appearance of successful aircraft of the latter type could result in a demand for many small "skyports" throughout the state, and especially in the metropolitan area. These ports would be small, with runways not over 500 feet in length, so it would not be difficult to find space for them if planning is initiated far enough in advance.

The passenger demand for air travel is expected to double within the next ten years, resulting in approximately double the number of flights. Improved traffic control procedures will result in a larger number of flights for a given airport, but some airports serving the larger metropolitan centers may become saturated, necessitating the construction of additional airports. Aircraft which are currently foreseen will not require runways longer than two miles, under normal conditions. However, the sensitivity of the turbine type of power plant to temperature leads to the possibility that in hot weather, runways should approach three miles in length, if payloads are not to be seriously limited. Approaches at each end of the runways should be one mile in length, with no obstruction above a 1 in 50 glide plane. Aircraft noise, and the threat of danger to nearby residents, will continue to be problems, and this fact, coupled with the size requirements, militates against the location of airports in or near the downtown or residential areas of the large cities which provide nearly all the support for the airports.

Remote location of airports creates a demand for some sort of rapid transport service between the airport and the city proper. This can be by rail, bus, or air, but a very attractive possibility is in the development of STOL aircraft, which can operate economically and quietly from heliports or very small skyports. These can be located within large cities, either beside lakes or rivers, with overwater approaches, on the median strips of express highways, on roofs of low buildings, or other available areas. The helicopter is capable of providing this service, but cannot operate economically, and must be subsidized.

CHAPTER I

Types of Aircraft - 1959-1970

For purposes of this report, the characteristics of an aircraft which are of the greatest interest are those which influence airport size and location, and those which determine the type of service in which the aircraft is used. These characteristics are concerned with the size, performance, type of power plant, and power plant rating. A few significant values are tabulated for airplanes of each type discussed. The size of an aircraft is fairly well established if one knows the wing span, gross weight, and number of passengers (or alternate cargo capacity). Useful performance parameters are cruising speed and altitude, maximum rate of climb, and length of runway required under normal conditions. In certain cases, other information is included, such as hovering ceiling for helicopters. Power plant information includes type, number of engines, and rated power or thrust. Aircraft themselves are classified as transport, general aviation, helicopter, vertical take-off and landing VTOL), and short take-off and landing (STOL). A few representative examples of each type are discussed in the following paragraphs.

Transport Aircraft

It is expected that during the next decade, all but a small portion of the common carrier fleet will be made up of conventional aircraft similar to those currently operating or under construction.

These can be classified as small (50 passengers or less), medium (50-100 passengers), and large (over 100 passengers) aircraft, with reciprocating engines or gas turbine engines, the latter comprising the shaft turbine-propeller (or turboprop) and the turbo-jet types of power plants. In the press and advertising, the shaft turbine-propeller engine is sometimes referred to by the misleading term "prop-jet." This nomenclature will be avoided in this report.

Currently, reciprocating (or piston) engines power all but a small portion of the civil fleet. Engines having ratings from about 80 to 4000 horsepower are now available, and it is not anticipated that larger reciprocating engines will be built because of their bulk, weight, and complexity compared to large turbine engines. No new piston engine transport designs are expected to follow current types, and there will be a major shift to the turbine type of power plant in the larger sizes. However, aircraft powered by reciprocating engines of lower horsepower rating will continue to be built, as the piston engine has better fuel economy than the turbine engine for low speed, low altitude, partial power operation. For this reason, few turboprop engines of less than 750 horsepower are being developed. On the other hand, for high altitude operation at speeds in the 300-450 MPH range, the turboprop has a definite advantage. Also, it can be built in larger sizes with consequent increase in efficiency.

As aircraft speeds exceed 450-500 MPH, the propeller begins to lose efficiency, and at high subsonic speeds and high altitudes, the turbojet power plant becomes more economical than a propeller driven by either a reciprocating engine or a shaft turbine. However, the turbojet is extremely inefficient at low speeds and altitudes, hence jet aircraft are restricted to rather narrow operating limits, necessitating careful flight planning, and strict adherence to flight plans.

At least one major American aircraft manufacturer feels that it would be possible to have a supersonic transport airplane ready for certification by 1965 (Ref 8) and one British manufacturer is shooting for 1970. However, it is not anticipated that supersonic transport aircraft will be actually operating within the next decade, as current experience, which is limited to military types, appears to be inadequate to produce a supersonic aircraft which could be economically competitive with subsonic transports. Consequently, the commercial fleet will continue to comprise principally the above-described types for at least the next ten years. The commercial use of helicopters, STOL aircraft, etc., is limited and will be discussed elsewhere. Brief descriptions of the major transport aircraft are given below, and the aircraft characteristics are found in Table I.

Small Transport Aircraft - Reciprocating Engine

Practically the entire short-haul passenger transport fleet is composed of these aircraft, ranging from DC-3 (and even a few older models) through the current series of Convair and Martin transports. Some cargo aircraft are also of this type. Approximate performance figures for older and newer models are given in Table I.

Aircraft of this type, expecially the more modern models, will continue in use through 1970 in local and non-scheduled passenger and cargo service, as the medium and larger transports in general require longer runways than are available at the majority of airports used in this service. Also, larger aircraft may be too difficult to fill to economic load factors at smaller cities and towns.

Small Transport Aircraft - Turboprop Engine

Aircraft of this type, such as the Vickers Viscount and Fairchild F-27 have started to replace small piston-engine transports in the short-to-medium haul field (under 1000 miles). Typical characteristics are given in Tabl I. These aircraft have good small-field characteristics, and may have a small speed advantage over the more modern small piston-engine transports. They are currently somewhat more expensive, and more sensitive to operating conditions. Consequently, the replacement of the reciprocating engine aircraft will be slow, but inevitable, as no new piston engine transports are being designed. Some airlines are already investigating the possibility of converting existing Convair transports to turbo-prop power plants.

Medium Transport Aircraft - Reciprocating Engine

Aircraft in this class currently comprise the major portion of the entire transport fleet, including both cargo and passenger service. Typical performance characteristics of one of the larger, long-range aircraft are given in Table I. These aircraft will remain in service throughout the next decade, although markedly inferior in passenger-mile capacity to the medium turbine powered transports. As time goes on, they will probably be used less on international passenger flights, and more for domestic passenger and cargo service, medium (500-1500 miles) to short-haul (less than 500 miles), although not in local service, because of the load factor problems and the small airports in the smaller cities.

Medium Transport Aircraft - Turboprop Engines

Aircraft of this type, such as the Lockheed Electra and the Vickers Vanguard are just going into service in the spring of 1959. Typical characteristics are given in Table I. These aircraft have a considerable speed advantage over piston engine aircraft of the same capacity and comparable horsepower, and therefore can produce more passenger-miles per airplane. They are somewhat more expensive in first cost and hourly operating cost, but under proper conditions of operation, the larger passenger-mile capacity results in lower direct operating costs. They may be expected to replace the medium piston engine transports gradually during the next ten years, and to continue in use for medium- to short-haul service for the next twenty years.

Medium Transport Aircraft - Turbojet Power Plant

Typical characteristics of aircraft of this type are given in Table I. Such aircraft as the Comet IV will provide service similar to that of the medium turboprop over the same time period. The turbojet aircraft shows a large cruising speed advantage over the turboprop, and therefore a larger passenger-mile capacity, especially over longer stages. However, its necessity for added runway length and its greater sensitivity to cruise altitude requirements, as well as its greater first cost and higher fuel consumption, will keep the direct operating costs above those of the medium turboprop transport. Its use can therefore be justified only over the longer stage lengths, where it must compete at a disadvantage with the large turbojets. The medium turbojet transport will probably not see very widespread service, and no small turbojet transport may be anticipated, as its probably speed advantage would be lost in the short-haul service, and it would be much less economical than the small turboprop or piston engine transport.

Large Transport Aircraft - Turbojet Power Plant

A large turbojet transport, such as the DC-8 or Boeing 707, (see Table I) can have lower direct operating cost per passenger-mile than medium aircraft of any type over medium and long stage lengths if it can be operated with capacity loads. At lower load factors it can compete only over the long stage lengths where the smaller aircraft can operate only at reduced payload capacity. In general, the large jet aircraft will operate over longer average stage lengths, at higher average block speeds, and can be expected to serve all long routes and a substantial portion of medium length routes during the next ten years. By the end of this period, it may even be used on shorter routes with high traffic density, except where limited by available runway lengths.

The use of jet assist take-offs and decleration devices could permit jet aircraft to operate out of smaller airports, but in the past, such devices have not found favor with passenger carrying airlines, and there is no reason to expect a change in this attitude in the future.

Summary - Transport Aircraft

During the next ten to fifteen years, aircraft of all types listed in Table I will be operated on commercial airlines. Piston engine and turboprop aircraft will serve all cities in Michigan capable of supporting an airline and having runways approximating a mile in length. The larger aircraft will operate only at airports with longer runways and higher traffic densities. Jet transports will probably operate only in and out of Detroit, except that by 1970 or 1975, some of the smaller cities may generate sufficient traffic to permit the profitable use of jet aircraft, if adequate runways are available.

Aircraft speeds will increase somewhat during the next ten years, especially over the long stage lengths, where jet transports will be used. However, no supersonic transports may be anticipated during the same period.

General Aviation

All aircraft types not in the common carrier or military fleets are normally grouped under the above heading. However, it is anticipated that during at least the next ten years, the general aviation fleet will comprise principally conventional fixed-wing aircraft similar to those currently in use. Consequently, only such aircraft will be discussed in this section; and rotary wing aircraft, STOL aircraft, etc., will be taken up separately.

Reciprocating engine aircraft will remain very much in the majority, as turbojet aircraft in the general aviation category are very expensive to purchase and operate, and there seem to be very few shaft turbine engines being developed which are sufficiently small to power single engine and light twin engine aircraft. It is doubtful if any small turbines will appear within the next decade in the mass production quantities necessary to bring prices down far enough for wide acceptance. This is not because of technical infeasibility but on account of the large development costs before the turbines could be produced in sufficient quantities. If any significant use is made of such engines in automobiles, this will probably result in the appearance of similar engines in the aircraft field. Some turboprop engines in the medium horsepower range have been developed abroad, and some are being manufactured under license in this country, but have not been widely used. The characteristics of a number of existing or technically feasible aircraft in the general aviation category are listed in Table II and discussed in the following paragraphs.

<u>Light Single Engine Aircraft</u>

The "light single" is a small, single-engine, fixed-wing airplane, usually two place, and used principally for flight training and private flying. A typical example is tabulated in Table II. Within the foreseeable future, the performance of such aircraft is not likely to improve appreciably. They will continue to be powered principally by reciprocating engines, as it is unlikely that any small turbine engines can be developed which will be economically feasible. The only possibility for a major break-through in the private aircraft market appears to be with the STOL aircraft, which will be discussed separately.

Heavy Single Engine Aircraft

The "heavy single" has higher performance and usually higher capacity than the "light single." It carries two to five passengers, and may range in size and performance from a reciprocating engine aircraft slightly larger than a light single to civil versions of military jet trainers. Frequently, it will have extensive radio, navigation, and instrument flight equipment. Typical examples of existing aircraft or models which could appear within the next ten years are listed in Table II.

A considerable number of heavy single engine aircraft are used in business and commercial flying, such as charter service. Within the next ten years, the reciprocating engine will predominate as in the case of the light single, although a substantial number will be powered with jet engines, and there is a possibility that some use may be made of turboprop engines, as these can be larger than would be required by the light single.

Light Twin Engine Aircraft

The "light twin" is generally larger than the "heavy single" (except military trainers) and carries from five to ten persons.

It offers multi-engine safety, and can carry complete all-weather flight, navigation, and communication equipment. Civil airplanes in this category make up much of the business fleet, and a few of the larger models are used as short-haul transports, or in inter-city service, using small down-town airports such as Detroit City Airport which are not available to the larger commercial transports. Military versions are frequently used for training and administrative flying. Characteristics of three typical light twin engine aircraft are given in Table II.

General Aviation Transport

Aircraft in this category do not constitute a class of aircraft per se, but include aircraft which are used for general aviation purposes but which fall into the classes of transport aircraft previously described, whose characteristics were listed in Table I. They range from 8-12 passenger twin-engine aircraft, such as the DeHaviland "Dove" or Sud Aviation "Diplomatic," through DC-3, Convair and Martin twin engine aircraft, and may include even larger aircraft which are corporation-owned or leased for special purposes. A few firms and a few private individuals operate amphibians, such as the Grumman "Widgeon," which fall into the small transport category.

Helicopters - General

The helicopter has been a subject of investigation since the early days of flying, but the first successful models appeared at the start of World War II. It is a logical outgrowth of the work done on the autogiro during the 1920's and early 30's. The helicopter became a reality when power plants of sufficiently low weight per horsepower were developed, and high strength alloys made possible an efficient system of power transmission, as well as a light weight structure. When the helicopter became physically able to rise and hover under its own power, problems of control and stability were soon solved.

Helicopters, in general, are currently more complicated to fly than conventional aircraft. They are inherently slow, short-range craft, with low ceilings. They are expensive to build, maintain, and operate. On the other hand, the copter has the unique advantage that it can take off and land vertically and can hover over a fixed point.

However, there are disadvantages connected with vertical rising and hovering operation. In the first place, it is a characteristic of the helicopter that the greatest amount of power is needed in level flight at top speed and at zero speed. At medium speed, the least power is needed to maintain altitude, and the most power is available for climbing. It is therefore uneconomical to climb vertically beyond the ground-effect cushion, which usually is considered to extend one wingspan (for conventional aircraft) or one rotor diameter (for copters) above the ground.

In the second place, there is a considerable element of risk during vertical flight in that under these conditions the sole source of lift is the power plant. Engine failure results in immediate loss of lift, which cannot be reestablished until the rotor is changed over from powered operation to autorotation, which involves the loss of a few hundred feet of altitude, so if the copter has less than this amount of ground clearance, power plant failure will result in a crash. The required altitude decreases as forward speed increases, and becomes zero at a certain velocity which is below the cruising speed of the copter.

In the third place, vertical operation in the vicinity of obstacles, especially on windy days, requires a very high degree of pilot skill, so a certain amount of risk of this type is involved in operation out of restricted areas.

As a result, in normal operations, climbing and descent are carried out at moderate forward speed. The copter usually takes off vertically for the first few feet, then proceeds to develop a horizontal velocity before gaining further altitude, and finally climbs out on a slant after the manner of conventional aircraft. This characteristic of helicopter operation has a very important effect on the size of the heliport from which it is to operate. The International Air Transport Association (IATA) recommends cleared approach paths having a 1 in 8 glide ratio (1 vertically to 8 horizontally) and landing strips at least 400 feet in length. This typifies the requirements for safe, economical operation, and does not represent the minimum required. Where necessary, of course, it is possible to operate from an area not much larger than the physical dimensions of the copter itself, with consequent reduction in efficiency and safety.

There are many varieties of helicopters. The rotors may have two, three, or more blades, and there may be one, two, or even more rotors. The rotors may be hub driven by one or more piston engines or shaft turbines, or they may be tip driven by various thrust producing devices, such as rockets, ram jets, pulse jets, or turbo-jets mounted on the wing tips. Compressed air or other gases may be generated in the fuselage, ducted to the rotor tips and discharged through nozzles or burners to generate thrust. The most common copter types are currently those which are hub driven through mechanical transmissions. The earlier copters were of this type, as engines producing jet thrust were not available twenty years ago. Good gear transmissions still require much expensive development, because of the severe vibration problems encountered in mounting extension shafts and gears in a relatively flexible structure. The shaft turbine, with its inherently smooth torque characteristics, can reduce the severity of the problem, but efficient low horsepower shaft turbines are still not available. During the next ten years, most copters in civil use will still be equipped with hub driven rotors, most of the smaller ones being powered by reciprocating engines, and the larger ones by shaft turbines. The turbine is much lighter for a given horsepower, a critical factor in helicopter design, but is available principally in the larger sizes. Also, the turbines are more expensive in first cost than reciprocating engines, their fuel consumption is greater, and their power output declines more in hot weather. The increase in helicopter load carrying ability can justify the use of turbines in larger sizes, but a good, economical, efficient, inexpensive, small turbine has yet to be developed.

The tip-driven rotor system offers some promise for reduction of first cost and complexity of copters, and increase of their performance. Tip-mounted engines can be very simple in design and very light, but the currently used ram jets, pulse jets, and rockets are extremely noisy, and have very high fuel consumption. Currently, they are being developed principally for military applications.

The recent development of efficient small turbojet engines rated between 1000# and 5000# thrust brings up the possibility of mounting engines of this type on the rotor tips of large helicopters. (Ref. 11) Turbojets are quieter and more economical than the pulse jet or rocket engines. A 40-passenger design study is included in Table III. This does not appear to offer weight or speed advantages over existing piston engine craft of equivalent capacity, but eliminates the transmission and gearing required by the hub-driven type, and offers multi-engine safety with reduced complexity.

Helicopters - Private Flying

The initial appearance of the helicopter was hailed from many quarters as the development which would bring about the replacement of the private automobile by the private aircraft, and evoked visions of a copter in every garage (ref. 5). However, the use of helicopters as private aircraft is limited to a few relatively wealthy businessmen, who usually operate them in connection with a business anyway. They often provide their own heliports, usually smaller than the IATA recommended size, and such use as they make of public airports has had and will have very little effect on traffic density, number of airports required, or servicing facilities. The copters used are usually small, two-place, low performance machines. Until the initial, operating, and maintenance cost of helicopters can be reduced, and the reliability improved, private helicopter flying will remain an almost negligible phase of the overall aviation picture. The development of a low-powered gas turbine suitable for use in small helicopters would materially enhance the future prospects of private copter flying.

Helicopters - Special Services

The helicopter has many advantages for certain specialized purposes. Its wide visibility had its ability to hover over a designated spot make it unexcelled for certain photographic or observation missions. It has been used occasionally in the dismantling or erection of structures. Its low speed and high visibility, coupled with the ability to hover and take off or land vertically from water as well as land areas are powerful tools in search and rescue work, and in the patrol of forests, farms, transmission lines, highways, pipe lines, etc. In crop dusting, it can operate from small open fields or roads adjacent to the crop areas, its excellent visibility is a safety asset, and the downward blast from the rotor improves the distribution of dust or spray. It can provide taxi or charter service, on a short-haul basis, to many points which could not otherwise be reached except by a combination of air and ground, or water transportation. Small, low performance two- to eight-passenger copters are used for the above types of services, but their widespread use is inhibited by inherent high costs. Also, their low ceilings and rates of climb severly limit their usefulness in mountain areas, but the economic factor is the principal bugaboo of the helicopter.

Helicopters - Suburban or Interurban Service

It is frequently proposed to link the downtown areas of cities such as Detroit and Cleveland by means of helicopters. However, such services seldom materialize because of the high costs involved in all phases of the operation, and also because the low speed of the copter limits its usefulness to short-haul operations. Short-haul helicopter passenger service is available in New York, Chicago, and Los Angeles, the three most populous metropolitan areas in the United States with a combined population of nearly 24,000,000. Chicago Helicopter Airways operates only between two points, O'Hare and Midway Airports, while New York and Los Angeles Airways offer passenger services between a variety of points. These airlines operated in 1956 at load factor less than 50% (ref. 4) with fares ranging from nineteen to thirty-six cents per passenger mile. Even at these rates, extensive subsidies are required, amounting to a total of over four million dollars in fiscal 1958.

If such a service could be established in the Detroit area, the most likely route would extend from a hypothetical heliport in downtown Detroit to Wayne County and Willow Run Airports. A meeting of helicopter operators and manufacturers was held in 1956 under the auspices of the IATA and, at that time, the manufacturers were reported as optimistic concerning the possible future development of copters capable to operation with direct operating expenses of ten to twelve cents per passenger mile (ref. 4). It is estimated that for a load factor of 50%, the fare charged in order to break even will have to be about four times the direct operating costs for copters similar to current models, or at least 40¢ per passenger mile. It is estimated that current direct operating costs are from two to three times the value quoted above, so the minimum break-even fare at present would be nearly a dollar per passenger mile. Even at the possible future break-even fare of 40¢ per mile, the trip from downtown Detroit to Wayne County Airport would cost $7.20, and the fare to Willow Run Airport would be $10.80. There are always a few passengers who would be willing to pay this much to save half an hour, but it is unlikely that the 3,500,000 persons in the Detroit Metropolitan Area could support such a service without an extensive subsidy.

Helicopters - Commercial Operation

The operation of copters in connection with businesses is slowly increasing. Aside from the unique services which the helicopter can provide, there are two additional incentives. In the first place, such operations are paid for before taxes; and in the second place, indirect costs are low as there is no necessity to charge overhead for ground operations, advertising, sales, administration, etc. The most extensive use of copters for business purposes is the carrying of personnel and cargo between the mainland and offshore oil drilling rigs in the Gulf of Mexico. Even here, however, the recent trend has been toward chartering the services of fixed base operators, and away from company ownership of the copters. The economics are not greatly changed by this shift, as the usual small, fixed base operator does not have a large overhead. He will usually operate at a better load factor and can thereby show a margin for profit. The ownership and operation of copters by business and industrial firms will probably continue to increase, but not to the extent that appreciable additional capacity will be required of municipal airports, although there may be some pressure for the establishment of downtown heliports in large cities.

The use of copters by fixed base operators will continue to increase, especially if turbine-powered copters in the smaller sizes can be developed. The principal services will be crop dusting, photography, charter services, etc. Municipal, county, and state agencies, such as police, fire, conservation, and highway departments, may prefer to use charter services rather than own their own copters. The use of copters with water landing gear by well-to-do sportsmen appears to be almost a "natural" for a state with as many lakes as Michigan.

Vertical Take-Off and Landing (VTOL) Aircraft

Aside from its high first cost and operating costs, an important drawback of the helicopter is its inherently low speed. Its great advantage of being able to take off and land in small areas is lost if it has to fly any distance. To overcome this advantage, the VTOL aircraft has been investigated as a type which can rise and descend vertically, but can be converted to something resembling a normal fixed-wing aircraft for high speed flight. For this reason, it is sometimes called a convertiplane. At present, the VTOL aircraft is in a very early stage of development. Some military prototypes have been flown, but none are operational or in production. One commercial prototype has been flown in England. It is unlikely that very many VTOL aircraft will be commercially available before 1965, or that very many will be in actual airline service before 1970 at the earliest.

The VTOL aircraft which was developed by Fairey in England is called the "Rotodyne." It uses a helicopter-type rotor for take off, hovering, and low speed flight, and a fixed wing and propellers for high speed flight. In hovering or vertical flight, all the power is applied to the rotor. In cruising flight, all power is applied to the propellers, while the rotor autorotates and supplies a small part of the lift. Performance figures for the Rotodyne are given in Table IV. The speed advantage over the helicopter is not large.

The tilt-wing type of VTOL has also been successfully flown as a military prototype, although no commercial transport of this type is either flying or under construction. The tilt-wing aircraft has its wing at about 90 degrees incidence for take-off and landing. The wing is rotated slowly to near zero incidence for normal forward flight. The characteristics of a design study based on this type (ref. 12) are given in Table IV.

In the supersonic range, it should be possible to build VTOL aircraft having the same gross weight as conventional aircraft for the same speed, range, and payload, using jet engines to provide the lift. The VTOL will, of course, require many more engines but will have lighter wings and landing gear so the gross weights will be comparable. However, the VTOL will have higher first cost and higher operating costs, and also may not be able to exploit its ability to operate from close-in heliports due to the noise problem. At any rate, supersonic transports of any type are many years in the future.

A comparison of VTOL aircraft with conventional aircraft having good small-field capabilities, such as the Fairchild F-27, indicates that, in general, the VTOL aircraft will be heavier, slower, and require more horsepower, in addition to being very much more complex and expensive. The advantage of this type must come entirely from the VTOL feature and must offset poorer performance and higher operating cost by eliminating the ground transportation link between the centers of cities, for example, and the larger airports from which the conventional aircraft must operate. Since the cost of operating the VTOL will be comparable to that of a corresponding helicopter, it is doubtful if very many VTOL aircraft will be operating during the next decade. No additional airport facilities will be required for these aircraft other than helicopter facilities.

Short Take Off and Landing (STOL) Aircraft

The so-called "STOL" aircraft is probably the most neglected category of modern aircraft. Using conventional means of developing high lift, coupled with the use of large diameter, slow speed propellers for high thrust at low airspeeds, aircraft can be built which take off and land with very short ground runs, and climb or glide very steeply, as has been demonstrated through the years by such aircraft as the Curtiss "Tanager," Fieseler "Storch," and Helio "Courier." None of these aircraft were produced in quantity, (except that the Storch was used to some extent by the German Air Force prior to World War II) in spite of the fact that their performance was and is startling. Furthermore, the noise of the aircraft is greatly reduced by the large, slow turning propellers.

Some recent studies based on preliminary designs carried out in 1951 are summarized in Table V and compared with a design study (taken from Ref. 1) using boundary layer control instead of the more conventional means of supplying high lift at low speeds. Design studies A and B use existing small reciprocating aircraft engines geared down to large diameter propellers. This produces high thrust at low speeds for good take off and climb performance and quiet operation. Full span leading edge slats and trailing edge flaps develop the high lift coefficients required for low stalling speeds. Small ailerons are used for lateral control at cruising, and slot interceptor spoilers for lateral control at low speeds. All of these devices have been separately used for many years, and their combination in a single airplane results in superlative short-field performance. An existing prototype using more of these devices is the small Helio "Courier," which is one of the few true STOL aircraft in existence.

A comparison of STOL possibilities with a currently operating helicopter are carried out in Table VI. This clearly indicates that a conventional aircraft can be built which will be able to operate from a heliport adequate for normal operation of the equivalent helicopter. The STOL aircraft is not capable of taking off and climbing vertically but can carry more passengers at higher speeds on less horsepower. Furthermore, it is a less complicated machine than the copter, so will have lower first costs and maintenance costs, as well as lower operating costs and improved safety.

The Army has recently become interested in STOL aircraft, but there are few existing commercial models, none being produced in significant numbers. Because of its relative simplicity, a STOL aircraft could be designed and placed in production within a year or two if a demand should arise. If successful small or medium size aircraft with true STOL capabilities should appear, a demand for small, close-in airports to accommodate them will also arise. Cognizance should be taken of this possible demand during long-range civic planning.

The factor of usefulness is an important one for aircraft.

The automobile did not begin to appear in quantity until it became useful to a large number of people. The STOL aircraft appears to offer the best chance for an aircraft to become useful to the average individual in the near future. It cannot replace the automobile, but it can be operated out of small fields which can be located much nearer the individual's home than existing aircraft, yet its first cost and operating costs should be comparable. The possible use of STOL transport aircraft for short-haul service is discussed in Chapter II.

Aircraft with excellent short-field performance are coming into use abroad (Ref. 10) although none of these appear to exploit all the possibilities of STOL aircraft. Scottish Aviation's "Pioneer" models are used extensively in the jungles of Malaya, and the high-performance single-engine Dornier DO-27 has been ordered in large numbers by the Luftwaffe. A two-seater French design, the Morane-Saulnier "Epervier" (Sparrow Hawk) powered by a 650-750 H.P. shaft turbine takes off from a grass field over a 50-foot obstacle in 800 feet and has a 205 m.p.h. top speed. It uses full span fixed slots and long conventional landing gear. The British are developing the "jet flap," in which air is ejected through narrow slots over a trailing edge flap. In common with boundary layer schemes being studies in this country, large amounts of air are required, necessitating auxiliary power and extensive ducting with cross-overs and multiplication for engine-out safety. Jet flap or boundary layer control (BLC) prototypes are not likely to appear in the near future, but could be flying within the next ten years, although they do not appear to offer substantial improvement in performance over more conventional STOL types.

To summarize, STOL aircraft are not currently in use in significant numbers; but if sufficient demand were to arise, they could appear in a very short time, due to their relative simplicity and the ease with which they could be designed and produced. Such a type would be almost ideal for farm use, patrol applications, or short-haul passenger and cargo service and, at the same time, would be much more useful for purposes of private or business flying. STOL aircraft could fly out of heliports constructed to IATA standards, with much greater economy than helicopters. Long range planning should reserve space in residential areas as well as in downtown city areas for possible use as small "heliports" or "skyports," as discussed in Chapter IV. Such skyports would be less objectionable in residential areas than the usual airports, as STOL aircraft, using large diameter, slow-speed propellers, are inherently quiet, and the usual airport noise problem is greatly reduced.

Miscellaneous Aircraft

The shrouded propeller, or ducted fan, can produce higher static thrust than a free propeller or rotor for the same diameter and power imput (Ref. 9). It has, therefore, been given consideration as a source of lift for vertically rising or hovering vehicles of the type frequently referred to as the "flying jeep."

This type of vehicle is usually intended to operate near the ground as a means of crossing terrain which would be impassable for ground vehicles, although it is sometimes regarded as a future private aircraft (ref. 5). Several firms in this country and Canada are working on projects of this nature, using two to four rotors driven by one or more engines. Only one has flown extensively at this time, although others may be flying in the very near future. The major difficulty encountered has been one of stability in horizontal flight. The machines appear to hover fairly well a short distance above the ground or move slowly about, but high speed has not yet been attained. These vehicles are in a very early stage of development, and are not expected to be used in numbers, except possibly by military agencies, within the next ten years.

Another type of vehicle being studied both in this country and abroad (ref. 18) is the "minimum ground-pressure" vehicle, which glides on a cushion of air and does not exceed an altitude of a few inches. Its movement is not restricted by mud, snow, ice, water, or other surface conditions which impede the movement of wheeled vehicles. Prototypes has "flown" both over water and over smooth terrain. This may or may not be classed as an aircraft, but is in an early stage of development and will not appear in significant numbers within the next decade. A vehicle of this type being developed in Canada has possibilities of forward flight at greater altitudes, but is also in a very early stage of development.

Lighter Than Air

Lighter-than-air craft form an insignificant fraction of the aircraft industry, except for non-rigid craft, or "blimps" used for military purposes principally by the Navy. However, many years ago, when the present air transport system was in its infancy and even before it was born, there were successful passenger-carrying services using rigid airships, or "dirigibles," and the future of such craft seemed assured. Adverse publicity accompanying an unfortunate series of military accidents to dirigibles climaxed by the fiery crash of the Hindenburg in full view of hundreds of people speeled the doom of the dirigible, and none are now in existence. However, the technical know-how for the construction of dirigibles still exists, and improved types could be built at any time if a demand should arise. At this time, there is no indication of such a demand, and no probability that dirigibles will be constructed, but the possible future of the dirigible is discussed more fully in Chapter II.

Table I. Transport Aircraft

Aircraft	Small Transport-Piston Engine		Medium Piston Engine Transport	Turboprop Transport		Turbojet Transport	
	Old (DC-3)	Late		Small	Medium	Medium (DC-9)	Large
Wing span, ft.	95	105	150	93.5	99	94	131
Gross weight, lb.	31,000	49,100	156,000	58,500	106,700	120,000	250,000
Passengers	25	44-52	58-94	40	66-85	68-92	109-125
Cruising speed, mph	173	288	313	313	405	580	575
Cruising altitude, ft	5,000	up to 18,000	22,600	10-20,000	22,000	35,000	30,000
Normal runway required	4,900 (max)	4,700	6,500	4,700	5,250	6,000	9,000
Max. rate of climb, fpm	1,000	1,000	1,080	1,200	2,500	--	6,500
No. of engines	2	2	4	4	4	4	4
Type	Reciprocating	Reciprocating	Reciprocating (Turbine Compound)	Turboprop	Turboprop	Turbofan	Turbojet
Total horsepower or thrust	2,400 (max)	4,800	13,600 (max)	5,600 (max)	15,000 (max)	33,000 lb.	--

Table II. GENERAL AVIATION AIRCRAFT

Aircraft Type	Light Single	Heavy Single: Piston Engine	Heavy Single: Design Study	Heavy Single: Jet Engine
Wing Span	33 ft.	33 ft.	33ft.	33 ft.
Gross Weight	1450#	2750#	2905#	4360#
No. Places	2	5	4-5	2
Cruising Speed	92 MPH	178 MPH	230 MPH	230 MPH
Cruising Altitude	5000 ft.	10,000 ft.	15,000 ft.	25,000 ft.
Normal Runway Req'd.	1500+ ft.	1500 ft.	1500 ft.	3500 ft.
Max. Rate of Climb	500 FPM	1300 FPM	2900 FPM	2700 FPM
No. Engines	1	1	1	1
Type	Recip.	Recip.	turboprop	Turbojet
Total Horsepower or Thrust	85 HP	413 HP	413 HP	900#
Range	400 mi.	700 mi.	700 mi.	350 mi.

Aircraft Type	Military Trainer	Light Twin: Piston Engine	Light Twin: Turboprop	Light Twin: Turbojet
Wing Span	38 ft.	44 ft.	---	33 ft.
Gross Weight	15,000#	6000#	---	7500#
No. Places	2	5	8-12	4
Cruising Speed	495 MPH	200 MPH	320 MPH	357 MPH
Cruising Altitude	25000 ft.	10,000 ft.	10,000+ ft.	20,000 ft.
Normal Runway Req'd.	5500 ft.	1600 ft.	1200 ft.	5000 ft.
Max. Rate of Climb	3400 FPM	1600 FPM	---	2500 FPM
No. Engines	1	2	2	2
Type	Turbojet	Recip.	Turboprop	Turbojet
Total Horsepower or Thrust	5000#	540 HP	1520 HP	1800#
Range	1000 mi.	1100 mi.	1250 mi.	900 mi.

Table III. Helicopters

Type	Light (S-55)	Medium (H21-B)	Heavy (H-16)	Heavy "Westminister"	Heavy Design Study
No. of rotors	1	2	2	1	1
Diameter, ft.	53	44	82	--	115
Gross weight, lb.	6,495	15,061	46,750	--	60,000
Passengers	7	24	40	42	40
Cruise speed, mph	85	98	130	150	138
Cruise Altitude, ft.	5,000	--	5,000	--	--
Max. rate of climb, fpm	1,040	730	860	920	--
Speed of best climb, mph	52	79	93	--	--
No. of engines	1	1	2	2	4
Type	Reciprocating	Reciprocating	Reciprocating	Turbine	Turbojet
Total horsepower	600	1,425	3,300	5,210	7,700
Range, mi.	340	233	166	448	230
Hovering ceiling, ft.	8,200	1,400	--	--	6,000 (95°F)
Vertical rate of climb, fpm	720	130	--	--	--

Table IV. VTOL Aircraft

Type	Fairey Rotodyne	Tilt-Wing Design Study
Gross Weight	39,000#	60,000#
No. of Passengers	40	50
Cruise Speed	184 MPH	460 MPH
No. of Engines	2	4
Type	Turboprop	Turboprop
Total Horsepower	5210	16,000 (plus auxiliary jet engines for pitch control)
Range	300 mi.	1040 mi.

Table V. STOL Aircraft

	Design Study A	Design Study B	Design Study C
Wing Span	50 ft.	100 ft.	131 ft.
Gross Weight	6500#	18,000#	63,000#
Passengers	10	40	50
Cruising Speed	161 MPH	155 MPH	300 MPH
Normal Runway Req'd.	400 ft.	400 ft.	400 ft.
Max. Rate of Climb	1600 FPM	1000 FPM	3500 FPM
No. of Engines	2	4	2
Type	Recip.	Recip.	Turboprop
Total Horsepower	520	1040	9600
Range	900 mi.	260 mi.	100 mi.
Hi Lift Devices	Flaps, slats	Flaps, slats	BLC (auxiliary power required)

Table VI. Comparison of STOL Aircraft and Helicopter

	Design Study A	S-55*
Wing Span (rotor diameter)	50 ft.	53. ft.
Gross Weight	6500#	6495#
No. of Passengers	10	7
Cruising Speed	161 MPH	85 MPH
Cruising Altitude	5000 ft.	5000 ft.
No. of Engines	2	1
Type	Reciprocating	Reciprocating
Total Horsepower	520	600
Range	900 miles	340 miles
Max. Rate of Climb	1600 FPM	1040 FPM
Speed of Best Climb	94 MPH	52 MPH
Vertical Rate of Climb	---	620 FPM
Take Off Ground Run	150 ft.	0
Total Take Off Run Over 50 ft. Obstacle	440 ft.	455 ft. (normal operation)

* Used by New York Airways in local passenger service.

CHAPTER II

AIR TRAFFIC

Commercial Air Transport

The major portion of the passenger air traffic in and out of Detroit is interstate (some international) rather than intrastate; and consequently, the traffic trends will be closely linked with nationwide and worldwide air traffic. The CAA (not FAA) has estimated (ref. 1) that between 1959 and 1970, the number of domestic air carrier revenue passengers will increase nearly linearly from about 60 million annually to 118 million, a 96% increase. Aircraft passenger-carrying capacity of newer models can be expected to increase, so the number of flights required to handle the domestic passenger traffic at any given city will be somewhat less than double the number of flights currently operated. At the same time, the number of international passengers is expected to increase, also linearly, from about 5.5 million in 1959 to 11.5 million in 1970, or more than double. This traffic will use a proportionately larger number of big civil jet aircraft; so again, the number of flights at any given airport will not quite double. However, there is every indication that air cargo and mail service will experience an even greater percentage increase than passenger service; so it is quite likely that by 1970 or very shortly thereafter, the average large American city, such as Detroit, which generates interstate and international air passenger and cargo commerce, can expect that the number of flights required will approximately double. Whether this increase can be handled by existing airports or will require the establishment of additional airports can be determined only by specific studies of the situation at the city under consideration, with consideration being given to such factors as increased runway length requirements for jet aircraft, and increased traffic handling capacity of proposed new traffic control systems.

Cities outside of the Detroit metropolitan area which are severed by shorter flights, frequently intrastate flights, also generate interstate passenger traffic, which can be expected to follow the trends discussed above. Surveys of intrastate traffic as such are not available, but presumably are included in the CAA surveys. Consequently, it can be anticipated that the number of commercial flights to be handled at city airports other than those in the Detroit area will also double by about 1970. The necessity of additional airports or airport capacity at these points can be determined only by local surveys.

Types of aircraft expected for international and interstate passenger traffic will include the large turbojet transports which will require runways approaching two miles in length under normal conditions, and possibly as much as three miles under high temperature conditions, if the aircraft are not to be penalized by take-off weight restrictions.

Types of aircraft expected for intercity service between the larger cities within the State probably include medium turboprop aircraft, requiring runways at least a mile in length, and may include medium turbojets requiring a runway at least 8,400 feet long under normal conditions. Runways of this length will be required in order to attract the larger national airlines.

Airports at the smaller cities probably will not be used extensively for commercial air travel unless STOL aircraft are developed which can be operated economically for short-haul passenger, mail, and cargo service. Such aircraft can also be used for local service within the metropolitan area, such as aerial "limousine" service between large airports and small skyports in the downtown area. Such service could also be used to serve a large airport centrally located with respect to a number of smaller cities, neither of which alone could support such an airport. Helicopters could also be used for such services, except that, as noted in Chapter I, substantial subsidies will be required.

General Aviation

General Aviation can be classified under the headings of private and commercial flying, with commercial flying further subdivided into business flying where a company operates aircraft for purposes connected with the business and fixed base operation where an operator, located at an airport, operates charter, flight training, crop dusting, aerial mapping, or other services. Business flying may be for the purpose of transporting executives or employees of the business, or for specialized services such as aerial photography, flight testing of company products, transmission line or other patrol purposes. Government agencies may own and use aircraft for forestry patrol, fire fighting, traffic or agricultural surveys, etc., or they may charter such services from fixed base operators.

In general, post-war private flying has not increased to the extent that was originally predicted. This may be due to the high cost of flying, and also to the inconvenience involved in maintaining an airplane at an airport which may be miles from the owner's residence. Until the usefulness of aircraft becomes compatible with the inconvenience and expense involved, private flying cannot be expected to increase to any great extent. The best hope of private flying appears to be the development of small, quiet aircraft having STOL characteristics, so that they can be operated from very small fields located near or in residential areas. The appearance of such aircraft in appreciable numbers could result in a widespread demand for many small fields, or skyports, and renewed public interest in pleasure flying.

Private flying in helicopters is too expensive for all but the very well-to-do, and the "flying jeep" is in too early a stage of development to be considered. Aside from the possible development of STOL aircraft in the near future, private flying cannot be expected to increase markedly, and existing facilities may be adequate for the next ten years.

Characteristics of the small two- and four-place aircraft used for private flying and flight training are not expected to change markedly in the next decade. As stated in Chapter I, most will still be powered by piston engines with possibly a few turbo-prop types, and performance will be similar to existing models with maximum runway lengths of about 1500 feet required. This applies to the light twin-engine aircraft as well as the singles, as shown in Table II.

The use of aircraft for business purposes will probably continue to increase, as long as the tax laws are not radically revised. Four- or five-place light twins and heavy singles will probably be most commonly used, with a few heavier aircraft and possibly a few jet aircraft. The latter will be more expensive to operate and maintain and will probably require longer runways, as shown in Table II. Such aircraft can be owned only near cities which can support airports with runways a mile or more in length. A few corporation-owned helicopters mayappear, but the numbers will be small and will have little effect on airport requirements.

The seaplane deserves some special attention because of the wonderful opportunities for seaplane flying which exist in the State of Michigan. It is difficult for an old "water pilot" to understand why the seaplane is so rare in a state that calls itself the "Water Wonderland." With lakes everywhere, ringed with summer cottages and permanent homes, and lakes or rivers adjacent to nearly all cities of importance, the seaplane would appear to be the ideal type for private flying. It offers unparalleled convenience to those who live near or on a lake during the summer months. Its safety exceeds that of the landplane, as in an emergency it can land anywhere than a landplane can and will suffer less damage from a landing on very rough terrain than the landplane. Besides, there is water within normal gliding distance throughout most areas of the State. The opportunities for pure pleasure flying place seaplaning in a class with sailboating or water skiing.

Seaplanes are usually normal aircraft with the landing gear replaced by pontoons, or floats. Amphibian types have never been very successful, and are rare compared to the float seaplane. The addition of floats to the average small or medium private airplane produces a surprisingly small change in performance. The average seaplane enthusiast usually installs the floats as soon as the ice going out inthe spring, and reluctantly removes them after the first autumn snowfall. Maneuvering a float plane on the water is a bit tricky at first, but the art is soon mastered. Seaplanes can be gassed from the average motor boat service dock, if the required grade of gasoline is available, and can be moored out, beached, or operated from a small ramp. A person who lives by a body of water can have his airplane as accessible as his automobile or boat, and it is not necessary to drive to an airport before flying. It is entirely possible that some day, the Michigan flying fraternity will "discover" the seaplane just as the general public recently "discovered" the small boat, and this could result in a sudden demand for seaplane facilities.

Some cities already have seaplane facilities on lakes or rivers in the heart of the city, which makes for very convenient access to the downtown areas. A quarter of a century ago, the writer landed at a seaplane ramp at the foot of Wall Street, New York City, a five-minute walk from the financial district, and has landed at boat docks in many other cities in this country and Canada. The provision of seaplane handling and servicing facilities in some of the larger Michigan cities could result in aconsiderable increase in seaplane activity. Seaplane ramps require a very small amount of waterfront, and can easily be established at marinas with aircraft storage in depth back from the waterfront, as seaplanes can be handled or taxied on the ground with very simple beaching gear.

A drawback of the seaplane is the fact that the floats are rather expensive, as one company has enjoyed a monopoly in this field for many years. Also, of course, the seaplane cannot be used during the winter months, as the lakes and rivers are frozen during this period.

Local Passenger and Cargo Service

Local passenger service is considered to involve the transportation of airline passengers to and from the airports, commuters from suburban residential areas to urban commercial and industrial centers, and interurban passengers between cities which may be less than fifty miles apart. There appears to be less and less demand for local common carrier service as more and better highways are built. With points as far distant as northern Michigan only a few hours drive from Detroit, for instance, passenger service must be very fast, very convenient, and very economical in order to compete with the private automobile.

Local common carrier passenger traffic is currently handled largely by buses, as the railroads appear to be doing their best to get out from under what is currently, and for several complicated reasons, a losing business (ref. 13). Aircraft are not used to any appreciable extent, except for longer haul interurban service. Helicopters are used for local service in three metropolitan areas, but must be subsidized.

Bus transportation by public highway is probably the most flexible means of service in that pickup and delivery points can be provided in a large number of places, and these points can easily be relocated as future situation changes develop. Operating costs are low, as public rights of way are utilized, and the tax burden is not commensurate with the costs of providing and maintaining such rights of way. Equipment costs are low, as buses are mass produced for widespread service. Fuel costs are probably as low as for most other forms of transportation, and manpower requirements are also near a minimum.

On the other hand, even with super-highways, bus service is slow, most buses are cramped and uncomfortable, and the presence of trucks and private automobiles on the same highway introduces an element of hazard which tends to reduce the overall safety and results in delays when traffic is heavy.

A rail rapid transit system is capable of transporting passengers at higher speeds and with greater comfort and safety than in the case of buses. It is also less subject to service interruption during bad weather or rush hour traffic. Equipment and fuel costs should approximate those of buses, and operating manpower requirements should be extremely low, as the operation of trains can be automatic or remotely controlled. Drone aircraft, which operate in three dimensions, are routinely taken off, flown, and landed without a human being on board; and there is no valid reason why trains, which operate in a single dimension, cannot be completely automatic with no compromise of safety, although there may be objections from organized labor.

The rail system has the disadvantage that it requires a private right of way with its large first cost and maintenance and, in addition, it is necessary to pay taxes on the property. Elevated structures, such as would be required by a monorail, could be constructed above existing railroads or highways and subways could be installed below them, greatly increasing the capacity of the original right of way, but the cost of elevated structures or subways would tend to offset this advantage. It is therefore unlikely that efficient rapid transit systems can be provided without some form of subsidy, or else the overhauling of outmoded labor policies and an antiquated tax structure. It should be pointed out that bus lines receive an indirect subsidy in their use of public highways, while airlines are similarly subsidized indirectly.

If large cities are to exist in the future in substantially their present form, some sort of rapid transit system appears highly desirable, and buses operating on the public streets is only a makeshift solution to the problem. Large municipalities may find it desirable to subsidize a rapid transit system rather than suffer the slow dispersion of industry and commerce to suburban or even more remote areas. However, if such a rapid transit system is to be provided, whether it be a general system or a specific line to serve an airport, so many contingencies and ramifications are involved that years can pass in frustrating negotiations so that if and when the system finally becomes possible, its potential usefulness may well have evaporated.

There is a solution to the problem of rapid transfer of airline passengers between downtown cities and airports and also to certain general rapid transit problems, which can be applied in the near future and which appears to be economically feasible. This is the use of STOL aircraft operating from small fields within the city, small riverside or lakeside airstrips in the downtown area, rooftop skyports, or between the lanes of express highways. At the airport, these craft could land between the runways, on taxiways or parking ramps, or on small auxiliary airstrips.

At first glance, the use of helicopters for such a service would appear to be almost ideal. Existing copters can handle up to 40 or more passengers at speeds of 100 MPH, and can surely provide the rapid, convenient service required. However, the copter is inherently a complicated, expensive machine with high operating costs, maintenance costs, and fixed charges. As a consequence, passenger service is not economically feasible except by subsidy in the very largest cities; and even there, only a few passengers can afford it and the majority must rely on buses, limousines, taxis, or private automobiles. VTOL aircraft, such as the Rotodyne, will have similar disadvantages for short haul runs, but may be more nearly feasible on longer intercity runs.

It has been brought out in Chapter I that it is entirely possible to build fixed-wing aircraft which can operate from heliports which are constructed to IATA standards, and which have lower first cost, operating costs, and maintenance costs, and at the same time improved safety and reliability when compared to the helicopter or VTOL aircraft. These aircraft would be simple to design and construct, and can use engines similar to those used in considerable quantities for light aircraft. First costs should be comparable to those of the larger private and executive type aircraf, and maintenance should be at a minimum. Fuel consumption at cruising settings results in a figure of nearly 75 passenger miles per gallon of fuel, which is similar to that of buses and private automobiles.

A minimum crew of two will be required, as against a single driver for buses. However, the number of passenger miles per vehicle per day is much larger, as the greater speed of the aircraft permits more trips for the same crew and vehicle than for the bus and driver.

The place to start an aerial passenger system would probably be in a service between the central areas of cities and the airports which serve those cities as, in general, airports can seldom be located for convenient access to city centers. For example, aircraft similar to those in Table V could make a trip from downtown Detroit to Willow Run Airport in 10 minutes flight time at 160 MPH. Because of the ability of the STOL aircraft to fly safely at very low air speeds and because of its multi-engine safety feature, it is assumed that it will be possible to obtain authorization for such aircraft, whenoperated in scheduled service, to utilize traffic patterns below those of conventional transport aircraft, to avoid mutual interference, and eliminate approach delays. It is further assumed that the STOL will be authorized to land off the runways at the big airports and near the loading ramps so that taxi time can be reduced to a minimum. It is therefore estimated that about five minutes will be required for taxi-take-off, approach, and landing. The trip from Detroit to Willow Run Airport can then be made in a total time of 15 minutes as against 50 minutes by bus. Assuming 10 minutes for loading in each case, it is possible for the aircraft to make more than twice as many round trips as the bus in a given length of time, transporting more than twice as many passengers. The air crew will be more expensive per man hour, so the direct operating costs per passenger mile will probably be slightly larger for the airplane. Maintenance costs and fixed charges will also be higher, so an unsubsidized "flying limousine" service will not be quite as economical as the bus line, but the difference will not be large and, for a substantial number of airline passengers, the convenience and the saving of valuable time will more than offset the small price differential. The slower and much less economical helicopter could not successfully compete with the buses over the same distance without a substantial subsidy.

Such a means of rapid and economical transfer of passengers from city to airport can also make it possible for cities which are too small to support a large commercial airport capable of attracting the large national or international airlines to combine with neighboring cities to build an airport serving several cities through the medium of an aerial rapid transit, or "limousine" service. This service can be logically extended to become an interurban network with intermediate airport stops, carrying mail and express as well as passengers.

All large cities have commuter troubles. Railway commuter services are losing money for reasons not likely to be corrected in the foreseeable future and are attempting, fairly successfully, to wash their hands of the business by making the service as unattractive as possible. In the words of a noted author (ref. 19), "When I first moved to the suburbs, our local railroad was a means of transportation. Today, — and I gather from the public prints that the same is true of almost every commuters' railroad in the country, — the seats are filthy, the washrooms detestable, the conductors sullen, the fares outrageous, the schedules lies, and the passengers helpless victims of the whole miserable system." Bus service, especially during the rush hours, is slow and uncomfortable; and so the majority commute by private automobile, suffering the annoyance of the accompanying traffic and parking problems. Express highways leading into the centers of some of our largest cities have speeded up automobile commuting, but it is still likely that there are a large number of persons who would prefer to commute by common carrier if the service were sufficiently convenient and attractive, and comparable in expense to operating an automobile.

Consider the case of one small city on the outskirts, but not really a suburb of a nearby city. It is estimated that approximately 1200 persons commute daily from Ann Arbor to Detroit, a distance of about 40 miles. Approximately 85 use rail transportation and a similar number uses buses, while at least 1000 or more use private automobiles. Station-to-station rail service requires 45 minutes, bus service requires one hour and 37 minutes, while, during the rush hours, autos require about an hour to reach a point in downtown Detroit.

An aerial commuter service with STOL aircraft using the existing Ann Arbor airport and an assumed skyport in downtown Detroit, an airline distance of 37 miles, would require 14 minutes flying time at 160 MPH plus an assumed five minutes for ground and approach time, or a total of 19 minutes. This is less than half the time required by rail, about one-fifth of the time required by bus, and less than a third of the time required by automobile. A small skyport located close in to Ann Arbor would reduce the local ground transportation time, and could make an aerial commuter service more convenient than any existing means of transportation. It has already been pointed out that STOL aircraft can be operated at direct operating costs per passenger mile which are comparable to those of buses.

In conclusion, the demand for local common carrier passenger service appears to be decreasing as improved highways increase the utility and speed of the private automobile. However, it is likely that a really fast and convenient passenger service could find a sizable market if it can also approach buses and private cars in economy. Helicopters can provide fast, convenient service over short stage lengths, but cannot compete with surface transportation except by means of a considerable subsidy. However, it is possible for STOL aircraft to operate from small fields, substantially the same size as heliports, with direct operating costs only slightly higher than for buses. Such aircraft are not available at present, but could be designed and produced quickly if a need should arise. Their appearance could result in a demand for many small skyports in urban areas. These could be rooftop or riverside strips, or could use the parkways between lanes of express highways. This possibility should be kept in mind when plans are drawn for future space utilization in large cities, as well as smaller cities and towns.

Military Flying

Characteristics of future military aircraft, the composition of the military fleet, and the nature of military flying are highly classified and not available to the general public. Most military flying, of course, will continue to be carried out from strictly military bases, and the occasional military aircraft which lands at a civilian airport will not cause undue problems at such airports. The major problems presented by military flying involve separation of military traffic from civilian traffic. This is under the cognizance of the FAA, which is developing traffic control procedures which will take this factor into account. Future bases, or expansions of existing bases, can be predicted only by defense agencies.

Missiles and Rockets

Missiles and rockets, including rocket-powered aircraft, are and will remain principally under the cognizance of government agencies. Defensive missile firing sites, such as the existing Nike installations, can be expected to increase in number and scope as long as the international situation remains in its disturbed and uncertain state. The extent of such possible future missile activity cannot be anticipated by civil agencies.

Rockets for research purposes are usually fired from established firing ranges, none of which exist in Michigan. The smaller research rockets, such as those used for upper atmosphere investigation, can be fired from temporary sites, and require rather small ranges, although dispersion is a problem if the experiment is to be carried out near populated areas. Such rockets could be fired safely over water from many places in Michigan, although at present there is no known requirement for such firings. If this problem ever arises, it should not be difficult to establish ad hoc procedures for safety and coordination with air and water traffic.

Rocket firings of this nature would be carried out by responsible agencies, usually government activities such as the Army or the Weather Bureau, who would be expected to take every possible precaution to insure that everyone who could be even remotely concerned would be kept advised of developments, and no planning is required at this time. However, it should be borne in mind that makeshift rockets have, in the past, been constructed and fired by less responsible parties, and the Michigan Department of Aeronautics should inquire into its responsibilities with respect to the regulation of such groups.

Lighter Than Air

Lighter-than-air aircraft have not been an appreciable factor in air traffic for many years. Blimps are a very useful military took, especially in anti-submarine warfare, where the craft's ability to hover or to cruise for long periods of time without landing enables it to perform long-range search and patrol missions over the ocean. An occasional blimp is used commercially for advertising purposes, but these operate with minimum crews out of small fields, and place no strain on existing facilities.

However, the lighter-than-air people, both in this country and in Germany, are firmly convinced that rigid aircraft, or "Dirigibles," withdisplacements up to several times that of the Hindenberg or Graf Zeppelin have great possibilities as aerial freighters (ref. 20). Such ships could be built fairly inexpensively, and with boundary layer control, could cruise economically at about 125 MPH. They would have great lifting power, extremely long range, and cargo space approximating that of 25 boxcars. Since more than 99% of all cargo still travels by surface carriers, there is a vast field for expansion of air cargo services if an economical carrier, such as the dirigible, could be developed.

If such a service were to be undertaken, the aircraft could be produced and be operative within about three years. The first ships would be diesel or diesel electric craft, but the next logical step would be the installation of nuclear power plants. The tremendous lifting power of the lighter-than-air craft would enable it to lift the heavy nuclear reactor and associated shielding with ease, whereas the difficulty of shielding has been the major stumbling block in the attempt to use nuclear power in heavier-than-air aircraft. Furthermore, the dirigible does not expend power in order to provide the necessary lift, as does the HTA aircraft. Power is needed only in order to move from place to place. Nuclear-powered dirigibles might appear within ten years, if dirigible freight services were to be undertaken in the near future.

Such a freight service could probably be started as an intercontinental freight line except that, unlike ocean vessels, the dirigible would not be limited to seaports but could take on and discharge cargo at any city in the world. It would not attempt to operate out of existing commercial airports with their dense traffic of HTA aircraft. Techniques currently in use for Navy blimps would enable the dirigible to be handled by a small number of persons with a few tractors. Any small field with access to highway or rail facilities for cargo forwarding would be adequate. The dirigible would never need to be placed in a hangar except at long intervals for overhaul purposes. If nuclear-powered, it need not even be refuled between overhauls. It would normally fly at low altitudes and would have little or no effect on airway traffic densities at altitudes normally used by HTA transport aircraft.

Just as in the case of ocean freighters, a few passengers could be accommodated in unbelievable luxury, spaciousness, and comfort. Facilities would be provided for landing helicopters or STOL aircraft aboard the dirigibles in order to transfer the passengers to or from skyports at their destinations or points of origin, or to HTA airline connections at commercial airports. International flights would be met at sea by customs officials; and all customs formalities would be completed very conveniently by the passengers while still in flight, effecting a considerable saving of time. No passengers need be handled at the small fields where the cargo is transferred.

A fact often overlooked is that, in spite of numerous accidents to military dirigibles in the past, commercial dirigibles had an enviable safety record. In nearly three decades of commercial operation, including international service between Europe, North America and South American at a time when intercontinental services in HTA aircraft did not exist, no paying passenger ever was killed until the unfortunate Hindenburg disaster, the only fatal accident to a commercial dirigible. Even in this case, it is remarkable that so many passengers escaped. The use of helium instead of the inflammable hydrogen would eliminate the major factor leading to the Hindenburg accident. When properly handled, dirigibles have been able to survive storms of great violence, but normally avoid storms by means of their great range and endurance. Lighter-than-air transport could well be safer than any other form of common carrier transportation service.

In spite of the attractive picture painted above, a dirigible freight or passenger service, like the possible STOL passenger service, is not likely to be established until an actual need is recognized and financial backing is forthcoming. Such services may be kept in mind for possible planning purposes, but their actual appearance cannot be predicted with certainty.

CHAPTER III

Air Traffic Control and Air Safety

The control of air traffic is the responsibility of the Federal Aviation Agency (FAA), formerly the Civil Aeronautics Authority (CAA). This agency has, by law, the sole responsibility for the establishment and operation of a common civil-military federal airway system comprising air traffic control, navigation, and flight information services. The establishments which the FAA will operate in Michigan and its control over aviation within the state are not the only aspects with which the Michigan Department of Aeronautics should be concerned. The future plans of the FAA and the mechanics by which it expects to implement these plans are of interest to all persons connected in any way with aviation. These plans (ref. 2 and 3) will be briefly summarized in the following paragraphs.

Air traffic in general is a short haul business as indicated by the fact that over 50% of the instrument flight rules (IFR) flight plans went less than 200 miles; and this situation is not expected to change in the foreseeable future. There are a number of indices for air traffic operations in good weather (VFR), but a good indication of VFR usage of both terminal and enroute airway facilities is the number of itinerant aircraft operations (air carrier, general aviation, and military) handled by airports with FAA traffic control service. Recent trends indicate that the number of such operations will double in the period from 1958 to

1970. It is expected that the number of instrument approaches will triple during the same period of time. It is interesting to note that in 1957 general aviation accounted for less than 10% of these instrument approaches, using tax-supported facilities. Military aircraft accounted for 27%, and air carrier aircraft for the remainder.

The present federal airway system includes a widespread net of visual and electronic aids to navigation and landing, extensive air-ground and point-to-point communications, dissemination of weather information and notices to airmen, and the control of air traffic at airports and in designated airspace which, as of December 1957, includes all airspace above an altitude of 24,000 feet over the continental United States.

The system serves both civil and military traffic. At civil and joint civil-military airports, it includes the terminal navigation aids and traffic control devices. At military air bases, airport traffic control and often approach control is exercised by the military agencies. However, these bases generate traffic to be accommodated by the federal airway system, and therefore are tied in with the air route traffic control (ARTC) centers for the clearance of traffic into and out of the system.

The expected increase in air traffic is coupled with an ever-increasing divergence of aircraft performance characteristics. Today aircraft using the federal airways have speeds ranging from 100 MPH to over 600 MPH, and fly at altitudes up to 40,000 feet and more. Current standards of separation require that the block of protective airspace which must be provided around an aircraft traveling at 360 MPH is ten miles wide, 1000 to 2000 feet thick, and 60 to 90 miles long, depending on the altitude and the available navigation aids. The length of the block severely limits the number of such aircraft which can be accommodated at a given altitude on a single airway. Aircraft flying at different speeds present the problem of overtaking, and the air traffic controller must place increasing reliance on lateral separation through the use of multiple tracks, or airways, and radar procedures. The higher general level of current aircraft speeds is a further complicating factor, as earlier action must be taken in a given case to eliminate potential traffic conflicts.

The need for immediate improvements is being met by the Federal Airway Plan which extends through 1936 and uses elements of the existing federal airway system, with expanded and improved facilities integrated into the system as they become available. The first elements of automation are already in operation at some of the ARTC centers. The Airways Modernization Board (AMB) was created by the Congress in 1957 to accomplish the planning and development of the new devices which will be needed to cope with traffic in the years beyond the scope of the present plan. The FAA and the AMB are cooperating to insure that the immediate improvements which are being planned by the FAA to meet current and near-future traffic requirements will be compatible with what the AMB will be developing for the less imminent future.

Expansion of the air navigation network is based on two objectives: increased traffic capacity, and extension of navigation coverage. The planned expansion includes additional long-range radar, airport surveillance radar, airport surface detection equipment, precision approach radar, airways traffic control radar beacon system (secondary radar, i.e. transponder equipment in the aircraft), new air route traffic control centers, direct controller to pilot, air/ground radio communications, automatic flight data processing, airport traffic control service, direction-finding equipment, air traffic communication stations, point-to-point commubications, international air traffic communication stations, VORTAC short-range navigation system, ILS instrument landing system, approach lighting systems, sequenced flashing lights for approach systems, and other facilities. None of these will be described here.

Before the end of 1962, the FAA expects to be able, through application of radar and other advanced techniques, to provide positive control and separation for each aircraft movement above 15,000 feet altitude within the continental United States, regardless of weather conditions. Despite the tremendous increase in facilities that must be provided for this plan, it is the firm belief of the FAA that this is the only practicable way in which the very difficult problem of collision avoidance at jet aircraft speeds and high altitudes can be solved in the near future.

The plan was developed in recognition of increasing military and civil requirements for additional air traffic control service for aircraft traveling at speeds and altitudes which make avoidance of collision by the "see and be seen" principle a difficult and doubtful procedure. There does not seem to be any hope for the development of automatic collision warning devices within the foreseeable future (ref. 7). The plan also recognizes the need for additional flexibility in the selection of tracks by high speed, high altitude aircraft, and the desirability of more direct flight between terminals for these aircraft.

A relatively limited number of high altitude navigation aids will be employed for the high altitude traffic control plan, and a route structure for flights above 27,000 feet, the ceiling of the federal colored and Victor (omnirange) airways, is specifically designed for high speed, high altitude operations. These high altitude facilities are used to delineate a system of high altitude tracks called "jet routes," which are depicted on USAF charts available to civil users through the Coast and Geodetic Survey.

The FAA is currently installing a VHF/UHF air/ground communication system which will provide direct pilot-controller radio communication throughout the airspace above 15,000 feet over the entire domestic U.S.A. This will enable the controller to have a more accurate idea of the pilot's position at any instant so that the time separation of aircraft along the airways can be reduced, and more aircraft can be flown over a given runway.

As more and more aircraft are enabled to use the airways, terminal facilities will become more crowded and the instrument landing procedures will present bottlenecks to the smooth flow of traffic. The use of dual runways can permit simultaneous landing and take-off operations with minimum spacing between departing and arriving aircraft, to permit "wave off," or "missed approach" procedures without undue danger of collision with aircraft taking off. The use of high intensity approach lights will reduce the number of missed approaches, and further increase the number of aircraft that can be landed in a given period of time. Existing types of instrument landing systems, such as ILS and GCA, will continue to be used, and new types which may be developed in the next ten years will not involve extensive changes in airports, or the planning therefor.

Long-range radar with altitude identification for enroute traffic control, with surveillance and approach radar for area control, will enable the controllers to maintain minimum separation of aircraft along the airways, permitting more aircraft to use the airways.

Such procedures may saturate existing airports serving large cities such as Detroit, and may necessitate the use of multiple airports withlocal shuttle service. As discussed in Chapter II, this could be provided by subsidized helicopter service or by unsubsidized STOL aircraft. Both of these offer the possibility of operation without interference with the normal transport traffic.

The characteristics of turbine engines, both the turbojet and the shaft turbine, are such that aircraft using this type of power plant will normally cruise at altitudes considerably exceeding those at which piston engine aircraft normally operate, and cannot economically depart from the optimum operating conditions. This relative inflexibility places particular emphasis on pre-flight planning, so that accurate meteorological information must be available for higher altitudes. The introduction of turbine-engine aircraft is taking place in a period of phenomenal growth in air traffic. Weather is and will continue to be a major factor affecting airspace and airport utilization. The safe and efficient operation of the number of aircraft to be accommodated will call for improved meteorological services for all phases of aircraft operation. The dependence of turbojet and turboprop take-off thrust on temperature reduces the tolerance on temperature prediction. Forecasts of upper air wings, jet streams, and tropopause heights will assume new importance, and forecasts of cloudiness, turbulence, hail, icing, etc., will require increased accuracy. New methods of gathering data, and new instruments may have to be developed for the measurement of such elements as gustiness and vertical motion in the atmosphere, and the collection of basic data, its evaluation, and dissemination must be accelerated. The entire forecase responsibility may have to be reallocated, with greater centralization, increased automation, and improved facsimile communication, ultimately linking with outlying territories and states, and certain foreign meteorological offices.

The question of obstructions, such as chimneys, water tanks, transmission lines, etc., in the vicinity of airports has long plagued the airport planners. Under future conditions of high traffic density and flat trajectory aircraft, such obstructions cannot be permitted above the 1 in 50 glide plane discussed in Chapter IV. New airports will have to be located in outlying areas so as to avoid such obstacles, or legal processes for the elimination or relocation of the obstacles must be provided.

In areas more distant from airports, tall radio or television towers are frequently encountered, which are not easy to see from the air in normal weather conditions and are extremely difficult to detect under conditions of low visibility. The presence of suchtowers is indicated on navigational charts, but an out-of-date chart or a small error in navigation can place an aircraft in a dangerous position.

Regulatory action should be taken to reduce the hazard by requiring the use of modern high-visibility paints or other means of increasing visibility during daylight hours, as well as adequate night lighting. The foregoing should apply both to towers and to such guy wires or other wires which may be attached to the structure. Maximum permissible heights for such towers should be established by law, and the future construction of any structure whatsoever which extends above the minimum permissible flight altitude should be permitted only after exhaustive investigation into the need for the structure as against the hazard to flight. In the absence of national regulation, it may be advisable for individual states to assume leadership.

CHAPTER IV

Airport Planning

Metropolitan Airports

Airport planning is to be discussed from the overall point of view of size, location, and access, with less attention to details such as arrangement, runway or taxiway capacity, etc. Individual studies of particular airport or airport requirements will be necessary for detailed planning. Major city airports must be able to handle the transport aircraft used by commercial airlines, so airports must be geared to the aircraft of the future which will some day use them. Airport planning is not a function of local of state agencies alone, but these agencies must coordinate their plans with the FAA.

The size of an airport is determined primarily by the lengths of runways and approach paths required. It will be seen from Table I that aircraft currently used or in prospect may require runways nearly 10,000 feet long under normal operating conditions. However, it is necessary to take into consideration the fact that future large aircraft will tend toward the gas turbine type of power plant, which is much more sensitive to operating donditions than the reciprocating engine. For a 10° F. increase in ambient temperature, the piston engine loses 1% in power, the jet engine loses 3%, and the turboprop loses 4% to 5%, although these figures are reduced when water injection is used (ref. 2). The effect of power loss, aggravated by the effect of air density on lift, is to decrease the rate of climb and increase the take-off distance as temperature increases, or to require a decrease of take-off weight in order to keep within existing field dimensions. The larger effect of temperature on the turbine engine is accounted for in recent changes to theCivil Air Regulations (Special Regulation 422). At standard temperatures, normal gross weights, and field altitudes of 1000 feet or less, no turbine-powered transport currently available or under development requires more than 10,000 feet of runway. However, on hot days, with gross weights permissible under Special Regulation 422, certain aircraft under development may require runways between 14,000 and 15,000 feet long at a temperature of 100° F. Such a temperature is occasionally encountered in Michigan during the summer months. If runways approximating three miles in length cannot be provided, at least provisions for future extension to this length should be included in any adequate airport plan.

For airport planning purposes, theobstacle plane, according to existing FAA criteria, has a slope of 1 in 50, starting at a point 200 feet from the end of the runway, although aircraft designed to SR-422 may have a flatter take-off slope under high temperature and high load conditions. Therefore, an object 100 feet in height could not be located closer than one mile from the end of the runway. Runway length plus obstruction-free distance adds up to a minimum diameter of five miles for the airport. This, of course, does not mean a five-mile square or circle, as compromises usually must be made for terrain or other problems at particular locations.

Airports which will be adequate under any conditions to handle the large transports which may appear within the next ten years should therefore be planned with sufficient space for accommodating runways and approaches at least five miles in length. Such airports will require on the order of 20 to 25 square miles of surface area, and therefore cannot be located near the centers of large cities which provide the traffic to support the airlines which will operate these new planes.

Community opposition to aircraft noise has been and will continue to be a serious problem to airport expansion or relocation. Our largest city is now having noise problems in connection with jet operations out of its international airport (ref. 15). Population growth in recent years has been concentrated almost entirely in the large metropolitan areas which originate and terminate more than 98% of airline traffic. At such high density airports, the density of traffic will probably prevent the use of the special low-noise flight procedures (ref. 14). The newer transport aircraft will be inherently more noisy than existing aircraft because of the higher speeds and larger power plants. It is likely that these aircraft may require larger traffic patterns in the vicinity of airports due to their higher speed and consequent larger turning radius. This may vastly increase the apparent dimensions of an airport by surrounding it with a "noise" area where population density should be low. The NASA and the British are carrying out basic research on aircraft noise generation and reduction. The noise of a high speed aircraft can be reduced somewhat, but at a cost level which the airlines are not likely to accept, and which may not be acceptable to residents in areas adjoining airports. Barring a major breakthrough, the noise problem will remain an important factor in airport planning, and will tend to force airports even father from the centers of the large cities which can support them.

The advent of the new jet powered transports will bring to the air passenger a level of comfort and speed which should accelerate the rate of growth of air traffic. It has been estimated the the number of domestic air carrier revenue passengers will double between 1959 and 1970, while the number of international revenue passengers will more than double during the same period. By 1970, 10% of all passengers will be carried on international flights, which will use large, high-speed aircraft which must operate from the large airports discussed above.

New traffic control precedures planned for the future were discussed in Chapter III. These will permit more aircraft to use the federal airways, and also will speed up the process of taking off and landing so that the capacity of a given airport may be expected to rise; and unless a given airport is currently operating far below capacity, it may easily become saturated within the next decade and additional entirely new airports may be required for some of the larger metropolitan areas. In this event, the question of possible overlapping traffic patterns may arise if airports are located too close together. Turning radii of future high-speed aircraft will increase the size of such traffic patterns, and it is not too early to consider the possibility of supersonic aircraft, even though these may not appear within the next ten or more years.

If this expected increase in air travel is to develop, it must be kept in mind that the airport-to-airport flight in the fast modern plane is but one of three phases of the entire trip from point of origin to destination. A second phase concerns ticketing, baggage handling, terminal waiting, check-in, and boarding procedures. It is disheartening to make a quick flight over thousands of miles, then be required to walk an interminable distance along a drafty corridor, stand in line before an overworked agent, and then find no place to sit while waiting for a connecting flight. Airport terminals should be designed for the most efficient handling of passengers and baggage, automatic machinery can speed the ticketing procedure, while buildings and waiting rooms should be adequate, comfortable, and esthetically satisfactory.

However, the passenger must still accomplish a third phase of the transportation system, namely his trip from the city to the airport and the corresponding trip at his destination. Through the years, there has been consistent improvement in aircraft speed and comfort, but the ground transportation to the airport has shown little improvement. The passenger must view air travel or any other kind of travel from an overall point of view, from place of origin to final destination. With the great increase in speed and comfort which the jet liner will bring, long and tedious trips between airport and city will appear increasingly unreasonable. The initial and final phases of the air transport system, the passenger's trip from city to airport and return, should receive the same imaginative treatment that the aircraft and the airport terminal should receive in the jet age.

Many passengers arrive at the airport terminal in their private automobiles and are at once faced with the parking problem. Airport planners, in common with city planners, seldom appear to realize the extent to which the average citizen depends upon his automobile or to comprehend the magnitude of the space required for its storage when he is not using it. One may decry the volumetric inefficiency of the modern automobile, but its existence is a fact which must be reckoned with, and valet parking at fancy rates is not the answer as far as the average airline passenger is concerned. Adequate parking space, multi-level if necessary, should be provided close to the terminal, with enclosed access corridors or subways leading to the terminal. Such parking can be provided at rates which existing parking structures have shown that the public will accept, and provisions for its expansion in future years should be included.

The common carrier passenger also requires better treatment. Since the airport of the future will probably be remote from the city it serves, it is up to the planners to consider the provision of fast, frequent, convenient, and comfortable transportation between all the airports serving a given city and as many points as practicable within the city. This can be done in a number of ways. It can be ground or air transportation and may or may not be integrated into other transportation nets not primarily for the purpose of serving the airports. Ground transportation can be by rail or highway, and air transportation can be by VTOL aircraft, helicopters, or conventional aircraft with STOL capabilities.

The separate possibilities are discussed in detail in Chapter II, where the conclusion is drawn that the major percentage of passengers using public transportation to the airport will probably continue to arrive in buses or limousines during the next decade. This service will be speeded up somewhat as new "super highways" are built, but it is still the slowest and least comfortable phase of the traveler's journey.

However, as pointed out in Chapter II, the most logical way for the prospective airline passenger to reach the airport in the "air age" is by air, and it is entirely possible that this can be done speedily and economically by the use of STOL aircraft operating from small heliports, or "skyports" strategically located throughout the area served by the large airport. It is further pointed out that these aircraft, due to their inherent characteristics, could operate in and out of airline terminals without interfering with normal airline traffic. Such a service could cut the time required to travel from downtown Detroit to Willow Run airport to one-third of its present value, and at rates which can seriously challenge the buses. The STOL aircraft would have to be designed and placed in production, whereas existing helicopters could do the job although only by means of a substantial subsidy. However, no heliports exist, and by the time these could by ready, the STOL aircraft could be ready and the service could be established without subsidy.

The establishment of such aerial limousine service at reasonable rates will bring the third phase of the airline passenger's point-to-point journey up to date and in tune with the swift intercity link which he will enjoy in the jet age. Since the airport cannot be brought to the passenger, the passenger must be brought to the airport, and plans for future airports as well as the expansion of existing ones should consider the encouragement of such services by providing for the needed satellite fields in the area to be served.

Heliports, or Skyports

The planning for extremely small fields to be used by helicopters or STOL aircraft will be discussed from the standpoint of the existing helicopter, since adequate heliports will require little or no modification to serve the STOL aircraft. A heliport may be considered to comprise four elements:

1. A pad, or pads, where the copter actually comes to rest and takes off.
2. An obstruction-free area where forward speed may be reduced for landing, or acquired for climb-out. This corresponds to the runway of a conventional airport.
3. Access areas where obstructions are limited in height to permit let-down and climb-out flight paths.
4. A service area for parking helicopters, for a terminal building, etc.

The size of the pad is variously recommended (ref. 4). Sikorsky recommends a square area with sides equal to $1\frac{1}{2}$ times the main rotor diameter as a "minimum size for an occasional landing under ideal conditions." For the Sikorsky S-55 helicopter, used by New York Airways, this requires an 80-foot square which is the size adopted by the New York Port Authority for routine operations. If two or more helicopters are to use the heliport simultaneously, there must be a corresponding number of individual pads separated by a reasonable distance to eliminate dangerous air currents between aircraft. The pad should be paved to provide a surface free of loose particles subject to rotor blast.

The size recommended for the obstruction-free area, or runway, ranges from 200 x 400 feet to 200 x 800 feet. The IATA recommends a length of at least 400 feet. However, the S-55 copter requires 455 feet to clear a 50-foot obstacle after take-off, so 500 feet appears to be a reasonable length for current requirements.

Access areas should provide obstruction-free flight paths with clearance-plane slopes of 1 in 8. The access areas should also include some open spaces for emergency landings. These can be parks, golf courses, rivers, lakes, parkways with wide center strips or adjacent space, or other open areas.

The service area needed will vary widely, depending on the amount and type of activity at the heliport. Space will be needed to park one or more helicopters, a small building will be required as a terminal building, and fire extinguishing equipment will be essential. Auto parking must be available in the vicinity.

All in all, an adequate heliport uses or affects a sizable land area, and is difficult to locate in a large city where no open spaces exist, unless it can be placed adjacent to a river or lake, with all approaches made over water. By this means, access and obstruction-free areas over land can be virtually eliminated, and the heliport reduced to its minimum dimensions. For example, the New York Port Authority heliport at West 30th Street occupies an area 400' x 70' along the water front, with two 80' x 80' pads, each extending about 40' over the water. The pads are supported by piles. Such a heliport would not be adequate for use by STOL aircraft.

It is often suggested that heliports be located on rooftops. This has many advantages, including the possible elimination of access and obstruction-free areas, due to the height of the heliport itself. Also, the heliport can be located at or near major sources of potential passengers. However, on tall buildings the provision of adequate structural support, except for small two or three place copters, will be a major problem. Access to and from the street level must be provided, and there are problems of fuel supply, difficulty in handling disabled copters, and inaccessibility from municipal emergency equipment. Such heliports would probably have to be limited to the landing pad alone, which is scarcely adequate for commercial operation.

In the case of low buildings covering a relatively larger area, such as warehouses or parking structures, it is easier to provide the structural strength for operation of transport helicopters, and also simpler to provide passenger access to the street, terminal facilities, etc. There is adequate space for multiple copter operation and copter parking, and handling facilities for disabled copters, emergency equipment, etc. Such buildings, especially parking structures, would be excellent sites for rooftop heliports.

Other possible sites for heliports could be located on the center strips of parkways or superhighways, or adjacent to such highways. However, this means that space for the heliport must be provided during the planning for and design of the highway. Relocation of traffic lanes of existing highways to provide more space in the center strip would be difficult. If heliports are also to be used for STOL aircraft, few changes are required. The STOL aircraft could not use the absolute minimum heliport, where only a landing pad is provided, but aircraft of the type listed in Table V can operate out of heliports constructed to the IATA recommendations and from even smaller areas at reduced load. For example, Design Study B, with 10 passengers instead of 40 can take-off over a 50 foot obstacle in 222 feet with a ground run of less than 100 feet. With corresponding wing loadings and power loadings, STOL aircraft of any required capacity can be built to operate from areas of similar size.

Since the helicopter is currently such an uneconomical machine, and will remain so within the foreseeable future, its widespread use of unlikely except for certain specialized purposes. It is therefore recommended that any heliports which may be planned for the next ten years be designed to IATA standards, so that these heliports may be used by STOL aircraft if desired.

Intermediate Airports

The huge airports required for existing and future jet aircraft and the small skyports for STOL aircraft and helicopters have been discussed above. Much of what was said about the large airports applies qualitatively to the smaller airports serving cities of intermediate size. The passenger must be brought to the airport expeditiously, and his comfort and convenience must be served after he has arrived. The capacity of the various airport facilities and the lengths of the runways are elements which must be tailored to fit the requirements of the particular city or cities to be served. Quantitative requirements can be determined only by careful local study of the individual case under consideration, and a determination of the type of aircraft to be accommodated.

REFERENCES

1. "National Requirements for Aviation Facilities: 1956-75," final report prepared by Cornell Aeronautical Laboratory for Mr. Edward P. Curtis, Special Assistant to the President for Aviation Facilities Planning.

2. "Jet Age Planning," A Report of Progress and Developments as of January, 1958. Progress Report No. 3. U.S. Department of Commerce, Civil Aeronautics Administration.

3. "Federal Airway Plan - Fiscal Years 1959-1963," U.S. Department of Commerce, Civil Aeronautics Administration.

4. "Helicopter Service Requirements of Pennsylvania," Frederic P. Kimball, Aviation Consultant, Westport, Connecticut, March 1957.

5. "The Development of thePiasecki 'Sky Car'," F. N. Piasecki, SAE Reprint, February 16, 1959.

6. "Flight Testing Experiments with the Tilt-Wing Aircraft," W. Z. Stepniewski and Paul J. Dancik. IAS Report #59-8, January 26, 1959.

7. "Fundamental Physics of the Aircraft Collision Problem," J. S. Morrel, Technical Memo 465-1016-39, Juhe 1, 1956, Bendix Aviation Corporation.

8. "The Case for the Supersonic Transport," Hall Hibbard and Robert A. Bailey. P. 32, Aero/Space Engineering, Vol. 18, No. 7, July 1959.

9. "Shrouded Propellers and Their Application," Robert K. Wattson and Vernon O. Hoehne. P. 58, Aero/Space Engineering, Vol. 18, No. 7, July 1959.

10. STOL's and VTOL's Highlight European Progress," Space/Aeronautics, Vol. 31, No. 6, June 1959, p. 40.

11. "Rotor Tip Turbojets Revive Interest in Large Copters," Space/Aeronautics, Vol. 31, No. y, June 1959, p. 56.

12. "What Price VTOL," Space/Aeronautics, Vol. 31, No. 5, May 1959, p. 46.

13. "How Not to Run a Railroad," Time, Vol. LXXIII, No. 25, p. 19.

14. "Anti-Noise Plan," Aviation Week, Vol. 70, No. 26, June 29, 1959, p. 29.

15. "Civic Groups Outroar Jets in Noise Protest," New York Sunday News, July 19, 1959, p. 19B.

16. "Smith Queries Mach 2 Transport Cost," Aviation Week, Vol. 70, No. 26, June 29, 1959, p. 32.

17. "FAA Moves to Speed Jet Traffic," Aviation Week, Vol. 70, No. 26, June 29, 1959, p. 39.

18. "Hovercraft Tested on Water," Aviation Week, Vol. 70, No. 26, June 29, 1959, p. 64.

19. "Why I am Leaving the Suburbs," Jerome Weidman. Suburbia Today, (Port Washington, New York, News), July 9, 1959.

20. "The Future of Lighter-Than-Air Aircraft," Vice Admiral Charles E. Rosendahl, USN (Ret.). Lecture presented before the Naval Reserve Research Seminar, Office of Naval Research, U.S. Naval Special Devices Center, Port Washington, New York, July 27, 1959.

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COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION INSTITUTE

Final Report

A Background Planning Study of Michigan's Aviation Needs

Part III. Growth and Technological Change in Aviation
Section II. Estimates of Growth in Michigan Aviation

JOHN C. KOHL

Under Contract With:

Michigan Department of Aeronautics
Capitol City Airport
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Administered by: *January 1961*

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T H E U N I V E R S I T Y O F M I C H I G A N

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January 1961

TABLE OF CONTENTS

SUMMARY

Michigan's civil aviation, which in 1958 contributed an estimated $48 million to the economy of the State through its purchases, wages, and taxes, may be expected to yield some $113 million in 1975 if its growth follows presently anticipated trends. These trends, which have been developed from a study of both national and local records as well as the projections of U.S. aviation, indicate the following levels of Michigan aviation in 1975:

Revenue Air Passengers Originating at Michigan Airports - 6.1 million - up 228% from 1960,

Air Cargo Originating in Michigan - 92,000 tons - up 171% from 1960,

Air Mail Originating in Michigan - 9700 tons - up 106% from 1960,

Air Carrier Aircraft Movements at Airline Airports - 814,000 landings and take-offs - up 189% from 1960,

Active Civil Aircraft in General Aviation Fleet - 4450 planes - 58% more than 1960,

General Aviation in Flying Hours - 840,000 hours, total for all activities - up 57% from 1960,

General Aviation Aircraft Movements - 3.4 million landings and take-offs - up 63% from 1958.

These expansions derive from the record of the past twelve years, 1948-1959, which revealed the following relationships between Michigan and the Continental United States:

Item	Percent Increase Continental U.S.	Percent Increase Michigan	Michigan as % of U.S.
Airline Passengers	Up 278%	Up 260%	3.51%
Air Cargo	Up 203%	Up 164%	6.04
Air Mail	Up 205%	Up 222%	2.42
Airline Aircraft Movements	Up 84%	Up 122%	3.54
Aircraft Registration	Up 23%	Up 8%	4.22
Active Pilots	Up 40%	Up 33%	4.00
Aviation Fuel Consumed	Up 39%	Up 54%	3.34
Airports	Down 6%	Down 20%	3.67
Federal Airways Mileage	Up 41%	Up 21%	2.99
Population	Up 19%	Up 22%	4.31
Personal Income	Up 83%	Up 93%	4.82

Note - Not all data covers same time period because of later recording of certain statistics; active pilots date from 1953, aircraft from 1952, and airports from 1950.

Careful consideration was given to the factors underlying the variations in the Michigan percentages of totals for the Continental United States. It was concluded that, in large degree, the relatively lower position was the result of the State's economic ills since 1955 which have been critical despite its relatively better level of personal income. It was assumed that adjustment of the State's economy will be accomplished in the early 1960's and that aviation growth from 1965 on will, in general, exceed national rates to achieve the fairly comparable levels of 1975.

The decline in airports and landing fields is expected to be arrested insofar as any real loss of service to general aviation is concerned. A vigorous public policy, both State and national, which endows airfields with a distinct measure of public interest will overcome the recent frustrations of unplanned abandonments. No attempt to forecast numbers of such facilities has been made because future requirements are so intimately tied to the results of more intensive planning studies than have yet been made.

A major factor in the growth of Michigan's airline traffic is believed to be the extensive coverage of the outstate cities by the local service airlines. Outside of the Southeastern Michigan Metropolitan Area (Detroit), Michigan's air traffic is projected as 317% larger by 1975 than at present as against a 200% increase for Detroit, and the average of 260% for the entire State.

Another factor is the relative strength of interest in the "Pleasure" category of general aviation in Michigan. Some 60% of Michigan's active fleet is classified as "Pleasure" or "Private" as against 48% nationally, and this situation is expected to continue because of the State's pre-eminence as a sports and recreation area. While a decline in the number of aircraft so owned is anticipated both nationally and in Michigan, it is expected to be less pronounced locally with favorable effects upon the total aircraft fleet size. By 1975, it is estimated that some 1651 aircraft will be active primarily for "pleasure" flying, whereas there were 1708 in 1958; but this modest decline will be more than offset by the privately-owned aircraft and executive planes primarily used for business purposes which are estimated to number 1432 in 1975 as against 549 in 1958.

This increase in business aircraft is believed to be of the greatest significance to the Michigan economy as an attraction for industrial location in the State, and will be given special attention in the final section of this report devoted to planning considerations.

INTRODUCTION

Sound policy and prudent development of aviation facilities in Michigan require careful projections of air activity. Even the smallest airport in the State represents the investment of appreciable capital which usually must be recovered during a long period of aviation usefulness. Change and growth may, unless intelligently anticipated, render obsolete a facility long before its return on the investment would justify its retirement. In the words of one aviation writer, "the airport must outlive many generations of aircraft and be able to accommodate planes which today are but the dream of some designer." To afford a base for planning, these dreams must be translated into such quantitative terms as aircraft movements, passengers, and passenger-miles, tons and ton-miles, and other specific factors dictating design.

This translation, which is an integral part of the planning process, is based upon the broad premise that future activities can reasonably be estimated from a careful study of their growth in the past, and of the forces influencing that growth. Such estimates, it must be emphasized, are not predictions of specific activities at a fixed date in the future, but are rather a statement of probable results under definite and reasonable assumptions.

Inherent in this study is the assumption that the economic, social and technological forces at play in the United States will continue under no abnormal or disruptive influences as might result from full-scale nuclear war, major economic depression, or other far-reacing upheaval. The condition of reasonably ordered change is assumed throughout; it is a qualification of every estimate and is implied, if not expressed.

Because the growth of aviation has been so intimately tied to national public policy, which has directed a substantial flow of public funds in support of aviation activities - development of aircraft, airways and airports, as well as airline operations - it must also be assumed that there will be no significant change in that policy. The imposition of user charges on the airways, a protracted lag in aviation research which, up until recently, has largely been sustained by the military, a substantial decrease in airline subsidies or in Federal airport aid - any of these could retard growth and might depress aviation activities in the future. While these possibilities have been considered in the course of these projections, it is concluded that public attitudes toward such policies would change so slowly that they will not be brought into significant force during the future time period of this study, if ever.

This time period is particularly difficult to establish in aviation, which is still undergoing the rapid technological and economic change characteristic of a young industry. As the projection periods lengthen, uncertainties and unknowns multiply to impair the precision of planning estimates. In aviation, even five years often involves variable of large order, so that a 15 to 20 year outlook is about all that can be warranted. Because much of the necessary economic data is based upon limited historic data, no attempt will be made in this study to look beyond 1975, although it is recognized that progress and growth will not stop with that year.

In searching for data on aviation upon which to base any determination of Michigan trends, even as far ahead as 1975, it quickly became evident that very little usable information was available. Despite the work of the Michigan Department of Aeronautics, records in Michigan are neither continuous nor complete. The local picture could only be developed by reduction from national data.

A further consideration favoring this indirect approach to local estimates was the well-known planning difficulty pertaining to smaller areas, even as large as the State. It is obvious that the smaller the area, the greater the possibility for distortions by purely local forces. At the national level, such forces may either be insignificant or compensating ("boom" in one section while another suffers depression), so that they produce no substantial deviations from the trend.

This study of aviation growth in Michigan, then, is approached in three stages: First, a national view of aviation growth is established and the factors supporting it are indicated; next, insofar as possible, the relationships among national and Michigan factors are determined; finally, through the application of the national-state relationships, the estimates of aviation growth in Michigan are derived.

Much assistance has been rendered, particularly in the efforts to establish Michigan data, by the Director and Staff of the Michigan Department of Aeronautics, and by the Research Staff of the Michigan Economic Development Commission. Without this cooperation, the assembly of this data would have been even more difficult and limited.

THE NATIONAL AVIATION ASPECT

Because of the growth of aviation and the economy has been so abundantly documented in national, rather than local, statistics, the basis for establishing an estimate of future aviation in Michigan lies in the development of the national aviation aspect. This is accomplished by the study of the growth and outlook of U.S. Civil Aviation in its two principal divisions - the air carriers and general aviation - which are significantly independent as well as inter-related.

Military aviation, despite its obvious importance and prominence, is included only by its general implications for civil aviation. So much of its data is classified information, anyway, that no accurate statistical record can be drawn. Further, with the rapid shift of emphasis in recent years to missiles and rockets, it seems probably that military efforts will have much less direct effect than in earlier years; technological changes in commercial airlines and general aviation, as a result of vast programs of aircraft research and development supported by the Defense budget, are likely to be materially lessened, if not virtually eliminated, in the years immediately ahead.

Also, since the objective of this phase of the study is a derivation of factors influential at the State and local level, international aviation statistics have been disregarded. Whenever possible, the national figures are cited in terms of domestic activity for the continental United States, even excluding Alaska and Hawaii which became states and are included in typical "United States" data since 1958. The forces for expansion of Michigan aviation are believed to be primarily those relating to the domestic economic growth under the conditions which have been broadly outlined.

These conditions, which assume no major disruptive forces such as a full-scale war, economic depression, or run-away inflation, seem to have prevailed since 1947. The year 1948 was therefore selected as the calendar base. All data have, insofar as possible, been brought forward from that year to afford a twelve-year period (1948 through 1959) of historic growth for trend analysis.

It is realized that twelve years is a meager historic record upon which to project even fifteen years in the future, yet any longer period which includes 1947 and earlier involves the highly abnormal influences of World War II. By 1948, much of the war-time impact had diminished and, particularly in transportation, there was a return to "normal" conditions with the restoration of a ready supply of motor vehicles, fuel and tires.

A threat to continued "normal" expansion was posed by the Korean Conflict, 1953-53, which, fortunately, subsided with only indirect influence upon the U.S. economy. Also short-lived was the so-called "recession" of 1958 whose effect can be noted in the statistical table, but was offset by 1959 recoveries.

Despite the shortness of the period covered in this statistical record, it nevertheless seems to warrant confidence as an analytical base upon which an estimate of the future can be built.

THE NATIONAL ECONOMY AND TRANSPORTATION, 1948-59

There are several indicators which are useful in denoting relationships between the national economy and transportation which are significant to aviation. Both the commercial airlines and general aviation involve, as their principal function, the movement of people; their activities, therefore, may be directly related to the numbers of people who are the potential travelers or users of aviation, and to their resources for meeting the expense of such travel or use. Measures of population, productivity, and income, thus, are of significance.

Table 1 summarizes the changes in these factors during the twelve-year period, 1948 through 1959, which is the basis for this study of aviation growth and a judgment of its future. Subsequent tables delineate the annual changes and list the sources from which this data has been drawn.

Population, it will be noted, has, on the basis of the annual estimates of the U.S. Bureau of the Census, increased from approximately 147 million in 1948 to nearly 178 million by 1959, for an overall gain of 21%. Productivity, as measured by Gross National Product, which represents the total value of goods and services produced in the United States, has risen by 86%, from $259 billion to $428 billion in the twelve years.

Purchasing potential, indicated by Disposable Personal

Income, rose slightly less than productivity, or some 78% from $189 billion to $337 billion in the same period. Relating this increased income to population, and converting to "constant dollars" to eliminate the bias of inflation, Personal Income Per Capita indicates a real gain of 22% from $1445 in 1948 to $1760 in 1959. On the average in 1959, there were six people for every five in 1948, and each one had $315 more to spend; in short, the figures show more people better able to pay, as a result of their increased purchasing power.

Much of this purchasing power was expended for transportation. Total transportation expenditures rose 131% while total personal consumption increased only 80% in this period; in 1948, transportation was 9.5% while in 1958, it reached 12.2% of the total personal consumption expenditure.

This shift was, in large measure, due to the increased expenditures for user-operated transportation - chiefly the private automobile - which showed a gain of 164%. In 1948, user-operated transportation represented 80% of the total U.S. transportation outlay; by 1959, this had risen to more than 91%. In contrast, purchased inter-city transportation (the fore-hire common carriers including the commercial airlines) increased by only 28%; the actual amount of $0.3 billion does not show in the tabulation because it was "lost" in rounding-off the figures in the summary table.

Table 2 shows detailed comparisons of population, gross national product and income by years from 1948 through 1959. In this period, the average year-to-year increase in gross national

Table 1

SUMMARY OF ECONOMIC CHANGES IN U.S., 1948-1959

Item	1948	1959	Change	% Change
Population	146,600,000	176,900,000	+30,300,000	+21%
Gross National Product	$259.4 billion	$482.1 billion	+$222.7 billion	+86%
Disposable Personal Income	$189.3 billion	$337.3 billion	+$148.0 billion	+78%
Personal Income Per Capita	$1445	$1760	$315	+22%
Personal Consumption Expenditures	$177.4 billion	$318.8 billion	+$141.4 billion	+80%
Total Transportation Expenditures	$ 16.9 billion	$ 38.9 billion	+$22 billion	+131%
Expenditures on User-Operated Transportation*	$ 13.5 billion	$ 35.5 billion	+$22 billion	+164%
Purchased Intercity Transportation**	$ 1.1 billion	$ 1.4 billion	+$0.3 billion	+28%

*User-operated transportation in the U.S. is private transportation and primarily is highway transportation, including the automobile.

**In other words, "For-Hire" or common carrier transportation.

Source: See Tables 2-4.

product (GNP) has been slightly over 5% with only two years, 1949 to 1954, showing decreases from the preceding years; even 1958, in spite of the business "recession" showed a very small increase over 1957 on a current-dollar basis. Disposable personal income closely paralleled the increase in gross national product. All of these figures support the view of the U.S. as a nationally expanding economy in which transportation may be expected to continue in a major role.

Table 2

U.S. POPULATION, DISPOSABLE PERSONAL INCOME, 1948-59

Year	Population (in millions)	Disposable Personal Income (in millions)	Gross National Product (in millions)
1948	146.6	$189,300	$259,426
1949	149.2	189,654	258,054
1950	151.7	207,655	284,599
1951	154.4	227,481	328,975
1952	157.0	238,714	346,999
1953	159.6	252,474	365,385
1954	162.4	256,885	363,112
1955	165.3	274,448	397,469
1956	168.2	292,942	419,180
1957	171.2	308,791	442,769
1958	174.9	317,872	444,224
1959	176.9	337,266	482,056

Source: Statistical Abstract of the U.S., 1959, Table 2, and U.S. Bureau of the Census, Current Population Reports, Series P-25. U.S. Department of Commerce Survey of Current Business, July 1960.

Table 3

U.S. PERSONAL CONSUMPTION AND TRANSPORTATION EXPENDITURES, 1948-59

Year	Total Personal Consumption Expenditures (in millions)	Total Transportation Expenditure (in millions)	Transportation as percent of Total Expenditures
1948	$177,446	$16,856	9.5%
1949	180,588	19,274	10.6
1950	194,550	22,570	11.5
1951	208,108	22,104	10.7
1952	218,328	23,234	10.6
1953	230,542	26,994	11.7
1954	236,513	26,995	11.4
1955	253,971	32,373	12.7
1956	269,917	33,987	12.6
1957	285,164	36,475	12.8
1958	293,495	33,707	11.5
1959	318,835	38,898	12.2

Source: U.S. Department of Commerce, Survey of Current Business, Table 30, July 1950, 1953, 1956, and 1960.

The relationship of transportation growth to personal consumption expenditures is shown in Table 3. Personal consumption expenditures rose year by year without interruption at an average annual change of approximately 5%, keeping pace but slightly behind the gross national product growth. Transportation expenditures, though somewhat erratic (in that two years showed decreases and one virtually no change), increased at an average annual change of nearly 8%, and accounted for a substantially greater share of personal consumption expenditures at the end of the twelve-year period.

Transportation expenditures in the national economy are further broken down in Tables 4 and 5 which exhibit yearly comparisons of user-operated, total-purchased-intercity, and airline transportation expenditures for the twelve-year period. The substantial trend away from "for-hire," or purchased," transportation to "private," or "user-operated," is marked by the consistent increase in the percentage of total transportation expenditures devoted to the latter category, and the continued decrease of "purchased" transportation. Private highway transportation and general aviation cannot be separated in the available figures, but the latter is still estimated to be an extremely small part of user-operated expenditures; airline transportation expenditures, on the other hand, represent sharply increasing amounts, both in dollar volume and percentage, of the purchased transportation category.

Table 4

USER-OPERATED AND PURCHASED INTERCITY TRANSPORTATION EXPENDITURES IN U.S., 1948-1959

Year	User-Operated Transportation Expenditures		Purchased Intercity Transportation Expenditures	
	Amount (millions)	% Total	Amount (millions)	% Total
1948	$13,461	79.7%	$1,086	6.5%
1949	15,995	82.9	1,016	5.3
1950	19,353	86.0	960	4.3
1951	18,690	84.6	1,096	4.9
1952	19,892	85.4	1,172	5.0
1953	23,631	87.8	1,165	4.3
1954	23,759	88.0	1,097	4.1
1955	29,127	90.2	1,129	3.5
1956	30,777	90.6	1,223	3.6
1957	33,205	91.0	1,289	3.5
1958	30,507	90.6	1,275	3.8
1959	35,506	91.3	1,396	3.6

Source: U.S. Department of Commerce, Survey of Current Business.

Table 5

AIRLINE TRANSPORTATION EXPENDITURES, 1948-59

Year	Amount (in Millions)	Percent of Purchased Intercity Transportation
1948	$133	12.2%
1949	151	14.8
1950	174	18.1
1951	231	21.1
1952	287	24.4
1953	325	27.9
1954	365	33.3
1955	430	38.2
1956	518	42.2
1957	576	44.5
1958	612	48.0
1959	739	52.9

Source: U.S. Department of Commerce, Survey of Current Business.

Thus, in the national economy, the record of the twelve years, 1948 through 1959, shows a greatly expanded transportation base in which the commercial air carriers have gained a dominant role in the for-hire segment, even though that activity is shrinking in total as the railroads drop more and more passenger service. No complete picture of aviation can be drawn in economic terms alone. To achieve balance in the record, physical activity as well as economic growth, must be measured.

NATIONAL AVIATION ACTIVITY, 1948-1959

As a base for future planning, economic indicators such as those just delineated in the previous section are necessary, although their inadequacies require that they be supplemented with measurements of the physical aspects of U.S. aviation.

Because of the distinctly different considerations involved, the commercial air carriers are reviewed as separate and apart from general aviation activities. Further, as previously noted, this study is confined to the domestic operations, for its ultimate application is to Michigan aviation in which international traffic will probably exert only a minor influence.

Domestic Air Carriers

Statistics for the commercial airlines are voluminous. The regulatory function of the Civil Aeronautics Board (CAB) and the planning function of the Federal Aviation Agency (FAA) and its predecessor agency, the CAA, both dictated the accumulation of large masses of detailed information; much of it is of little direct use to the purpose of this study. Only the statistics useful in providing the base for estimates of Michigan's aviation future have been extracted and correlated herein.

Aviation activities covered in this section are those of the commercial airlines, both trunk and local, and of the certificated, irregular and supplemental carriers which are recognized by the CAB. The so-called "for-hire" flights by commercial operators in general aviation are excluded here. Likewise, the non-military transport activities by the military air services are not included. Fundamentally, then, the following data pertains to domestic air carrier activities which, it should be emphasized, represent a very large part of the impression of aviation upon the U.S. public.

Table 6

SUMMARY - GROWTH OF U.S. DOMESTIC AIRLINE ACTIVITY, 1948-1959

Item	1948	1959	Change	% Change
Air-Carrier Passenger-Miles (in millions)	5,910	29,158	+23,248	+395%
Total Revenue Passengers (in millions)	13.17	54.77	+41.60	+317%
Total U.S. Mail Carried By Air (millions of ton-miles)	37.9	118.8	+80.9	+213%
Total Air Cargo (freight and express) (Millions of ton-miles)	101.4	342.6	+241.2	+238%
Air Carrier Aircraft Departures (Total)	1,861,199	3,420,682	+1,559,483	+84%
Average No. of Passengers per Aircraft Departure	7.0	14.4	+7.4	+106%
Cities Served	507	566	+59	+12%

During the twelve-year period of study, 1948, through 1959, the U.S. airlines demonstrated impressive growth. Table 6 summarizes the changes in the principal measures of airline activity while subsequent tabulations develop the records in detail, and indicate the sources of the data.

By far the greatest increase, 395%, was recorded in the passenger-mile category and reflects not only the rise in number of passengers carried, but also the increasing distance traveled. Because of the increased capacity of planes in air carrier service, the number of aircraft departures necessary to handle this growth did not gain as rapidly and showed a net rise of only 84%; this face is reinforced by the rise in the average number of passengers per departure which more than doubled in the twelve years.

Table 7

AIR CARRIER TRAFFIC - DOMESTIC PASSENGERS, 1948-1959

Year	Total Revenue Passengers (in millions)	Annual Increase %	Revenue Passenger-Miles (in millions)	Annual Increase %
1948	13.17	---	5,981	---
1949	15.08	14.5%	6,753	12.9%
1950	17.35	15.1	8,003	18.5
1951	22.65	30.5	10,566	32.1
1952	25.01	10.4	12,528	18.5
1953	28.72	14.8	14,760	17.7
1954	32.34	12.6	16,769	13.6
1955	38.02	17.6	19,819	18.2
1956	41.74	13.3	22,362	12.8
1957	48.46	16.1	25,340	13.4
1958	48.13	-0.7	25,343	0.0
1959	54.77	13.8	29,269	15.5

Source: FAA Statistical Handbook of Aviation, 1960 Edition, page 79.

Table 7 shows the annual volumes of revenue passengers and revenue passenger-miles recorded by the scheduled domestic air carriers - trunk, local and helicopter - including Hawaii, but excluding Alaska which has been handled separately. Because of a change in reporting methods during the period, passengers for 1957 and subsequent years are not strictly comparable to earlier years; the inconsistencies are, reportedly, small and insufficient to invalidate the indication of general trends.

More significant, in face, were the labor disputes which affected several major airlines in 1958. Protracted suspensions of service, coupled with the effect of the business recession, account for the dramatic interruption in the year-to-year growth for 1958 as compared to 1957. Including this special year in the series, the average annual growth in revenue passengers has been over 14%, and that of revenue passenger-miles over 15% - well above the annual increases indicated by economic factors.

A major factor in this growth of passenger business has been the introduction of the "economy flight" or the so-called "air coach" service. Beginning late in 1948 without general enthusiasm by the carriers, air coach service was first limited to off-peak hours and certain routes; public response was enthusiastic, and soon forced rapid expansion of schedules and service with the results tabulated in Table 8.

Table 8

AIR CARRIER TRAFFIC - DOMESTIC AIR COACH OPERATIONS

Year	Total Revenue Coach-Passenger-Miles (in millions)	Coach Pass. Miles as % Total Air Rev. Pass. Miles
1948	0.1*	---
1949	7.9	3.7%
1950	24.3	13.2
1951	27.7	12.5
1952	47.7	18.7
1953	75.8	25.2
1954	109.0	31.7
1955	139.6	33.9
1956	174.0	36.1
1957	214.3	37.5
1958	242.0	39.8
1959	292.3	42.0

*Service began November 1948, and includes miles flown in combination first-class and coach aircraft.

Source: FAA Statistical Handbook for Aviation, 1960; page 88.

Table 9

AIR CARRIER TRAFFIC - COMPARISON TO TOTAL DOMESTIC INTERCITY PASSENGER MILES, 1948-1959 (in millions)

Year	Common Carriers Intercity Pass. Miles (in millions of miles)				Private Auto	Total Intercity Travel
	Air	Rail	Bus	Total Carriers		
1948	5,910	35,330	23,529	64,779	287,423	352,192
1949	6,705	29,622	22,411	58,738	376,313	435,051
1950	7,954	26,781	21,254	55,989	402,843	458,832
1951	10,500	29,750	22,299	62,549	457,787	520,336
1952	12,461	29,262	21,223	62,946	495,547	558,493
1953	14,688	26,905	19,634	61,227	529,194	590,421
1954	16,696	24,537	16,934	58,167	548,763	606,930
1955	19,741	23,755	16,562	60,058	585,817	647,875
1956	22,278	23,349	16,409	62,036	617,713	679,749
1957	25,250	21,060	16,377	62,687	644,800	707,487
1958	25,261	18,474	15,083	58,818	663,700	722,518
1959	29,158	17,522	14,781	61,461	677,600	739,061

Source: FAA Statistical Handbook for Aviation, 1960; page 80.

The expansion of air service, particularly through the authorization of new local carrier routes and their addition of stations, and the effect of lowered air fares as a result of air coach travel have had a telling impact upon the distribution of intercity travel among the various modes of passenger transportation. Table 9 delineates the shift which has been taking place since 1948, and closely approximates the record derived from analysis of transportation expenditures. While the private auto continues to dominate the intercity travel picture, the impact of the airlines is clearly defined in the common carrier segment.

All intercity travel has increased with the demands of an expanding population and economy, but air travel has developed at an even faster rate. The average annual growth of total intercity passenger-miles approximates 7%, while air passenger-miles on the same basis averaged 11%. Rail passenger-miles decreased every year with an average annual loss of 6%; bus passenger-miles also decreased, and these, combined with rail losses, more than offset the air increases to produce a gradual decline of approximately ½% a year in total common carrier performance. Table 10 presents another aspect of this relationship.

Table 10

AIR CARRIER TRAFFIC - PERCENTAGES OF INTERCITY TRAVEL, 1948-59

Year	Percent Passenger-Miles			
	Common Carriers to Total Intercity	Air Carriers to Total Common Carrier	Air Carriers to Rail	Air Carriers to Total Intercity
1948	18.4%	9.1%	16.7%	1.7%
1949	13.5	11.4	22.6	1.5
1950	12.2	14.2	29.7	1.7
1951	12.0	16.8	35.3	2.0
1952	11.3	19.8	42.6	2.2
1953	10.4	24.0	54.6	2.5
1954	9.6	28.7	68.0	2.8
1955	9.3	32.9	83.1	3.1
1956	9.2	35.9	95.4	3.3
1957	8.9	40.3	119.9	3.6
1958	8.2	42.9	136.7	3.5
1959	8.3	47.4	166.4	3.9

Source: See Table 9.

New patterns of travel apparently have been brought about through the new standards of time introduced by air transportation and increasing acceptance of air travel by an ever larger share of the public. Decentralization of industry, accelerated by a variety of influences, has no doubt been a factor, though its impact upon general aviation will probably be greater than upon air carrier movements.

Table 11

DOMESTIC AIR CARRIER AIRCRAFT DEPARTURES
AT CONTINENTAL U.S. STATIONS, 1948-59

Year	Air Carrier Aircraft Departures	Average No. of Passengers per Aircraft Departures	No. of Cities Served
1948	1,861,199	7.0	507
1949	2,023,702	7.3	482
1950	2,137,294	7.9	568
1951	2,319,143	9.4	593
1952	2,431,633	10.0	585
1953	2,612,767	10.7	582
1954	2,660,579	11.9	565
1955	2,901,758	12.8	544
1956	3,094,075	13.2	544
1957	3,318,282	13.3	553
1958	3,176,102	13.7	549
1959	3,420,682	14.4	566

Source: FAA Statistical Handbook of Aviation, 1960 Edition, page 110; FAA Air Commerce Traffic Pattern (Scheduled Carriers).

As a measure of these movements, air carrier aircraft departures are recorded, and totals by years are shown in Table 11. Indicative of the increase in aircraft capacity as well as travel demand, the steady gain in the average number of enplaned passengers per aircraft departure is of interest. Unfortunately, the 1959 figure includes only a very limited amount of jet service which has dramatically expanded capacity and generated popular demands. Departures can be converted to airline traffic by doubling the tabular value so as to account for arrivals as well, but must be further enlarged to include movements not directly involved with scheduled passenger service; an estimate of total air carrier movements of 7 million in 1955 compares with the 2.9 million aircraft departures of the same year.

Also shown in Table 11 is the number of cities actually served by air carriers during each year. The annual numbers show some fluctuation although the twelve-year trend is upward. Revisions in route structure, as well as changes in metropolitan areas entirely independent of air service, account for the variations. Close interpretation is not warranted, but a general impression of expanding geographical coverage is supported.

Air Mail

The first interests in commercial aviation actually were in air mail rather than passengers because the ever-increasing tempo of modern life in the early 1900's, seemingly, demanded a speed-up in communications. Air mail flights were the beginnings of the scheduled airlines in the 1920's, and payments for the transportation of mail have formed important financial support for civil aviation, as well as an inducement to growth. Table 12 shows the growth of air mail transportation, 1948-1959, by the scheduled domestic air carriers. The twelve-year period shows a 213% increase in air-mail ton-miles, and a 51% increase in operating revenues, including subsidy, from air mail pay. The vast expansion of passenger traffic and other operations is reflected in the declining and stabilized proportion which air mail pay represents in total operating revenues.

Table 12

AIR MAIL - DOMESTIC U.S. TRAFFIC IN TON-MILES

Year	U.S. Mail (millions of ton-miles)	Operating Revenues inc. Subsidy for Mail	Percent of Total Operating Revenue
1948	37.9	$59.3 million	13.7%
1949	41.4	59.3	12.2
1950	47.0	63.8	11.4
1951	63.8	57.4	8.2
1952	69.3	58.9	7.2
1953	72.9	64.5	6.9
1954	81.6	65.7	6.3
1955	87.4	55.5	4.6
1956	93.3	61.9	4.6
1957	98.9	69.7	4.6
1958	105.8	77.4	4.8
1959	118.8	89.7	4.6

Post Office policy, in the face of curtailed surface transportation resulting from widespread discontinuance of railroad trains carrying mail, dictated the shipment of regular or non-priority mail in unused plane space on an experimental basis, and thus has somewhat increased the air-mail ton-miles without corresponding increases in airline revenues. Periodically under attack by surface carriers, this policy apparently was not consistently applied so that its influence upon air-mail growth has been erratic, and the year-to-year change somewhat irregular. The yearly increase in air-mail ton-miles has averaged just over 11% since 1948, to a 1959 level of almost 119 million ton-miles.

Air Cargo

Domestic air-cargo transportation, including both air express and air freight which are separately developed, is performed by the regularly scheduled passenger airlines, by the so-called "all-cargo" carriers, and by the noncertificated air carriers (or "large irregular carriers" as distinct from the for-hire category in general aviation). Table 13 shows the growth of cargo traffic in ton-miles from 1948 through 1959, and reveals an increase of 282%, or substantially less than the 395% increase in passenger traffic.

Table 13

AIR CARGO - DOMESTIC U.S. TRAFFIC, 1948-59
(in millions of ton-miles)

Year	Scheduled Air Lines	All-Cargo Carriers	Non-certificated Carriers	Total All Air Carriers
1948	101.0	38.6	11.2	150.8
1949	123.7	37.6	13.2	174.5
1950	152.3	63.6	13.1	229.0
1951	142.8	79.1	17.7	239.5
1952	159.7	86.4	10.3	256.4
1953	176.5	81.3	18.1	275.9
1954	186.7	62.3	23.7	272.7
1955	226.7	112.7	40.1	379.4
1956	244.0	142.7	58.8	444.9
1957	265.1	203.0	47.2	515.3
1958	291.0	171.0	61.3	523.3
1959	341.1	173.9	63.3	577.3

Note: Totals do not always "add" becausing of rounding-off.

Source: FAA Statistical Handbook of Aviation, 1960 Edition, page 107.

This lag in cargo growth has persisted in the face of many optimistic claims for its potential, and can be explained by the fact that freight movements by air are still largely emergency, or supplemental transportation where speed is an all-important consideration. Influences of varying extent and intensity have produced fluctuations in the annual volumes of the various cargo categories even though the yearly totals have shown consistent increases.

A significant factor has been the military traffic carried under contract by the non-certificated carriers (which runs up to 90% of their total) and by some of the scheduled carriers. Statistics do not permit separation of such traffic for all carriers, and these introduce an element of uncertainty in this record because the effect of shifts in military policy cannot be accurately delineated as they may have occurred.

Table 14

AIR CARGO - AIR EXPRESS COMPARISONS
Scheduled Domestic Air Carriers, 1948-1959
(in millions of ton-miles)

Year	Total Air Cargo	Air Freight	Air Express	Air Express As % of Total
1948	101.4	71.3	30.1	29.7%
1949	123.0	95.2	27.8	22.6
1950	151.4	114.1	37.3	24.6
1951	143.6	102.4	41.3	28.8
1952	160.8	119.5	41.3	25.7
1953	177.9	134.5	43.5	24.5
1954	188.3	147.1	41.2	21.9
1955	228.0	177.0	51.0	22.4
1956	245.1	193.7	51.4	20.9
1957	266.5	222.1	44.4	16.6
1958	292.1	244.3	47.7	16.3
1959	342.6	287.2	55.4	16.1

Notes: Total Air Cargo does not always "add," nor correspond precistly to Table 13 because of rounding off.

Source: FAA Statistical Handbook of Aviation, 1960, page 82.

Within the scheduled air carrier category, the somewhat erratic record of air express traffic is shown in Table 14. As the carriers themselves have stepped up promotion efforts, some shippers have evidently shifted from air express to air freight for economy as their volumes may have increased to offset the convenience of the comprehensive express service for small shipments. Air express volume grew only 84% in contrast with 202% for air freight and 238% for the total air cargo from 1948 to 1959. Uncertainties over the continued role of the Railway Express Agency, whose Air Express Division has been a major element in the traffic, may have contributed to the fluctuations during this period.

A definitely limiting factor has been the lack of adequate cargo-carrying aircraft. Virtually all civil aircraft carrying cargo are modifications of passenger planes, or are principally in passenger service with only a small portion of their space and capacity assigned to cargo. The result has been that cargo could not always be carried; in some cases, the physical characteristics of the cargo as it was offered for movement prevented its loading in the aircraft not designed for cargo; in more cases, capacity was not immediately available and cargo had to wait. That growth took place, and much of it very substantial growth, in the face of such handicaps is believed to be a strong indication of the potential of air cargo, once the "right" equipment is in service.

Non-Certificated Air Carriers

Statistics for the growth of the supplemental or non-certificated carriers are generally unavailable before 1953 when the CAB undertook an investigation of these irregular carriers and later issued more specific rules under which their non-certificated status might legally be continued. Since that investigation, more adequate reporting has permitted the development of Table 15, which summarizes data from 1953-1959.

Both the total number of operators and total revenue-miles flown have been shrinking; only 23 operators remain from the more than 50 in active service prior to 1953 when flagrant violations, or near-violations of the rules establishing their special status were reported and brought the attention of the CAB. Extent of operations, as measured by revenue-miles flown, has not approached the 1953 level.

Traffic, however, has shown some increase in both the numbers of revenue passengers and passenger-miles, particularly in the proportion of military contract passenger-mileage, which made up 54% of the 1959 total. Including this military movement, these non-certificated carriers performed as much as 4.6% of the passenger-mile service of the scheduled airlines - up from a low of 1.7% in 1957.

Because the military traffic introduces an incompatible element into domestic traffic considerations, and further, because some international passenger-miles seem inextricably involved in non-scheduled data, the role of these carriers, while small, is also of uncertain influence upon the domestic, scheduled air carriers.

Table 15

NON-CERTIFICATED AIR CARRIERS - DOMESTIC, 1953-1959
(in millions)

Year	No. of Operators	Total Revenue Miles Flown	Revenue Passengers	Passenger-Miles, Total	Passenger-Miles, % Comm. (Note 1)	% of Pass.-Miles Scheduled Air-lines (Note 2)
1953	N.A.	45.7	0.72	1,257	52%	4.4%
1954	N.A.	35.8	0.70	1,243	47	3.5
1955	50	40.3	0.79	1,396	51	3.6
1956	48	42.4	0.66	1,004	62	2.8
1957	37	32.9	0.54	767	56	1.7
1958	35	36.8	0.68	1,153	47	2.3
1959	23	38.7	0.86	1,590	46	4.6

Note 1: Represents proportion of commercial civilian traffic to total passenger-miles; balance is military traffic flown under contract.

Note 2: Represents percentage of total passenger-miles by non-certificated carriers, including military traffic.

Source: CAB Records, Docket No. 5132, and FAA Statistical Handbook of Aviation, 1960, page 109.

General Aviation

General aviation, as distinguished from the field of the commercial air carriers, is made up of the flying activities of a number of groups recognized by the FAA, and previously described in Part I of this report. Because an understanding of the nature of these general aviation activities is essential to their evaluation and to an estimate of their growth, the principal categories are again defined.

Business or Executive Flying - the use of aircraft for the transportation of personnel or cargo as a part of the conduct of a business in which transportation is not a primary purpose. The aircraft is owned or leased by the company or individual conducting the business, and the persons or cargo transported are intimately related to that business.

Commercial and Industrial Flying - those aviation activities, including for-hire and air taxi service by fixed-base operators, in which flying is an essential part of the service - aerial application, aerial surveys and mapping, power line patrol, and the like.

Instructional Flying - all flying under the supervision of an accredited instructor in connection with training and air education; but not including military flight training.

Pleasure or Personal Flying - the use of aircraft for pleasure and personal uses, as well as miscellaneous minor uses not covered in other categories.

No hard and fast distinctions are practical, for the same aircraft or pilot may engage in several of these aviation activities in the course of his regular flying. The individual may fly for pleasure on one day, and on another for business, while a commercial operator may also perform as an instructor. In all cases, the primary purpose of any particular flight is the basis for its classification. All civil flying except that performed by air carriers reporting to the CAB is, however, classified as general aviation.

Unlike the air carriers for which statistics are collected regularly and comprehensively by the CAB, no complete records of general aviation exist. Rather, as an outgrowth of the planning responsibility of the old CAA, periodic surveys of general aviation activity have been made since 1947; for years when no specific surveys were conducted, annual data has been estimated from the established trends or by expansion from limited samples. Table 16 summarizes general aviation activity by its principal divisions for the years 1948-59, while Table 16-A reduces flying hours to percentages in each category.

Total flying time in general aviation has not recovered to the high level of 1947 and 1948 when the post-war boom in instructional flying under "the G.I. Bill" for education and training created an abnormal interest. All comparisons prior to 1951 reflect this bias which distorts earlier figures. Since 1952, which was the low year, general aviation has steadily increased in total activities and, by 1959, recorded an estimated 12.4 million flying hours and roughly 1.65 billion miles to show a utilization more than three times that of domestic airline transports in scheduled service.

Table 16

GENERAL AVIATION - HOURS FLOWN BY TYPES, 1948-59
(by thousands of hours)

Year	Total	Business	Commercial	Instructional	Pleasure & Misc.
1948	15,130	2,576	1,066	8,701	2,787
1949	11,031	2,615	1,449	4,187	2,780
1950(1)	9,650	2,750	1,500	3,000	2,400
1951	8,451	2,950	1,584	1,902	2,015
1952	8,186	3,124	1,727	1,503	1,832
1953	8,527	3,626	1,649	1,248	2,004
1954	8,963	3,875	1,829	1,292	1,967
1955(1)	9,500	4,300	1,950	1,275	1,975
1956(1)	10,200	4,600	2,000	1,500	2,100
1957	10,938	4,864	2,013	1,864	2,109
1958(1)	11,700	5,300	2,200	2,000	2,200
1959(1)	12,400	5,700	2,300	2,000	2,400

(1) Data for these years estimated from trend; other years from CAA surveys of aircraft use.

Source: FAA Statistical Handbook of Aviation, 1960; page 47.

Table 16A

GENERAL AVIATION - DISTRIBUTION OF FLYING HOURS
Based on Table 16

Year	% Business	% Commercial	% Instructional	% Pleasure & Misc.	Total
1948	17%	7%	58%	18%	100%
1949	24	13	38	25	100
1950	28	16	31	25	100
1951	35	19	23	23	100
1952	38	21	18	23	100
1953	42	19	15	24	100
1954	43	20	15	22	100
1955	45	21	13	21	100
1956	45	20	15	20	100
1957	45	18	17	20	100
1958	45	19	17	19	100
1959	46	19	16	19	100

Business flying has consistently increased from 17% of the total in 1948 to 46% in 1959 when it is estimated, some 25,000 business aircraft flew approximately 5.7 million hours. This represents an increase of 120% over 1948.

Commercial flying, including, as it does, a variety of activities, has increased from roughly 1 million flying hours in 1948 to 2.3 million in 1959, or 109%. In proportion to total general aviation, it has ranged between 18% and 21% of the total flying hours since the inflated instructional activity disappeared in 1951.

Instructional flying, reflecting its drastic inflation, shows a sharp decline from more than 8.7 million flying hours in 1948 to 2.0 million in both 1958 and 1959. After several years of relatively little activity, it is showing evidence of renewed vigor. The trend in student pilot license issuances, included in Table 20, supports this conclusion.

Pleasure flying in the 1948-51 period was influenced by the strong post-war interest in civilian flying which boomed instruction. Since then, it shows a similar, though less drastic, decline and recovery. From an estimated 2.8 million flying hours in 1948, through a low of 1.8 million in 1952, pleasure and personal use of aircraft accounted for 2.4 million hours in 1959, or 19% of that year's general aviation hours.

CAA surveys in 1954 and again in 1957 provide data, shown in Table 17, from which the distribution of aircraft among the principal categories of general aviation could be estimated. Most significant is the increase in business aircraft, even though the largest number of planes is still found in pleasure and personal use; these personal planes are substantially the older single-engine, one- and two-place models. In 1959, the business fleet of 25,000 planes is estimated to be some 35% of the total active fleet of more than 69,000 aircraft.

Table 17

GENERAL AVIATION AIRCRAFT BY PRIMARY USE

Category	No. and Percent of Total Active Aircraft			
	No. 1954	%	No. 1957	%
Business Transportation	18,570	30%	21,520	32%
Commercial				
Aerial Application	4,210	7	4,960	7
Patrol and Survey	1,580	2	1,810	3
Passenger and Cargo for Hire	2,170	4	2,030	3
Instructional	4,720	8	5,680	9
Pleasure and Personal	29,350	48	29,850	45
Experimental, Test, Etc.	690	1	670	1
Total	61,290	100%	66,520	100%

Note: Excludes all aircraft operated by scheduled airlines, but includes those of irregular carriers operating under CAB authorization. Because of estimates and rounding off, totals do not check with Table 18.

Source: FAA Statistical Handbook of Aviation, 1957; page 51; and 1960, page 54.

Table 18

ACTIVE CIVIL AIRCRAFT - CONTINENTAL U.S.

Year	Total Aircraft	Active Aircraft	Active Aircraft As % of Total
1954	90,297	57,939	64%
1955	83,612	59,297	71
1956	85,707	63,532	74
1957	88,240	64,660	73
1958	94,616	67,052	71
1959	102,883	69,310	68

By FAA definition, an "Active" aircraft is one holding a valid certificate of air-worthiness and which has had an approved inspection within the 12-month period immediately preceding its current registration.

Table 18 indicates an important aspect of the U.S. Civil Aircraft fleet in its delineation of "active" aircraft. As noted in the table, an "active" aircraft is considered by the FAA as a plane holding a valid certificate of air-worthiness and an approved inspection within the twelve-month period immediately preceding its current registration. From the planning standpoint, only active planes are significant; the "total aircraft" is a misleading figure, although it reflects the potential fleet.

Table 19

AIRPORTS AND AIRFIELDS, 1948-59

Year	Total Existing U.S. Airports and Airfields recorded with FAA	Lighted Airports
1948	6,414	1521
1949	6,484	1480
1950	6,403	1670
1951	6,237	N.A.
1952	6,042	1858
1953	6,760	1050
1954	6,977	1108
1955	6,839	1247
1956	7,028	1399
1957	6,412	1713
1958	6,018	1809
1959	6,426	1943

Source: FAA Statistical Handbook of Aviation, 1960, page 5-6.

Still another aspect of general aviation is the number of airports and airfields recorded with FAA. While the tabulation, Table 19, fails to include all air facilities, and particularly those of the military, it nevertheless indicates the extent and nature of general aviation growth. The relatively constant number in 1948 and 1959, despite the peak in 1956 and the low in 1958, reflect a basic geographic stability in airport patterns, while the trend toward a larger number of lighted airports denotes greater dependence upon air transportation and less on purely local flying; a similar conclusion is warranted by the fact that 1757 fields, or 27%, had one or more paved runways by 1959.

Table 20

CERTIFICATED CIVIL AIRMEN, 1948-59

Years	Total Certificated Airplane Pilots (1)	Other Certificated Airmen (2)	Student Pilot Issuances (3)
1948	491,306	88,542	117,725
1949	525,174	94,219	49,575
1950	N.A.	N.A.	44,591
1951	580,574	105,156	45,003
1952	581,218	108,975	30,537
1953	585,974	113,820	37,397
1954	613,695	118,327	43,393
1955	643,201	124,599	44,354
1956	669,079	129,560	45,036
1957	702,519	136,953	76,850
1958	731,078	142,192	58,107
1959	758,368	151,126	67,618

Notes: (1) Includes airline transport, commercial and private pilots.

(2) Includes glider pilots, mechanics, parachute riggers, and ground instructors holding FAA certificates.

(3) Yearly totals of student pilot licenses issued during each twelve months.

Source: FAA Statistical Handbook of Aviation, 1960; pages 37-38.

Finally, the growth of U.S. Civil Aviation, including general aviation, is delineated in Table 20 which shows its human resources. Certificated pilots have increased from 491,000 in 1948 to more than 758,000 in 1959, or 54%, while crewmen and ground personnel have increased from almost 89,000 to more than 151,000, or 70%. Although the decline in student pilot licenses from 1948 through 1952 dispelled visions of automotive-like growth for general aviation, the continuing recovery of interest on a firmer base is observed in the continuing expansion beginning in 1953; the decline in 1958 was due in large measure to economies necessitated by the recession in business - flight instruction usually involves a personal expenditure which is an appreciable amount to the younger person most likely interested, and is not an essential expense no matter how much the individual loves flying. The reviving interest has significance for the future.

Aircraft Operations

Yet another feature of the national aviation aspect is the growth of aircraft operations which, in the last analysis, forms the basis for planning and design of the airways and approaches as well as the airports. Complete records are manifestly impossible to assemble, but a measure of the more important operations is obtained from the records accumulated by the FAA-operated traffic control towers at the major airports. Military operations have been excluded as inconsistent with the limits of this study.

Table 21

CIVIL AIRCRAFT OPERATIONS - FAA-OPERATED TRAFFIC CONTROL TOWERS AT MAJOR AIRPORTS, 1948-1959

Year	Total Operations	Air Carriers	General Aviation		
			Total	Itinerant	Local
1948	16,118,760	3,241,941	12,876,819	2,499,919	10,376,900
1949	14,159,555	3,713,257	10,446,298	2,721,925	7,724,373
1950	13,586,827	4,001,947	9,584,880	3,048,838	6,536,942
1951	14,176,438	4,555,509	9,620,929	3,442,225	6,178,704
1952	12,830,647	4,866,358	7,964,289	3,398,600	4,565,689
1953	13,103,010	5,384,416	7,718,594	3,704,780	4,013,814
1954	13,535,399	5,520,599	8,014,800	4,068,638	3,946,162
1955	14,527,379	5,985,916	8,541,463	4,533,275	4,008,188
1956	16,573,197	6,553,366	10,020,831	5,366,175	4,654,656
1957	19,240,833	7,112,208	12,128,625	6,616,364	5,512,261
1958	21,029,527	6,997,079	14,032,448	7,935,575	6,096,873
1959	22,360,952	7,352,849	15,008,103	8,637,675	6,370,428

Source: FAA Traffic Control Summaries, FAA Statistical Handbook of Aviation, 1960, page 24.

Table 22

CIVIL AIRCRAFT OPERATIONS AT MAJOR AIRPORT TRAFFIC CONTROL TOWERS

Year	% Total	% Air Carrier	% General Aviation	General Aviation	
				% Itinerant	% Local
1948	100%	20%	80%	19%	81%
1949	100	26	74	26	74
1950	100	29	71	32	68
1951	100	32	68	36	64
1952	100	38	62	43	57
1953	100	41	59	46	54
1954	100	41	59	51	49
1955	100	41	59	53	47
1956	100	40	60	53	47
1957	100	37	63	55	45
1958	100	33	67	56	44
1959	100	33	67	57	43

Based on Table 21.

Table 21 summarizes this record of operations and reveals an increase of 39%, 1959 over 1948; air carrier operations jumped from 3.2 million to nearly 7.4 million, or a gain of 127%, while general aviation showed a net increase of only 16%. At the reporting airports, these figures as summarized in Table 22 indicate a basic shift in traffic patterns in which air carrier movements and itinerant general aviation operations have assumed the important share of the traffic.

Local operations tend to be displaced as the importance of the airport increases. Not only is freedom of movement subordinated by the heavier activity, but airport charges are likely to increase to the point that the pleasure aircraft seek out lesser, more economical airports in the vicinity. Whereas 81% of the general aviation operations in 1948 were local at the reporting airport, only 43% were so classified in 1959; itinerant operations had exceeded local since 1954.

A further influence on the declining importance of local flights at major airline airports, as well as most other airports, was the substantial reduction in instructional flights, hitherto discussed. From a commanding lead in classes of flights in 1948, largely supported by instructional operations, local operations fell to a minority position in 1954 and have remained there despite some recovery occasioned by a revival of training and new commercial applications of aviation utilizing a fixed-base.

NATIONAL AVIATION IN THE FUTURE

The extensive statistics of the foregoing paragraphs together with much other data have formed the basis for numerous forecasts of future civil aviation activity in the United States. Ranging from elementary extensions of rather meagre historical data to elaborate model building, these forecasts have yielded a confusing array of estimates, although every one of them indicates a substantial, if not spectacular, growth in the next two decades of American aviation.

Because of the short historical period and the imperfect documentation of aviation, it was concluded early in this study that any projections to be at all reliable would require consideration of a large number of transportation and economic factors. When it was found that Mr. Edward P. Curtis, the Special Assistant to the President for Aviation Facilities Planning, had commissioned the Aeronautical Research Foundation to undertake extensive research in this area, and then incorporated the findings in his final report in June 1957, it was decided to utilize that study rather than undertake any new and separate national projection with the limited resources at hand. Accordingly, the "Curtis Report" forecasts have been adopted as the basis for estimating the future aviation activity in Michigan.

To show the basis for the reduction of national estimates to the state level, the Curtis forecasts are briefly summarized. Consistent with the usual division of civil aviation, these are shown under the headings of "Air Carriers" and "General Aviation." Military flying, for reasons previously explained, is again omitted.

DOMESTIC AIR CARRIERS TO 1975

Air carriers, as a part of the for-hire transportation activities, were analyzed in the Curtis study for their role in the common-carrier passenger travel market of the United States. Inherently, it was assumed that air transportation will grow at a somewhat more rapid rate than the U.S. economy as a whole, but that there will be no abrupt and radical shift of public attitudes toward air travel over the next fifteen or twenty years. Also in this period, it is assumed that the air carriers, despite some talk to the contrary, will continue to be predominantly passenger-oriented and that the air-cargo "breakthrough" will evolve gradually.

The somewhat more rapid rate of air expansion is a reasonable assumption, it was concluded, because the utilization of new equipment, already being introduced, will improve the quality of service over already high standards. Further, the application of the new turbo-prop planes to local service airlines will mean an expansion of route coverage and more extensive transportation links which will generate new traffic above that of normal growth. These assumptions are reflected in the summary of the "Curtis" forecasts in Table 23.

Table 23

FORECAST OF DOMESTIC AIR CARRIER ACTIVITY IN U.S.

Year	Passenger-Miles (billions)	Revenue Passengers (millions)	Air Carrier Movements (millions)
1955 (actual)	20.0	38.0	7.0
1960 (estimate)	29.7	52.0	7.6
1965 (estimate)	41.1	84.8	11.8
1970 (estimate)	53.1	113.1	11.7
1975 (estimate)	66.7	153.3	14.9

As indicated, traffic in terms of passenger-miles is expected to increase slightly more than three times, while the number of passengers will rise almost four-fold. It is expected that the trip-length in miles will decrease in line with an already evident trend which shows air replacing surface transportation on many shorter hauls, particularly in the 500-1000 mile range. On the other hand, our expanding economy is likely to move more people into the income brackets at which air travel is accepted, while the probably lowering if air fares will reduce the lower limit to that bracket to bring in a greater segment of the population as potential air travelers.

Air carrier movements, it will be observed, are not expected to grow as rapidly and may, in fact, level off for a time. This projection is postulated on the assumption that the present carrier fleet will be replaced by 1965 with the new models which have nearly double the seating capacities and higher speeds. As a result, traffic capabilities will expand at a much lower rate of aircraft movement.

With the availability of 1959 data of actual traffic, a comparison with the projections from 1955 is of interest. Actual 1959 passenger-miles totaled 29.3 billion and correspond closely with the anticipated 29.7 billion for 1960. Revenue passengers totaled 54.7 million in 1959, or somewhat above the forecast of 52.0 million for 1960 but still close to the limits of the projection which estimated a possible "high" of 54.5 million. No record of 1959 air carrier aircraft movements was available for comparison.

These comparisons can also be made with FAA forecasts appearing in their "National Airport Plan - 1959." According to FAA projections, 66 million passengers and 35 billion passenger-miles were anticipated for 1960, and are slightly higher than preliminary indications revealed, as well as much above the Curtis forecast. It can only be concluded that the Curtis estimates are realistic and reliable, though periodic review and adjustment will be essential in the light of changing conditions.

In the domestic air cargo area, numerous forecasts have appeared in which it was assumed that a "breakthough" into low-cost equipment was imminent; new all-cargo aircraft in the design and development stages were expected to be added to the active air carrier fleets in the early 1960's and were to accomplish a major shift in traffic away from the surface carriers. Delays in the production of such new equipment have postponed the date of the anticipated "breakthrough." In the meantime, as Table 24 shows, domestic air cargo ton-miles have steadily increased and are conservatively estimated to grow at the same rate in the future to some 1700 million ton-miles in 1975, or just over four times the 1955 level of 379.4 million ton-miles of air freight and air express.

Table 24

AIR CARGO PROJECTION
(Domestic air carrier traffic in millions of ton-miles)

Year	Air Cargo
1955	379.4 (actual)
1960	650.0
1965	1,000.0
1970	1,350.0
1975	1,800.0

In 1959, the total domestic air cargo carried by the scheduled passenger carriers and the certificated all-cargo carriers was about 580 million ton-miles, or roughly 7% below the projection for that year. In view of both the somewhat erratic history of air cargo development and the impact of the 1958 business "recession," this variation is considered well within acceptable limits for the short time period involved. Should present prospects for the introduction of new all-cargo aircraft be substantially changed to earlier dates, however, this projection should be scrapped and a new one devised on the basis of changing cost-time relationships.

Air mail, like air cargo, can be predicted with much less confidence than passenger traffic and is also neglected in the "Curtis Report." In that study, it was considered so much an adjunct of passenger service that its growth would largely follow the expansion of the scheduled air carrier movements rather than exert a decisive influence. Unless there is a drastic change in Post Office policy, this subordinate role of air mail in the future traffic picture will continue and its forecasts are of only secondary concern in aviation planning.

Assuming, however, that the scheduled airlines and air-cargo carriers dominate the domestic transportation field to the extent that alternate surface transportation can be maintained only at Post Office expense for distances beyond 300 to 500 miles, then air mail transportation becomes a decisive planning factor on certain routes and schedules. In this circumstance, as well as under the pressures of an expanding population, air mail growth has been projected as shown in Table 25.

Table 25

AIR MAIL FORECAST

(Domestic traffic on certificated carriers in millions of ton-miles)

Year	Air Mail
1955	87.4 (actual)
1960	135.0
1965	229.0
1970	371.0
1975	599.0

This increase to 1975 air mail traffic of five times the 1959 level of 118.8 million ton-miles is a somewhat more rapid rate of growth than indicated for passenger traffic and can be supported, it is again emphasized, only through basic changes in mail transportation policy.

Projections of irregular and supplemental carrier traffic have also been studied but, as in the Curtis Report, their role in the future was concluded to be essentially the same as today. Any expansion in this area of aviation activity is more than covered by factors considered in the traffic and air carrier movement projections for air passengers. No separation in figures is possible.

GENERAL AVIATION FORECAST

As is pointed out in the Curtis Report, "The problems of forecasting general aviation over the next twenty years center about the great diversity of activities involved, the limited experience base available, the gragmentary nature of the reported data, and the difficulties of interpreting trends of development which are, in some instances, dimly defined and often seemingly inconsistent. A particular problem is created by the lack of total aircraft movement data." In the face of such problems, it seemed even more sensible than in the case of the air carriers, to rely upon the extensive research and analysisof the Curtis study instead of to presume a knowledge which was unavailable locally.

To the extent that general aviation activity is associated with a prospering economy, its expansion may parallel economic growth but several inhibiting factors indicate some moderation in future gains. Particularly significant in this regard is the high cost of ownership of aircraft; not only is the initial capital outlay relatively high with respect to other personal expenditures, but also the operating and maintenance cost is expensive in terms of practical utilization. This economic fact has disillusioned many aviation enthusiasts and no doubt has retarded growth.

Another retarding factor is the failure of the aircraft industry to realize its long-heralded goal of a mass-produced, low-cost, light, and virtually foll-proof aircraft. Technically, it seems entirely feasible to produce such a personal aircraft with an annual cost level similar to that of the luxury automobile, but, practically, the extensive investment in development costs required have discouraged capital and there is no current prospect for any actual undertaking.

Fear of flying in private aircraft was found, in a survey associated with the "Curtis study," to be a major inhibiting factor in personal ownership. While it was concluded that this fear will "exert a progressively diminishing influence" on general aviation as greater familiarity increases its public acceptance, it was also concluded that this fear will dissipate slowly.

Balancing such retarding factors with the demonstrated activities as shown by the historic record of general aviation, there is basis for the general assumption of continued growth, but with little prospect for any appreciably accelerated rates of development. And to be of value in planning for local areas, this aspect of growth must be separated into the principal categories of general aviation which receive varied emphasis in particular environments. Tables 26 and 27, largely extracted from the

Curtis report, summarize the outlook for general aviation to 1975.

Table 26

ACTIVE GENERAL AVIATION FLEET
(Thousands of aircraft)

Year	Business	Commercial	Instructional	Pleasure	Total
1954	18.6	8.6	4.7	29.4	61.3
1957	21.5	8.8	5.6	29.9	66.5
1960	29.0	10.0	5.0	23.0	67.0
1965	38.0	14.0	6.0	15.0	73.0
1970	50.0	17.0	7.0	16.0	90.0
1975	60.0	20.0	8.0	17.0	105.0

Note: 1954 and 1957 totals are actual aircraft, while their respective categories are based upon periodic CAA surveys of general aviation as reported in "Airplane At Work For Business and Industry."

Records in 1959 indicate that this projection is on the conservative side because the active fleet in that year exceeded 70 thousand, or some 3,000 aircraft above the projection for 1960. This excess is in some measure explained by the continued use of older planes which have been maintained in "active" status for personal use, contrary to the assumption of the Curtis study which predicted wholesale "junking" of such planes as operating costs climbed. Flying clubs, achieving some spreading of these costs, seem to be a new factor in sustaining pleasure flying and may warrant a revision in estimates for the immediate future of general aviation.

Also, the assignment of aircraft to one or another of the four categories becomes arbitrary because planes are used for more than one type of flying, though their classification depends upon "primary" use. For example, it is assumed in the Curtis report that roughly one-half of all pleasure flying will be done in aircraft assigned to the "business" category.

This overlapping is in part corrected in Table 27, which estimates the probable use in terms of flying hours.

Table 27

HOURS FLOWN IN GENERAL AVIATION BY TYPE OF FLYING
(millions of flying hours)

Year	Business	Commercial	Instructional	Pleasure	Total
1954	3.9	1.9	1.3	1.9	9.0
1957	4.9	2.0	1.9	2.0	10.9
1960	6.9	2.1	1.5	2.2	12.7
1965	9.5	2.7	1.7	2.4	16.3
1970	13.0	3.3	1.8	2.9	21.0
1975	16.0	4.4	2.0	3.4	25.8

Note: 1954 and 1957 are actual totals with distribution based upon CAA Surveys in these years. See Table 16.

Except for the 1957 increase in "Instructional" flying hours, the 1957 experience closely coincides with the projection; this rise in training hours reflects the substantial increase in student pilot license issuances in recent years and may be a factor upsetting the projection of "Pleasure" flying in the 1956-65 period.

In the longer run, however, it is believed that the inhibiting factors of investment and operating cost will operate to return the future experience to the values projected. The study of general economic factors, at variance with the finally adopted projections, tends to confirm this conclusion of a deferred decrease in pleasure flying.

It should be noted that the forecast of business flying was supported by two surveys on business ownership of aircraft by the CAA, and by a special survey of the aeronautical Research Foundation in which attention was given to aircraft owned by companies headed by young executives. Essentially, the forecast is based upon the estimated increases in the number of corporations owning planes as a result of changes in the acceptance of aircraft by such corporations indicated in the surveys.

Commercial flying in general aviation includes so many diverse activities that no comprehensive projections are completely rational. The air taxi and charter operations are likely to be curtailed by the projected expansion of air carrier service to new areas, while they may be enhanced by the standards of transportation time set by faster jet service on long hauls; agricultural operations, and patrol or inspection services are likely to increase at increasing rates. The composite totals for this category, though, show an increase somewhat more modest than business flying which accounts for the greatest portion of the growth in general aviation.

Other significant factors such as the probable number of certificated airmen in the future could not be reasonably established from the available data. Table 20, which lists the historic data for certificated civil airmen through 1959, incorporates so many variables that any extrapolation seems unreliable. Similarly, data on airports is so much a matter of records rather than actual change that there is no basis for expansion.

Accordingly, the future picture of general aviation in the United States must be drawn from the projections of the size of the aircraft fleet and flying hours, as set forth in Tables 26 and 27.

THE MICHIGAN AVIATION ASPECT

Part I of this report established the Michigan aviation aspect for a particular year, 1958, with only casual reference to its change with time or to the national picture. It was there intended, primarily, to develop as complete a record as possible of the economic impact of aviation activity at a given date in Michigan rather than provide a base for estimating growth in the future. While some of that data has application here, the primary purpose of this phase of the study is the writing of the historic record of Michigan aviation in comparison to the better documented national aspect compiled in earlier pages of this section.

Not all of the available Michigan data could, thus, be utilized because many local records are maintained in accordance with Michigan laws and regulations which are at some variance with national definitions. Hence, only those statistics were employed for which consistent national-state relationships could be established.

First, however, certain population and economic statistics were developed because of their basic role in influencing all aviation developments. Table 28 delineates the growth of U.S. and Michigan resident population which provides the air traffic potential for all civil aviation. Tables 29-A and 29-B exhibit the economic resources which afford potential support to demands growing out of population, while Table 30 introduces the disturbing element of unemployment which acts as a retardant to transport expansion.

Table 28

MICHIGAN POPULATION COMPARED TO U.S.
1900 - 1960

Year	U.S.A. (Continental) Population (millions)	U.S.A. (Continental) % Increase	Michigan Population (millions)	Michigan % Increase	Michigan as % of U.S. Pop.
1900	76.0		2.42		3.18%
		21.0%		16.1%	
1910	92.0		2.81		3.05
		14.9		30.5	
1920	105.7		3.67		3.47
		16.1		32.0	
1930	122.8		4.84		3.94
		7.2		8.5	
1940	131.7		5.26		4.00
		14.5		21.2	
1950	150.7		6.37		4.23
		19.0		22.8	
1960	179.3		7.82		4.36

Source: Statistical Abstract of the U.S., Table 9, except for 1960 which is based upon final figures of the 1960 Census as released to the press on November 15, 1960.

Table 29-A

PERSONAL INCOME - MICHIGAN AND U.S.
(Billions of dollars)

Year	Continental U.S.	Michigan	Michigan as % of U.S.
1929	$ 85.6	$ 3.80	4.44%
1940	78.5	3.61	4.60
1945	164.5	7.22	4.39
1948	207.4	9.58	4.61
1949	205.5	9.52	4.64
1950	225.4	10.80	4.79
1951	252.9	12.10	4.78
1952	269.1	12.90	4.80
1953	283.1	14.52	5.13
1954	285.3	14.13	4.96
1955	306.6	15.79	5.14
1956	329.9	16.36	4.95
1957	345.3	16.71	4.85
1958	359.0	16.60	4.63
1959	380.2	17.50	4.59

Source: U.S. Department of Commerce, Office of Business Economics, Survey of Current Business

Table 29-B

PERSONAL INCOME PER CAPITA COMPARISONS
(in current dollars)

Year	Continental U.S.	Michigan	Michigan as % of U.S.
1948	$1420	$1542	108.6%
1949	1382	1504	108.8
1950	1491	1684	112.9
1951	1649	1855	112.5
1952	1727	1932	111.9
1953	1788	2120	118.6
1954	1770	1982	113.1
1955	1866	2145	115.5
1956	1961	2158	111.1
1957	2027	2141	105.6

Source: Same as Table 29-A.

Table 29-C

DISPOSABLE INCOME COMPARISONS
(Total in millions of dollars)

1959 Rank Order	State	1959	% U.S.	Per Capita Disposable Income		
				1955	1957	1959
1	New York	$ 38,738	11.56%	$1964	$2195	$2350
2	California	35,774	10.68	1982	2162	2334
3	Illinois	22,590	6.74	2023	2215	2291
4	Pennsylvania	21,775	6.50	1696	1892	1957
5	Ohio	19,484	5.81	1850	2032	2063
6	Texas	16,040	4.79	1475	1611	1696
7	MICHIGAN	15,570	4.65	1915	1957	2006
8	New Jersey	13,533	4.04	2043	2228	2288
9	Massachusetts	10,850	3.24	1806	2020	2142
10	Indiana	8,663	2.58	1707	1815	1875
--	Wisconsin	7,248	2.16	1589	1728	1858
--	Cont. U.S.	335,131	100.00	1653	1804	1907

Source: U.S. Dept. of Commerce, Office of Business Economics - Survey of Current Business, August 1960, p. 12-13

Table 30

PROPORTION OF THE LABOR FORCE UNEMPLOYED

Year	U.S.	Michigan
1949	5.5%	7.3%
1950	5.0	4.1
1951	3.0	4.0
1952	2.7	4.1
1953	2.9	2.6
1954	5.6	7.1
1955	4.4	3.7
1956	4.2	6.5
1957	4.3	6.8
1958	6.8	13.4
1959	5.5	8.9

Source: U.S. Department of Labor.

With regard to population, it is a generally known fact deriving from Census studies and interim estimates that Michigan is one of the outstanding "growth" states of the United States other than Florida and the western states, chiefly California. The tabular data merely confirms this in the steadily increasing percentage of the U.S. population resident in Michigan which currently has reached a high of 4.36%.

Tables 29-A and 29-B indicate that Michigan's residents have consistently enjoyed in recent years a personal income somewhat above their share based upon population. Both as a percentage of total U.S. income and on a per-capita basis, the values for Michigan are above national averages. Table 29-C indicates the place of Michigan in the national picture, as well as in the Great Lakes area. On the basis of disposable income, which is regarded by economists as one of the best indicators of relative buying power, Michigan's seventh place ranking is consistent with its population rank among the states; it is almost 6% above the national average and approximately at the median level for the East North Central States.

Some uncertainty as to the immediate future is illustrated by Table 30 which shows a disturbing rise in Michigan unemployment as compared to the national average. The out-of-proportion increase in the percentages of unemployed in the state since 1955 imply a softening of the Michigan economy which, unless checked and sharply reversed, could restrict demands for aviation expansion. In this study, however, it is assumed that measures will be taken to assure continued growth.

With such background, an examination of Michigan aviation trends since 1948 is much more pertinent. As in the case of the national aviation aspect earlier delineated, the Michigan picture is viewed in the two broad categories of air commerce as supplied by the scheduled carriers, and of general aviation.

AIR COMMERCE IN MICHIGAN

The scheduled air carriers, including the all-cargo lines, serving Michigan have been required to submit to the CAB certain operational data which has been utilized by the FAA in the preparation of planning studies. From the annual issues of the "Air Commerce Traffic Pattern (Scheduled Carriers)," Tables 31 through 34 have been compiled and Michigan-U.S. relationships established. While there have been some changes in reporting procedures which impair the precision of the trends, the national and local figures for any year are consistent so that the proportion of the national traffic indicated for Michigan is an accurate representation.

Table 31-A shows the "Enplaned Passenger" data beginning in 1948, but since 1958 has been officially termed "On-Line Passenger Originations" by current FAA definition, these figures represent the revenue passengers boarding air-carrier planes at every domestic on-line station, with duplications of transfer and short lay-over passengers continuing on the originating airline eliminated. Still duplicated are passengers transferring from one airline to another without through ticketing which would record the transfer.

In the twelve years beginning with 1948 and ending with 1959, the national air travel has grown by 278% while Michigan passengers rose 260%. During that period, Michigan's percentage of the total domestic traffic volume has ranged between 3.30% and 3.68% with the twelve-year average of 3.51%, or somewhat below its population percentage of a current 4.36%. In 1958, when both U.S. and Michigan traffic declined, the extended labor difficulties, along with the business "recession," were assigned the blame; and, though both showed recovery in 1959, persisting economic difficulties seem to account for the new low in Michigan's percentage.

A factor that has planning significance is revealed by Table 31-B which shows for alternate years beginning in 1949 the enplaned passengers boarding at the Detroit airports as compared with the 17 out-state stations in service during most of the period. Consistently, approximately 80% of the Michigan traffic boards at Detroit. Because of its magnitude, this traffic tends to "shadow" a number of stations in Lower Michigan and creates a question in determining trend influences.

Table 31-A

AIRLINE PASSENGERS - MICHIGAN AND NATIONAL

Year	Continental U.S.	Michigan	Michigan as % of U.S.
1948	13,060,000	441,300	3.38%
1949	14,732,687	503,022	3.32
1950	16,937,018	598,424	3.53
1951	21,895,612	773,344	3.53
1952	24,350,307	853,300	3.50
1953	28,004,269	1,031,095	3.68
1954	31,657,852	1,134,420	3.58
1955	37,226,432	1,330,147	3.57
1956	40,752,365	1,449,859	3.59
1957	44,017,548	1,581,615	3.60
1958	43,568,139	1,473,310	3.38
1959	49,357,870	1,630,784	3.30

Table 31-B

AIRLINE PASSENGERS - DETROIT AND OUTSTATE STATIONS

Year	Detroit Stations		Outstate Michigan	
	Number	%	Number	%
1949	409,142	81.4%	93,880	18.6%
1951	621,451	80.4	151,893	19.6
1953	822,879	80.0	208,216	20.0
1955	1,040,728	78.3	289,419	21.7
1957	1,251,142	79.1	331,473	20.9
1959	1,290,738	79.2	340,046	20.8

Source: FAA Air Commerce Traffic Pattern (Scheduled Carriers)

Table 32

AIR CARRIER AIRCRAFT DEPARTURES

Calendar years

Michigan vs. U.S., 1948-1959
(in thousands)

Year	Continental U.S.	Michigan (18 Stations)	Michigan as % of U.S.
1948	1,861	56.01	3.01%
1949	2,024	57.25	2.83
1950	2,137	67.29	3.14
1951	2,319	76.46	3.29
1952	2,432	78.26	3.22
1953	2,613	89.46	3.42
1954	2,661	93.54	3.51
1955	2,902	111.82	3.84
1956	3,094	120.77	3.90
1957	3,318	132.13	3.94
1958	3,176	124.63	3.93
1959	3,421	124.65	3.64

Source: FAA Air Commerce Traffic Pattern (Scheduled Carriers)

Closely related to "enplaned passengers" in planning significance are the statistics on aircraft departures shown in Table 32. The number of departures is affected in part by the capacity of individual aircraft, and in part by the level of scheduled service supplied; for a given traffic volume, aircraft of larger capacity reduce the number of departures required - the introduction of the new, larger jets, for example, temporarily reduced the number of flights on certain routes. Increasing departures, on the other hand, indicate both an extension of service if new stations are added, and greater frequency of service when the number of stations is held constant.

Departures nationally have increased only 84%, in contrast to the passenger increase of 278%, and reflect the increased capacity and utilization of the air carrier fleet. In Michigan, the 122% increase in departures is interpreted as due largely to the increases in service to airports outside the Detroit zone. The average 3.54% of the national total departures, as compared to 3.51% for passengers, is likely the result of this out-state service aspect. In 1959, the small recovery in Michigan is attributed to the lag in jet service to Detroit, and is believed to be offset by 1960 adjustments in new jet aircraft schedules.

Air-mail and air cargo in Michigan, as compared to U.S. totals, is developed in Table 33 which shows air-mail tonnage at an average of only 2.42% of the national level, and air-cargo at just over 6% (6.04%) - the largest percentage of any category of air carrier comparison. Conversely, the air-mail increase since 1948 - a net of 222% in Michigan against 205% nationally - is, along with aircraft departures, an activity in which local growth ran ahead of the United States; this circumstance is the result of improved service to out-state areas which permit Post Office use of planes on some routes where air-mail was forwarded by surface carriers. An irregular element has, in the national picture, been the inclusion in the air-mail tonnage of non-priority mail moved by air between certain major terminals as plane capacities might be available; this tonnage, which is not separately identified, may inflate national figures in comparison to local air-mail movement out of Michigan and thus distort the relationship.

It should also be noted that air-mail is dependent upon the prior existence of air-carrier service and is rarely a principal, or exclusive reason for the establishment of air service. As such, air-mail statistics are, in reality, indicators of secondary importance in planning, despite their implications to any particular community.

Table 33 Calendar Year

AIR MAIL AND AIR CARGO TRAFFIC - MICHIGAN AND U.S.

Year	Air Mail (Tons)			Air Cargo (tons)		
	U.S.	Michigan	% U.S.	U.S.	Michigan	% U.S.
1948	53,987	1174	2.18%	165,366	9,090	5.50%
1949	65,301	1584	2.43	211,472	10,592	5.01
1950	69,673	1957	2.81	289,491	19,790	6.71
1951	90,057	2288	2.53	286,836	17,037	5.94
1952	98,052	2469	2.51	296,469		
1953	100,341	2415	2.40	316,580	20,400	6.46
1954	113,608	2546	2.34	310,894	21,130	6.77
1955	124,763	3011	2.42	389,308	30,009	7.72
1956	132,113	3393	2.56	422,517	28,086	6.64
1957	142,052	3574	2.51	434,788	26,671	6.14
1958	150,788	3558	2.36	431,562	20,965	4.86
1959	164,216	3785	2.29	501,714	24,000	4.78

Source: FAA Air Commerce Traffic Pattern (Scheduled Carriers), and Air Carrier Reports submitted to CAB on Form 41, Schedule B-5.

Air cargo, on the other hand, is a factor of growing interest because it is traffic increasingly sought and promoted by air carriers. As hitherto commented, cargo is regarded in some aviation quarters as ultimately of more importance than passenger traffic in spite of its relatively minor role in recent years. The relatively few cargo planes, the lack of specialized aircraft and cargo-handling equipment, and pre-occupation with passengers have all caused a rather erratic growth pattern for cargo tonnage carried; three of the twelve years recorded show decreases in U.S. totals from preceding years, and Michigan traffic has been even more irregular in growth.

Comparing these U.S. and state trends, it will be noted that the national trend is rising with 1959 showing the greatest volume, up some 203% above 1948, while Michigan traffic reached a peak in 1955 and only in 1959 again showed an upward turn. Nevertheless, the 1959 traffic was 164% above the 1948 movement out of the state. Local economic and air service factors combined to cloud the trend.

A summary of Michigan-U.S. air carrier activity relationships is shown in Table 34.

Table 34

SUMMARY OF MICHIGAN-U.S. AIR CARRIER TRAFFIC RELATIONSHIPS, 1948-1959

	Percent Increase, 1948-59		Michigan as % of U.S.
	U.S.	Michigan	
Passengers	+278%	+260%	3.51%
Aircraft Departures	+ 84%	+122%	3.54%
Air-Mail Tonnage	+205%	+222%	2.42%
Air Cargo Tonnage	+203%	+164%	6.04%
Population (1950-1960)	+ 19%	+22%	4.31%
Personal Income	+ 83%	+93%	4.82%

GENERAL AVIATION GROWTH IN MICHIGAN

The study of past trends in general aviation activities in Michigan, as distinguished from air commerce, just described, is developed from several series of data which have been assembled from a variety of sources and cover at least the latter part of the selected 1948-1959 period. Aside from the comprehensive information derived from the Transportation Institute's survey of general aviation and reported in detail in Part I, very few direct measures of activity exist. Even the available statistics for Michigan are difficult to reconcile and compare with national figures because there has been no systematic recording on any consistent basis; differences in definition and reporting periods result in such uniqueness of reference that much of the data can be used only generally.

As the need for basic statistical information has become more evident, the Michigan Department of Aeronautics has initiated improved procedures for its collection. Flight activity - a major factor in planning data - is now being determined from a brief questionnaire on the annual aircraft registration form, but cannot as yet be sufficiently developed to permit continuous comparison with the national figures derived from the periodic surveys of general aviation conducted by the FAA.

A basic indicator of Michigan and national flight activity in general aviation, which seems to provide a consistent comparison is the consumption of aviation fuel. Table 35 delineates the record of aviation fuel. Table 35 delineates the record for Continental U.S. and for Michigan and clearly shows both the abrupt decline from the high, immediate post-war activity and the gradual recovery from the 1951 low. Nationally, the consumption of general aviation fuel increased by 39% from 1948 to 1959 while, in Michigan, the increase was 54%, or well above the United States; until 1959, however, when the Michigan consumption jumped sharply for reasons not yet clear, the comparison was more nearly parallel. Overall, Michigan has averaged 3.34% of the national consumption, or somewhat lower than its 3.51% of air commerce traffic, but the 1959 percentage of 4.15 shows a significant shift if that relationship is maintained.

Table 35

AVIATION FUEL CONSUMED - MICHIGAN AND U.S.

General Aviation

Year	United States	Michigan	% of U.S.
1948	179,368,000 gal.	6,833,000 gal.	3.80%
1949	131,766,000	4,067,000	3.11
1950	131,200,000	3,833,000	2.92
1951	131,833,000	4,333,000	3.28
1952	137,846,000	4,767,000	3.46
1953	168,948,000	5,100,000	3.03
1954	176,649,000	5,167,000	2.93
1955	190,000,000	5,867,000	3.09
1956	198,000,000	6,908,000	3.48
1957	209,868,000	7,105,000	3.40
1958	227,000,000	7,856,000	3.46
1959	249,000,000	10,519,000	4.15
Average			3.34%

Source: U.S. - FAA Statistical Handbook of Aviation, 1960, page 50.

Michigan - Michigan Department of Aeronautics, based upon Motor Fuel Tax Records.

Table 36

AIRCRAFT IN MICHIGAN
1948-1959

Year	Aircraft Registrations: By Michigan Dept. of Aeronautics	Aircraft Registrations: By FAA Total	Aircraft Registrations: By FAA "Active"	Active Mich. Aircraft as % U.S. Active
1948	3478	4450	N.A.	N.A.
1949	3492	4249	N.A.	N.A.
1950	3421	4172	N.A.	N.A.
1951	3303	3914	N.A.	N.A.
1952	2978	3876	2225	4.18%
1953	2359	3899	2286	4.19
1954	2498	3940	2452	4.23
1955	2570	3611	2625	4.43
1956	2656	3626	2710	4.27
1957	2833	3757	2812	4.27
1958	2968	3868	2833	4.21
1959	2988	3416	2728	3.94
1960	3136	N.A.	N.A.	N.A.

Source: Michigan Department of Aeronautics, and FAA

Table 36-A

CIVIL AIRCRAFT - MICHIGAN AND CONTINENTAL U.S.

Year	Continental U.S.			Michigan			
	Total	Active	% Active	Total	Active	% Active	% U.S.
1948	94,914	N.A.	---	4,450	N.A.	---	---
1949	91,420	N.A.	---	4,249	N.A.	---	---
1950	91,517	N.A.	---	4,172	N.A.	---	---
1951	87,128	N.A.	---	3,914	N.A.	---	---
1952	87,762	53,173	61%	3,876	2,225	57%	4.18%
1953	89,420	54,561	61	3,899	2,286	59	4.19
1954	90,297	57,939	64	3,940	2,452	62	4.23
1955	83,612	59,297	71	3,611	2,625	72	4.43
1956	85,707	63,532	74	3,626	2,710	74	4.27
1957	88,240	64,660	73	3,757	2,812	75	4.27
1958	94,616	67,052	71	3,868	2,833	73	4.21
1959	102,883	69,310	68	3,416	2,728	79	3.94
	Average:		68%	---		69%	4.22%

Source: FAA Statistical Handbook of Aviation, 1953-60; FAA U.S. Active Civil Aircraft by State and County.

Other relationships have been established for aircraft registration, pilots, airways mileage, and airports although the implications are less direct than would be desirable for planning purposes. Supplemental Michigan data on aviation schools' and instructors' licenses are included to indicate trends of longer range significance.

Table 36, which shows the historical record of aircraft registrations, illustrates the problem of utilizing local aviation data as it is presently collected. The three columns of registration figures represent: first, the Michigan Department of Aeronautics tabulations in accordance with the registration requirements of the Michigan statutes which refer to a fiscal year beginning August 1; second, the total number of aircraft in Michigan as recorded by the FAA; third, and of greatest import, the "active" aircraft in Michigan as registered by the FAA under Federal laws and regulations. Under these specifications, an "active" aircraft is one which possesses a valid certificate of air-worthiness and has been officially inspected within the twelve-month period preceding its current registration; only such "active" airplanes can be legally flown and, obviously, constitute the realistic fleet producing general aviation activity. Over the period, 1948-59, the active fleet represents about 69% of the total number of registered aircraft, as noted in Table 36-A, and is used as the comparison base in this study.

A further explanation of the lack of agreement between Michigan and FAA figures lies in the difference in time periods; FAA records on a calendar-year basis as contrasted to the Michigan fiscal year.

Considering the five-month lag, the Michigan and the "active" FAA columns are more nearly consistent than they first appear.

Active Michigan aircraft average 4.22% of U.S. active fleet, or consistently above the activity percentage indicated by aviation fuel consumption. The 1959 decline in registration percentage and the rise in fuel consumption indicates a more intensive use and probably reflects the growing importance of business and commercial flying.

A somewhat erratic pattern is indicated in Table 37 which lists the registration of pilots by the FAA. The totals indicate the number of Michigan pilots holding Federal certification, while the "active" pilots are those possessing currently valid medical examination approval in accordance with FAA regulations. "Active" pilots in Michigan have averaged 37% of total Michigan airmen as against 44% active nationally; and the proportion of Michigan "actives" to U.S. active pilots has declined to 3.72% from a peak of 4.21% and now lags the population ratio.

Among the states, Michigan, in eighth place in active pilots, ranks one spot below its population order. Florida, which has shown spectacular aviation growth in recent years, has run ahead of its population rank to displace Michigan. In the East-North-Central Region, however, as shown by Table 37-B which shows the distribution of pilots among the FAA license classifications for 1959. Above in "Private" and below in "Commercial" and "Air Transport," ratings tend to confirm the minor role of air transport base operations in the State, and the limited development of the commercial or industrial category of general aviation. The coincident percentages of student ratings indicate a normal level of local aviation interest.

Table 37

MICHIGAN AIRPLANE PILOTS

Year	Total FAA Certificated Pilots	Current "Active" Pilots	Percent Active	"Actives" as % Total U.S. Actives
1953	28,931	9,979	35%	3.93%
1954	30,025	12,537	42	4.09
1955	32,842	12,296	37	4.18
1956	34,405	10,758	31	4.21
1957	35,259	12,404	35	3.99
1958	36,184	13,528	37	3.90
1959	N.A.	13,272	--	3.72

Source: FAA Statistical Handbook of Aviation.

Table 37-A

ACTIVE PILOTS IN EAST NORTH CENTRAL STATES
as Percentages of Continental U.S., 1953-59

Year	Michigan	Ohio	Indiana	Illinois	Wisconsin	Cont. U.S.
1953	3.93%	5.03	2.87	5.86	1.92	100%
1954	4.09	5.03	2.91	5.75	1.89	100
1955	4.18	5.12	2.97	6.05	1.88	100
1956	4.21	5.00	2.92	6.05	1.87	100
1957	3.99	4.86	2.85	6.03	1.76	100
1958	3.90	4.75	2.79	5.80	1.87	100
1959	3.72	4.76	2.73	5.65	1.86	100

Table 37-B

LICENSE CLASSIFICATIONS - ACTIVE PILOTS, 1959

	Michigan	U.S.
Private	45%	29%
Commercial	22	26
Air Transport	3	5
Student	30	30
Other	negligible	negligible
Total	100%	100%

Table 38

AVIATION SCHOOL AND INSTRUCTOR LICENSES IN MICHIGAN, 1948-1959

Year	Aviation Schools Licensed	Instructors Licensed
1948	228	1021
1949	255	1120
1950	279	1250
1951	155	1276
1952	127	667
1953	70	307
1954	86	222
1955	88	320
1956	88	338
1957	74	322
1958	81	338
1959	76	310

Source: Michigan Department of Aeronautics.

The changing pattern of such local interest is well illustrated by the tabulations of aviation school and instructor licenses issued by the Michigan Department of Aeronautics and shown in Table 38. 1950, the peak year for schools, was at the end of the G.I. training bulge and reflected the hope that the generous Federal-Aid program might be continued by new Congressional action. When it failed to materialize, the sharp drop of 1951 resulted and the further shrinkage to a level consisted with the sustained demand for instruction has been maintained since 1954. Instructor licenses show a similar history. Because of wide differences in regulations, no sound comparison with national statistics could be developed and FAA instructional data is purposely omitted.

Table 39

MICHIGAN AIRPORTS AND LANDING FIELDS

Year	Michigan Dept. Of Aeronautics	Listed by FAA	
		No.	% Cont. U.S.
1948	242	---	---
1949	270	---	---
1950	269	248	3.86
1951	264	249	3.99
1952	253	247	4.08
1953	235	263	3.89
1954	240	255	3.65
1955	230	252	3.78
1956	230	252	3.65
1957	231	194	3.20
1958	231	187	3.31
1959	226	197	3.27

Source: Michigan Department of Aeronautics and FAA Statistical Handbook of Aviation.

Similar difficulties in correlation are involved in comparisons of airports, but both FAA and Department of Aeronautics figures are cited in Table 39 to indicate the trend as well as the national-state comparison. The Department, which is required by statute to inspect and license airports, maintains a record currently more accurate than the FAA record which shows a similar, but lagging trend. Assuming this lag as general throughout Continental United States, the Michigan percentage of the total number of FAA recorded airports was computed from FAA, not local, figures. The percentage is not greatly out of line with other Michigan-U.S. aviation relationships in its ten-year average of 3.67%. The decline in numbers of general aviation airports, which has evoked national attention, is more severe in Michigan where there were 20% fewer airports and airfields in 1959 than in 1950, while nationally, the decrease was 6%.

From a geographical coverage standpoint, Michigan enjoys 2.99% of the total Federal Airways mileage for its 1.93% of the area of the Continental U.S. Strict comparisons are somewhat meaningless at present because of the conversion of the older "Low-and-Medium Frequency" airways (L/MF) to the modern "Very High Frequency" facilities (VHF), and revisions in the Federal Airways System. Table 40 shows the magnitude of the two systems and the proportion in Michigan in which the total mileage has increased some 21% since 1952 as compared to a 41% increase throughout the Continental United States.

Table 40

FEDERAL AIRWAYS MILEAGE IN MICHIGAN

Year	L/MF Airways			VHF Airways		
	Cont. U.S.	Michigan	% Mich.	Cont. U.S.	Michigan	% Mich.
1952	65,940 mi.	2,682 mi.	4.07%	45,831 mi.	1,040 mi.	2.27%
1953	65,617	2,627	4.02	53,466	1,364	2.56
1954	61,498	2,540	4.14	63,971	1,364	2.14
1955	59,759	2,502	4.19	80,185	1,390	1.73
1956	59,763	2,438	4.09	89,244	1,943	2.18
1957	56,725	2,438	4.28	103,460	2,404	2.32
1958	49,613	2,216	4.46	123,846	2,419	1.95
1959	39,289	1,929	4.90	128,364	2,560	1.99

Source: FAA Statistical Handbook of Aviation.

Table 41

RANK ORDER OF STATES IN GENERAL AVIATION AIRCRAFT
January 1, 1960

Rank	State	Aircraft-Active General Aviation	Aircraft per 1000 sq. mi. area	Aircraft per 10,000 population
1	California	8,641	54.4	5.5
2	Texas	6,051	22.7	6.3
3	Illinois	3,584	63.7	3.5
4	Ohio	3,108	75.4	3.2
5.	New York	2,727	55.1	1.6
6	MICHIGAN	2,715	46.7	3.4
7	Pennsylvania	2,494	55.0	2.2
8	Florida	2,232	38.1	4.5
9	Minnesota	1,950	23.2	5.7
10	Indiana	1,875	51.7	4.0
11	Kansas	1,790	21.8	8.2
12	Washington	1,703	25.0	6.0
13	Iowa	1,626	28.9	5.8
14	Oklahoma	1,511	21.6	6.5
15	Missouri	1,461	21.0	3.4
16	Oregon	1,391	14.4	7.9
17	Wisconsin	1,323	23.6	3.3
18	New Jersey	1,259	161.5	2.1
19	Nebraska	1,174	15.2	8.3
20	Louisiana	1,159	23.9	3.5
21	North Carolina	1,149	21.8	2.5
22	Arizona	1,065	9.3	8.2
23	Colorado	987	9.5	5.6
24	Montana	984	6.7	14.7
25	Maryland (inc. D.C.)	927	87.4	2.4
26	Massachusetts	878	106.0	1.7
27	Georgia	877	14.9	2.2
28	Arkansas	859	16.2	4.8
29	Virginia	802	19.7	2.0
30	Tennessee	800	19.0	2.2
31	South Dakota	779	10.1	11.3
32	New Mexico	726	6.0	7.6

Table 41, continued

Rank	State	Aircraft-Active General Aviation	Aircraft per 1000 Sq. Mi. Area	Aircraft per 10,000 population
33	Mississippi	718	15.0	3.3
34	Idaho	689	8.2	10.3
35	North Dakota	675	9.6	10.7
36	Alabama	668	12.9	2.0
37	Connecticut	536	107.0	2.1
38	Kentucky	529	13.1	1.7
39	Utah	442	5.2	5.0
40	South Carolina	408	13.1	1.7
41	Wyoming	401	4.1	12.2
42	Maine	371	11.2	3.8
43	West Virginia	368	15.2	2.0
44	Nevada	333	3.0	11.5
45	Delaware	221	105.0	4.9
46	New Hampshire	176	18.9	2.9
47	Rhode Island	130	108.5	1.5
48	Vermont	97	10.1	2.5
	Continental U.S. Total	67,369	23.4	3.8

Source: FAA U.S. Active Civil Aircraft by State and County, January 1, 1960; Statistical Abstract of the United States, 1960.

A more significant comparison of Michigan's place in the general aviation picture can be derived from Table 41 which lists the 48 continental states in rank order of active general aviation aircraft (commercial transport and military planes are excluded), and also indicates the ratios of aircraft to area of the state and to its population. In total number of general aviation aircraft in the "active" fleet, Michigan is one place above its population position, having displaced Pennsylvania. Its ratios indicate good balance as contrasted with the very small, compact states such as New Jersey, Delaware and Connecticut, and the sparsely populated states, such as Wyoming, Nevada, and Montana where abnormally high ratios exist. In Michigan, geographical extent and population combine to give general aviation a high significance level supporting the absolute value of aircraft registrations.

In summary, general aviation, like air commerce, can be compared by the percentage changes in the available indicators, and by their relative level to the statistics for Continental United States, as shown in Table 42.

Table 42

SUMMARY OF MICHIGAN-U.S. GENERAL AVIATION RELATIONSHIPS

	Percent Change, 1948-59		Michigan as % of U.S.	
	U.S.	Michigan		
Aviation Fuel Consumed	+39 %	+54 %	3.34%	(1948-59)
Aircraft Registration	+23.1	+17.5	4.22	(1952-59)
Active Pilots	+40	+33	4.00	(1953-59)
Airports and Airfields	- 6	-20	3.67	(1950-59)
Airways Mileage	+41	+21	2.99	

MICHIGAN AVIATION TO 1975

Considering the relationships between domestic aviation as it has grown on a national scale and the State's aviation developments during the same period, and utilizing the unusually comprehensive forecasts of the "Curtis" report, this estimate of Michigan's aviation activity to 1975 has been prepared. Several attempts to apply more sophisticated forecasting techniques were abandoned because inadequacies of basic data required assumptions no more accurate than the approximations produced by simpler methods.

Essentially, the methods employed in developing the Michigan aviation projections were as follows:

(1) The various series of U.S. and Michigan were closely compared to indicate the historic trend relationships expressed as percentages of Michigan values to those of Continental U.S. (As previously explained, aviation developments in Alaska, Hawaii and international air traffic are subject to influences not operating directly upon Michigan Aviation, and hence, these areas were excluded.)

(2) The trends, determined both arithmetically and graphically, were reduced to series of index numbers with the base equal to 100 for the calendar year 1955, and these index numbers were then plotted and smooth curves fitted to the charts.

(3) These trend lines were then projected graphically to 1975, and the five-year index numbers read from the chart.

(4) By applying the proper index numbers to the value of the desired factor for the base year, 1955, the projected values for 1965, 1970, and 1975 were computed.

It is recognized that this method has limitations in accuracy imposed by the graphical steps; variations in scale and plotting can yield variable answers, but certainly the resulting variations are consistent with the accuracy and extent of the basic data. In the long run, the FAA has found that a local area's share of aviation activity is relatively stable and has continuity through time, and it is upon this premise that the percentage basis for trend development was founded.

The value for the 1955 base was not necessarily the actual statistical quantity reported for that year, but may, in the case of several factors showing erratic fluctuations, represent an annual average for several years including 1955. Only in this way was it possible to resolve contradicting trend indications for factors with abbreviated historical data.

When comparing local data with national, weight was given to the findings of the Transportation Institute Survey of General Aviation, reported in Part I, in which some departures from national averages were noted. Insofar as reasonable modification could be justified, Michigan values were adjusted on the basis of local indication rather than by automatic application of national averages.

Finally, in support of this approximate method, it should be noted that 1955 was apparently a "normal" year in which no spectacular changes took place and no unusual economic or social forces were exerted to produce unique data. It was a year, as seen in retrospect, of "leveling off" and was spaced near the middle of the 1948-59 period over which much of the data was derived. Important, also, though not alone the deciding factor, was the use of 1955 as the base year for the "Curtis" projections; the use of the same base facilitated projections.

MICHIGAN AIR COMMERCE TO 1975

Careful evaluation of growth of air carrier traffic in Michigan reveals much ground for uncertainty about the magnitude of its expansion. Decisions in the Great Lakes Service Case, discussed in Part I, are to impose extensive changes in routes and services beginning late in 1960 and early 1961 which introduce discontinuities of unknown effect upon particular communities. For the state as a whole, however, they are believed to be "expansionist" and, as a consequence, trend adjustments have been applied to the Michigan percentages of national levels rather than assume a constant 1955 relationship through 1975.

Much of this increased percentage, which is estimated to be 4.00% by 1975, is assigned to traffic outside of the Southeast Michigan Metropolitan Area, because of new cities served and improved at other cities, such as Lansing and Grand Rapids, which to promote air service locally. Table 43 shows the estimated total revenue passengers originating at Michigan airports in the period 1960 - 1975.

Table 43

MICHIGAN AIR PASSENGER TRAFFIC
(Revenue Passengers Originating)

Year	Detroit Airports	Michigan Airports other than Detroit	Total Michigan Traffic
1960	1,390,000	480,000	1,870,000
1965	2,330,000	730,000	3,060,000
1970	3,140,000	1,230,000	4,370,000
1975	4,230,000	1,900,000	6,130,000

By 1975, assuming the trends indicated by 1948-1959 traffic patterns adjusted to recognize the 1960-61 service changes, the total revenue passengers originating at all Michigan airports will have increased some 228%, while those at airline airports outside of the Southeastern Michigan Metropolitan Area will have increased by 317%.

On the basis of the average annual contribution from the air carriers to the economy of Michigan in the 1955-59 period, as developed in Part I of this report, the anticipated 1975 traffic of 6.13 million revenue passengers would yield payrolls, purchases, taxes and miscellaneous local expenditures of more than $76 million as compared to $23.7 million in 1959. Thus, the air carriers will play an increasingly important economic role in the State even though they do not base any new operations at Michigan airports.

Air cargo is much more difficult to project with confidence. First, Michigan's traffic has shown a mixed pattern unlike the national trends. And second, the uncertainty of the date of the long-awaited "breakthrough" in aircraft and handling equipment, of largely unknown appeal, makes any adjustment at a future date almost completely an unqualified guess. It is "guessed," however, that the traffic effects of any new all-cargo aircraft will not be influential until 1970 and after.

Table 44

MICHIGAN AIR CARGO AND AIR MAIL TRAFFIC

Year	Air Cargo	Airmail
1955	30,010 tons	3,011 tons
1960	34,000	4,670
1965	49,500	6,340
1970	67,000	8,010
1975	91,600	9,680

Note: Both aircargo and airmail are net tons of originating traffic at Michigan airline airports, and do not represent total traffic inbound as well as outbound, for which no reliable figures are available.

With this in mind, Table 44 has been calculated from the U.S. trend on the basis of Michigan's increasing percentage of U.S. traffic. The current low level is regarded as temporary and offset by increases begun in 1959 and continuing into 1960. Ultimately, the 1975 traffic is expected to be roughly three times the 1955 tonage, or a 200% increase.

Annual tonnage, particularly for a local area such as outstate

Michigan, will probably not be influenced by any policy decisions which might move all first-class mail by air on 500-mile, or over, distances. Only the Detroit area, served by a major postal facility, would develop such traffic with the result that Michigan's airmail growth will probably continue to trail that of the U.S. Table 44 also shows the projections for air mail tonnage originated in Michigan; by 1975, it is anticipated that Michigan traffic will slightly more than double the currently estimated volume of some 4,600 tons.

To handle this increasing volume of traffic, passengers, cargo, and mail, an increasing number of aircraft movements will obviously be required. Yet, this increase in movements, as measured by "airline aircraft departures," will not be proportional to the traffic increase because of increased capacity of new equipment. The major hubs may actually show, as in Detroit between 1957 and 1959, an increase in the number of passengers and a decrease in aircraft departures; in other words, passengers per departure rise, in part due to traffic development in early service stages and in part due to increased plane capacity.

The lesser hubs and non-hubs, which show a much smaller ratio of passengers per departure, will, as in outstate Michigan, show a rising trend of departures until new equipment replaces older, smaller planes (DC-3's). Even then, the full effect of larger capacity per plane may be offset by maintenance of higher levels of schedule frequency than the existing volume would justify for its seating requirements.

These two forces - larger planes and maintenance of schedule frequency - work against each other and tend to obscure growth patterns of aircraft departures. Balancing these forces and modifying the 1948-59 trend at Detroit where as much as 20% of the traffic may be jet aircraft of 100+ passenger capacity, the following projection of air carrier aircraft departures has been developed and converted to movements by doubling the departures (for every take-off, there is presumed to be a landing).

Table 45

AIR CARRIER AIRCRAFT MOVEMENTS, 1955-1975

Year	Outstate Airline Airports	Detroit Airline Airports	All Michigan Airline Airports
1955	96,246	125,390	223,636
1960	122,000	160,000	282,000
1965	222,000	306,000	528,000
1970	250,000	320,000	570,000
1975	360,000	454,000	814,000

It will be observed that the 1975 movements are 3.6 times those of 1955 while passengers are expected to show only 3.25 times the 1955 volume. This disparity is due to weight given to the anticipated demands for frequency of service at the expense of optimum load factors. And the sheer numbers of carrier movements (almost 1,250 per day at the Detroit airports by 1975) will, it is widely surmised, drive many general aviation aircraft to non-carrier fields.

The outstate movements, divided among the 25 or so airports which will be served by air carriers, will not produce such friction with general aviation which, in turn, may create operational problems for the carriers approaching some of the more intensively used airports such as Capital City at Lansing.

GENERAL AVIATION IN MICHIGAN TO 1975

Because ownership and operation of aircraft in the general aviation fleet are apparently correlated with a number of objective characteristics (such as population, income and types of business, and agricultural activities) which have not been fully investigated in Michigan, and because trends in the available, local aviation data have been mixed, the projections of general aviation activities for Michigan have been derived principally from the national forecasts. As previously noted several times, greatest weight was given to the findings of the "Curtis" report, although its projections have been modified as more recent data warranted adjustment.

Three specific indicators of general aviation activity basic to planning have been projected: the probable size of the aircraft fleet active in Michigan and its distribution among the principal categories; next, the operation of that fleet in terms of flying hours; and finally, the probable number of aircraft movements, both itinerant and local.

The Active Aircraft Fleet

As a base for the projection of aircraft ownership, the 1955-59 average percentage of Michigan activeaircraft to those of Continental United States, as registed by FAA, was used along with an index series projected from "Curtis" data to yield the total aircraft in each of the future dates considered. The distribution among the four principal categories was then achieved by utilizing the 1958 Michigan proportions found in the Transportation Institute Survey and applying these percentages adjusted to the "Curtis" trend in each grouping. Table 46 shows the results of these computations using the 1958 Survey year as the base.

Table 46

ACTIVE AIRCRAFT FLEET IN MICHIGAN TO 1975

Category	1958	1960	1965	1970	1975
Business	549	883	1066	1395	1432
Commercial	288	331	422	509	627
Instructional	269	302	332	371	440
Pleasure	1706	1334	1280	1425	1651
Total	2812	2850	3100	3800	4450
% Increase	----	1%	11%	35%	58%

The total active fleet is anticipated to increase by 58%, or 1638 aircraft, although the increase is not spread uniformly. In the "Pleasure" category, a decrease is actually expected as the result of two forces; one, the cost of individual ownership and operation will promote increasing "flying-club" memberships which permit a substantial increase in personal interest without demanding more planes; and second, many aircraft now in this category,will, through change in usage, be shifted to the "Business" category. The same aircraft may, it will be recalled, be utilized for several purposes so that rigid classifications are not practical.

Incidentally, the projected decline and partial recovery of Michigan "pleasure" aircraft is less severe than the "Curtis" forecast nationally. Relatively high per capita income, extensive rural-resort areas, and the less densely populated areas of Michigan outside the Detroit metropolitan area all favor a higher rate of private ownership than the national average. This circumstance is reflected in the 1958 data which revealed 60% of the Michigan fleet in the "Pleasure" category versus 48% nationally.

Flying Hours

The operation of this Michigan fleet is projected to 1975 on the basis of flying hours per year per aircraft for the four principal categories, as derived from the Transportation Institute Survey of General Aviation in Michigan reported in Part I. These figures were roughly similar to national averages, and were considered more applicable to the local area. Table 47 summarizes the projections of flying hours.

Table 47

GENERAL AVIATION FLYING HOURS IN MICHIGAN, 1958-1975

Category	1958	1960	1965	1970	1975
Business	164,100	264,000	319,000	417,000	428,000
Commercial	56,900	65,000	83,000	100,000	124,000
Instructional	87,600	99,000	108,000	121,000	154,000
Private	138,600	108,000	104,000	115,000	134,000
Total	447,200	536,000	614,000	753,000	840,000
% Increase over 1958	----	20%	37%	69%	88%

The 88% increase anticipated in flying hours, as compared with the 58% increase in fleet size reflects the more intensive use of planes in the "Business" and "Instructional" categories, assuming that 1958 rates of use remain typical. This is believed a conservative assumption because there may be a tendency to achieve greater utilization in the "Commercial" category as that area of aviation industry gains greater knowledge of its potentials. At present, however, there is no basis for applying any numerical increase in probable utilization.

Pleasure flying, large confined to summer weekends, has little opportunity for expanded utilization. The prospect of a 35-hour, or shorter, work week will probably not materialize for most of those people in the income brackets which support private plane ownerships.

With 1958 data on aviation expenditures per flying hour, it is also possible to express the 1975 general aviation activity in dollars. Making the inherently conservative assumption that costs in 1975 will be no greater (except for rounding-off) than 1958, it is estimated that some $37 million, exclusive of purchases of new aircraft, will bespent in 1975 as compared to $15.9 million in 1958, or an increase of 133%. Expenditures outrun growth in fleet-size because of the expansion of the business fleet with its larger, more costly planes flying more hours. "Pleasure" flying is expected to involve relatively lower expenditures through flying clubs rather than individual operations.

Aircraft Movements

Conversion of flying-hour estimates to aircraft movements (landings and take-offs) has been accomplished crudely by applying the findings of the "Curtis" report in the absence of any local data. In the "Curtis" report, it was assumed that itinerant flights of general aviation aircraft produced 1.54 movements per flying hour, while local flights (heavily weighted by "Instructional" activities) produced 10 movements per hour. CAA surveys of general aviation further revealed that the percentages of itinerant flights were: Business - 100%; Commercial - 60%; Instructional - 55%; and Pleasure - 55%. While the 1958 Michigan data indicated a slightly lower percentage for "Pleasure" itinerants, no real basis for changing the CAA value was established, and the above percentages were applied. Table 48 summarizes the probable growth of Michigan aircraft movements with these assumptions.

Table 48

GENERAL AVIATION AIRCRAFT MOVEMENTS IN MICHIGAN, 1958-75

Category	Itinerant		Local	
	1958	1975	1958	1975
Business	253,000	659,000	[illegible]	[illegible]
Commercial	53,000	116,000	228,000	494,000
Instructional	14,000	14,000	788,000	1,390,000
Pleasure	117,000	113,000	624,000	602,000
Total	437,000	902,000	1,640,000	2,486,000
% Increase	107%		52%	

Obviously, the expansion of business flying, which is virtually 100% itinerant, accounts for the much larger increase in itinerant flights. For planning purposes, the growth underlines the need to view general aviation increasingly as transportation rather than as primarily a fixed-base operation of local flying.

HELICOPTER (VTOL) PROSPECTS

Helicopter services have existed only temporarily in the Detroit area and elsewhere in Michigan so that no record of growth or trend has been established. Although requested for CAB certification have been filed for passenger service in the Southeastern Michigan Metropolitan Area, and semi-serious suggestions have been advanced for limited inter-city services between several cities in Lower Michigan, their materialization is at this time so indefinite that any forecast of traffic for Michigan would be sheer presumption.

In the general aviation area, it has been assumed that VTOL (Vertical Take-Off and Landing Craft) will be increasingly a part of the specialized services offered by commercial aviation operators, largely on a fixed-base type of operation. While no separation by types of aircraft has been made, the expansion factors employed in the forecasts of Table 46, 47, and 48 have given consideration to the helicopter and similar craft, as well as the present conventional aircraft.

CONCLUSION

This study of Michigan trends in aviation, supplemented by the intensive survey of general aviation in Michigan for 1958, reveals a strong basis for aviation growth. Aviation interest, fostered by an active leadership in the Michigan Department of Aeronautics is widespread throughout the State; on the basis of numbers of active aircraft and pilots, Michigan is approximately in line with its population and income rank among the Continental United States. In actual number of airports and landing fields, Michigan, as nearly as can be determined from rather indefinite reporting, ranks with, or above, adjacent states and in seventh place nationally.

Air carrier service and traffic from Michigan's airline airports has lagged, except for air cargo, behind national growth, and its proportionate level for its population and income. Much of this lag is expected to be made up as new routes and services authorized by the CAB become firmly established. Total revenue air passengers are expected to increase in the next several years somewhat more rapidly than for the nation as a whole, and number more than 6 million in 1975 as compared to 1.9 million in 1960; carrier movements, because of new equipment with greater capacity, will not grow quite as much in relation to the increased traffic.

An important aspect of Michigan's air carrier future is the traffic generated outside of the Southeastern Michigan Metropolitan

Area where as much as 80% of passenger originations in the State have occurred. With intensive development of local service at outstate airline airports. Detroit's share of the totals will probably decline even though its upward trend is well maintained.

In general aviation, it is believed that total load activities will closely parallel the national trend, but that pleasure or private flying in Michigan will continue to be somewhat above the national average, with both on a declining trend over the next 15 years. The large increase will be in business flying, as is the national prospect, with commercial usage and flight instruction also moving upward, though more modestly.

The entire picture of Michigan's aviation future as far ahead as 1975 depends, however, upon the strong economic growth of the State and its recovery from the rather critical situation resulting from shifting industrial patterns, particularly automotive. Since so many are well aware of the economic problems and the urgency of their solution for the well-being of the State, it seems eminently reasonable to conclude that they will be solved so that the predicted aviation growth will not be inhibited.

In fact, any fostering of aviation growth may tend to assist in strengthening the Michigan economy by insuring continuing economic contributions from this relatively small, but not minor, activity of many facets. Good air service, both by regular air carriers and via well-distributed, adequate airports for business aircraft may well be the deciding factor in holding present industries and attracting new ones to the State.

The basis for continued air transportation and aviation growth is here, and its expansion will take place according to pattern if public policy continues to hold Michigan aviation as an important asset deserving support.

References - Part III, Section 2

Adler, R.B. and S.J. Fricker. The Flow of Scheduled Air Traffic (1) and (2). Research Laboratory of Electronics, Technical Reports No. 198 and 199. Cambridge, Mass.: Massachusetts Institute of Technology, 1951.

__________. Summary Report on the Flow of Scheduled Air Traffic. Research Laboratory of Electronics. Cambridge, Massachusetts: Massachusetts Institute of Technology, 1951.

Air Transport Association of America. Air Transport Facts and Figures, 20th edition, 1960.

__________. A Development Guide for Domestic Airport Terminal Passenger Facilities. Washington, D.C.: Air Transport Association of America, 1958.

Airborne Instruments Laboratory, et al. National Requirements for Aviation Facilities: 1956-75. Vol. I: Summary. Vol. 2: Air Traffic. Vol. 3: Aircraft Characteristics. Vol. 4: Forecast of Aviation Activity. Prepared for Edward P. Curtis, Special Presidential Assistant for Aviation Facilities Planning. Washington, D.C.: Government Printing Office, 1957.

Barnes, Leslie O. What Aviation Means to Our Cities. Given at the annual meeting of "League of Cities of the Third Class in Pennsylvania," 1953.

__________. The Future of Air Service at Intermediate Cities. Talk given at meeting of Johnstown Chamber of Commerce and other aviation interests, Pennsylvania, 1953.

Bernardo, James V. Aviation in the Modern World. New York: E. P. Dutton & Company, 1960.

Boeing Airplane Company. Mathematical Analysis and Operations Research Group, Mathematical Service Unit, Electro-Dynamics Staff. Mathematics and Forecasting. Prepared for Market Research and Planning Unit, Boeing Airplane Company, 1958.

__________. Market Research & Operations Analysis Section, Sales Department, Transport Division. Traffic Forecast of Domestic U.S. Airlines to 1965. TSR 389, November 26, 1956. Boeing Airplane Company, 1956.

Convair. Airline Analysis Group, Commercial Sales Department. Forecast of North American Commercial Air Traffic. Report SE 389. San Diego: Convair, 1958.

__________. Commercial Market Research Group, Sales Engineering, Commercial Sales Dept. Post War Growth of Commercial Air Transportation in the Free World. Report SE #265-2, December 12, 1958. San Diego: Convair, 1958.

Copeland, Lewis C. Travelers and Arkansas Business, 1948 to 1956.

Curtis Publishing Company. Research Department. The Travel Market of the United States. Fourth National Survey, April 1952-March 1953. Curtis Publishing Company, 1954.

Detroit Metropolitan Aviation Authority. Airports for the Detroit Region. September, 1948.

Douglas Aircraft Company. Total - Douglas Air Cargo System. Santa Monica, California: Douglas Aircraft Company.

Emery, John C. Air Freight - A Blueprint for 1965. Paper prepared for ASME meeting, Chicago, Illinois, November, 1955.

Haber, William, Eugene C. McKean and Harold C. Taylor. The Michigan Economy: Its Potential and Its Problems. Chapter 1: What's Ahead for Michigan? Kalamazoo, Mich.: W.E. Upjohn Institute for Employment Research, 1959.

Hackney, L.R. and C. J. Rausch. Air Cargo Trends in the United States. Burbank, Calif.: Lockheed Aircraft Corp., 1952.

Harris, Thomas J., Director - Cargo Sales, American Airlines, Inc. Airfreight's Iron Curtain. Delivered at Joint ASME-IAS meeting, Los Angeles, March 14, 1956.

Harvard University. Division of Research, Graduate School of Business Administration. The Role of Air Freight in Physical Distribution. Boston: The Alpine Press, 1956.

Harvey, A. D'Arcy. Air Traffic Facts. Presented at 24th Annual Meeting of the Institute of Aeronautical Sciences. New York: Institute of Aeronautical Sciences, 1956.

Hellmuth, Yamasaki & Leinweber (Architects) and Landrum & Brown (Consultants). Lambert St. Louis Municipal Airport, Economic Studies, Terminal Building and Area Design for the City of St. Louis.

Landrum & Brown. Air Transportation Requirements of the Southeastern Michigan Metropolitan Area, 1960-1975.

Lansing, John B. and Jung-Chao Liu. An Analysis of Interurban Air Travel. Research Seminar in Quantitative Economics, University of Michigan. Ann Arbor, University of Michigan Press.

Lansing, John B. & Ernest Lilienstein. The Travel Market, 1955. Survey Research Center, University of Michigan. Ann Arbor: University of Michigan Press, 1957.

Larsson, K. H. A Critical Review of Earlier Forecasts of Air Traffic and a New Approach. Montreal: Canadair Limited, 1956.

Leigh Fisher & Associates. Michigan Department of Aeronautics. Air Trade Forecasts, Recommended Lease Policy and Rates and Charges for the Airfield and Building Areas of Capital City Airport, October 1958.

Massachusetts. Legislative Research Council. Regional Airports and Aerial Approaches. Report. Boston: Wright & Potter Printing Company, 1958.

McCracken, Paul W., Editor. Taxes and Economic Growth in Michigan. Kalamazoo, Michigan: The W.E. Upjohn Institute for Employment Research, 1960.

Michigan Department of Aeronautics. Great Lakes Local Service Investigation: Brief for Michigan Department of Aeronautics. Submitted to Barron Fredericks, Esq., Examiner.

__________. Michigan Airports, Airfields, and Landing Areas. Annual summaries and listings. mimeo. 1946.

Michigan State University. Bureau of Business and Economic Research, College of Business and Public Service. Michigan Tourist Survey, 1957. Sponsored by the Michigan Tourist Council. Lansing, Mich.: MSU Press, 1958.

National Planning Association. Long-Range Projections for Economic Growth: The American Economy in 1970 - A Staff Report. Planning Pamphlet No. 107, October 1959. Washington, D.C., National Planning Association, 1959.

Neil, Herbert E., Jr. and John B. Lansing. An Analysis of Non-Business Rail Travel. Research Seminar in QuantitativeEconomics, University of Michigan. Ann Arbor: University of Michigan Press.

Ogburn, William Fielding. The Social Effects of Aviation. Boston: The Riverside Press Cambridge, 1946.

Philpett, LaVerne R. The External Acceptance Rate of an Airport, an Analysis. Air Navigation Development Board, Technical Memorandum No. 3, June 22, 1951.

Port of New York Authority. Aviation Department, Forecast and Analysis Division. New York's Air Travelers. Saugatuck, Conn.: The Eno Foundation for Highway Traffic Control, 1955.

Taaffe, Edward J. The Air Passenger Hinterland of Chicago. Dissertation submitted to the Department of Geography for the Degree of Ph.D. Chicago: The University of Chicago, 1952.

Tyler, Poyntz, Editor. Airways of America. New York: H.W. Wilson Company, 1956.

U.S. Civil Aeronautics Administration. Air Commerce Traffic Pattern, Fiscal Year 1958. Washington, D.C.: U.S. Government Printing Office, 1958.

__________. Airline Airports. Washington D.C.: U.S. Government Printing Office, 1958.

__________. Airline Passengers, revised. Washington D.C.: U.S. Government Printing Office, 1951.

__________. Airport Planning. Washington D.C.: U.S. Government Printing Office, 1952.

__________. The Federal Aid Airport Program, Policies and Procedures. Washington D.C.: U.S. Government Printing Office, 1955.

__________. Federal Airway Plan, Fiscal Years 1959-1963. Washington D.C.: U.S. Government Printing Office, 1958.

__________. International Air Commerce Traffic Patterns - U.S. Flag Carriers, 1957. Washington: U.S. Government Printing Office, 1958.

__________. National Airport Plan for 1958. Washington D.C.: U.S. Government Printing Office, 1958.

__________. Office of Air Traffic Control. Enroute IFR Peak Day-Peak Hour Relationships. Washington D.C.: U.S. Government Printing Office, 1958.

__________. Office of Planning, Research and Development. Civil Air Traffic Forecasts, 1960-1965. For official distribution. Washington D.C.: U.S. Government Printing Office, 1955.

Civil Aeronautics Board. Brief of the Pennsylvania Aeronautics Commission before Examiner John A. Cannon, in the matter of the proceeding known as the Northeastern States Area Investigation, Docket 6436. April 25, 1958.

__________. Great Lakes Local Service Investigation (Docket No. 4251): Initial Decision of Barron Fredricks, Hearing Examiner. September, 1959.

__________. Jet Age Planning. A Report of Progress and Developments as of July, 1957. Washington D.C.: U.S. Government Printing Office, 1957.

U.S. Congress. House of Representatives, Subcommittee of the Committee on Armed Services. Adequacy of Transportation Systems in Support of the National Defense Effort in Event of Mobilization. 86th Congress, Session 1, H. Res. 19. October 10, 1959.

U.S. Department of Commerce. Survey of Current Business. Quarterly. Washington D.C.: U.S. Government Printing Office.

U.S. Federal Aviation Agency. FAA Air Traffic Activity, Fiscal Year 1960. Washington D.C.: Government Printing Office, 1960.

__________. National Airport Plan, 1959 and 1960. Washington, D.C.: U.S. Government Printing Office, 1960.

__________. FAA Statistical Handbook of Civil Aviation. 1960.

University of Michigan. Survey Research Center. The Travel Market, 1956. Ann Arbor: University of Michigan Press, 1957.

__________. Survey Research Center, Institute for Social Research. The Travel Market, 1957. Ann Arbor: University of Michigan Press, 1958.

Virginia. Division of Aeronautics, State Corporation Commission. Aviation in Virginia. 1949.

White House, U.S. Government. Systems Engineering Team of the Office of Aviation Facilities Planning. Modernizing the National System of Aviation Facilities. Washington D.C.: U.S. Government Printing Office, 1957.

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THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION INSTITUTE

Final Report

A Background Planning Study of Michigan's Aviation Needs

Part IV. Planning for Michigan Aviation

JOHN C. KOHL

Under Contract with:

**Michigan Department of Aeronautics
Capitol City Airport
Lansing, Michigan**

Administered through:

February 1961

OFFICE OF RESEARCH ADMINISTRATION · ANN ARBOR

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TABLE OF CONTENTS

FOREWORD

This fourth part marks the completion of the report of the "Background Planning Study of Michigan Aviation Needs" which was undertaken as a research project by the Transportation Institute of the University of Michigan for the Michigan Department of Aeronautics. The formal report is in four parts, each issued separately:

Part I - Aviation and the Economy of Michigan (June 1960)

Part II - A Field Survey of Aviation and Airports in Selected Michigan Communities (August 1960)

Part III - Growth and Technological Change in Aviation

Section 1 - Technological Trends in Aircraft, Air Traffic and Traffic Control (August 1960)

Section 2 - Estimates of Growth In Michigan Aviation (January 1961)

Part IV - Planning for Michigan Aviation (February 1961)

The purpose of these studies was the development, if possible, of an objective, scientific basis for measuring aviation needs in Michigan and for guiding public policy in the planning and financing of new ground facilities.

Early in the research efforts, it became increasingly apparent that the major task would be the gathering of reliable and accurate statistical information. Much of the available data proved superficial, inadequate, and inapplicable to the local areas of the State. Even the records of the Department of Aeronautics were found to be incomplete and lacking information which, presumably by regulation, had been collected.

Problems of data collection required so much time and effort that the original outline of the study was seriously unbalanced to the point where only limited attention could be devoted to the final phases of objective planning. The firm, theoretical base of facts could not be sufficiently established to permit any early abandonment of the subjective approach to airport planning.

This study, nevertheless, has brought together for the first time comprehensive economic data measuring the impact of aviation upon the state. It has explored and related at the local level a variety of aviation activities in typical Michigan communities. And it has developed estimates of growth of Michigan aviation, and comparisons with national growth, as well as an assessment of the effects of technological change upon planning. Finally, it has pointed to serious shortcomings in knowledge about the Michigan economy as it affects transportation demands and indicated fields of urgently needed research which must precede any more rationally developed aviation plan.

Without the interested cooperation of many individuals, agencies, and organizations, both public and private, this assembly of data would have been even more difficult. Helpful suggestions and useful information were contributed generously by many people who deserve this grateful acknowledgement. It is hoped that the utility of this report will, in part, compensate for their efforts.

INTRODUCTION

The first three parts of this "Background Planning Study of Michigan's Aviation Needs" have developed some indications of the economic role of air transportation, its impact upon typical communities of the State, and its probable future, both in its technological aspects and its general growth. This section presents an approach to the translation of the state-wide pattern of growth into more specific needs for aviation facilities throughout the local areas.

Originally, it had been anticipated that this effort would result in a detailed state-wide plan from which relative priorities and reasonable estimates of costs of the indicated facilities could be derived. Also to be included were detailed considerations of administrative and fiscal arrangements which would seem best suited to the accomplishment of the plan. These elements are all, obviously, requisite to a complete transportation plan.

Soon after research was underway, however, it became evident that the gaps and shortcomings in basic information about aviation and its transportation relationships at the state and local levels were even more serious than had been realized. The major effort in this study, accordingly, was devoted to the search for and assembly of data upon which planning could be based; and, as has been previously noted, that effort fell short of expected goals because certain statistics and relationships, particularly those relating to general aviation traffic, just were not to be found with the resources available.

The development of a desirable and detailed state-wide plan must be postponed until the results of more extensive research studies can be incorporated in the transportation planning process. At this stage, it has been possible only to develop the general outlines of an aviation plan for Michigan and to emphasize those aspects to which additional study should be devoted.

First, a method is described for identifying the individual terminal regions and developing the subdivision of the state into aviation areas, or "communities of interest" for planning purposes. The characteristics of these areas are summarized.

Next, the determination of aviation demand is considered to the extent that known relationships to area characteristics permit.

Finally, an approach is made to the evaluation of airport deficiencies and aviation needs, and is coordinated with the FAA "National Airport Plan."

As an appendix, there is included the basic economic data for Michigan, county by county, as derived from official sources by Dr. C. L. Jamison, Professor-emeritus of Business Policy, School of Business Administration of the University of Michigan, who participated in the study. When additional reports of the U.S. Bureau of the Census are issued, the later figures can be used to extend these charts and, thus, maintain a more nearly current indication of trends throughout the State.

AVIATION AREAS OF MICHIGAN

The subdivision of the entire area of Michigan is the initial step in the development of a comprehensive plan for aviation facilities. If consistent with the pattern of transportation demand, the resulting regions indicate the discrete aviation areas in which it will eventually be possible to measure air traffic potentials, and to estimate more precisely the required character and capacity of airports and supporting facilities. It is to be noted, though, that areas can be established presently on a tentative basis which will not become firm until they can be tested against evolving patterns of demand.

While Michigan has often been sub-divided into various kinds of smaller sections for various administrative and technical reasons, no standard, generally accepted description of local areas could be found. The standard metropolitan areas, as defined by the U.S. Bureau of the Census, cover only a small portion of the state; after closer study, they were deemed unsuited to aviation planning because they could neither be satisfactorily extended to include all of the state, nor did they always correspond to known terminal areas. Several other efforts, including a study of election districts, were made to find a more suitable, rational basis for delineating the "transportation communities" of the state.

Finally, it was concluded that a sound basis for aviation planning could be found in the existing pattern of highway transportation. Obviously, most air trips, even in general aviation, involve some ground transportation; and the Transportation Institute survey had revealed some criteria for the length of such ground travel associated with aviation. A base for this approach was, fortunately, available because the state-wide patterns of highway traffic have been regularly recorded by the Michigan State Highway Department.

Method of Districting Aviation Areas

On a map on which the average daily traffic volumes on the State Trunkline System had been graphically plotted to scale, the points of minimum volume between cities were located. Then, by connecting these "low" points, the areas of traffic influence from the generating cities were delineated upon the map and thus divided the state. The zones so outlined were quite irregular and could not be coordinated with any boundaries for existing statistical data which is assembled on a county basis.

To overcome this difficulty, the plotted zone, or area boundaries, were arbitrarily shifted to coincide with the nearest county lines. Also, the already defined Southeastern Michigan Metropolitan Area, which was under a separate aviation study, was excluded from these adjustments because its boundaries were regarded as already definite. The resulting areas, thus established, are shown in Figure 1 and described in Table 1.

Most of the adjustments could be made quite readily because the "low" lines fell fairly close to county lines. For some areas, however, the adjustments were not obvious and required considerable study; further review, as earlier noted, will be desirable and may indicate need for revision of boundaries.

REGIONAL DIVISIONS FOR

AVIATION NEEDS STUDY

Shaded area - Detroit
Metropolitan Region,
to be studied by others.

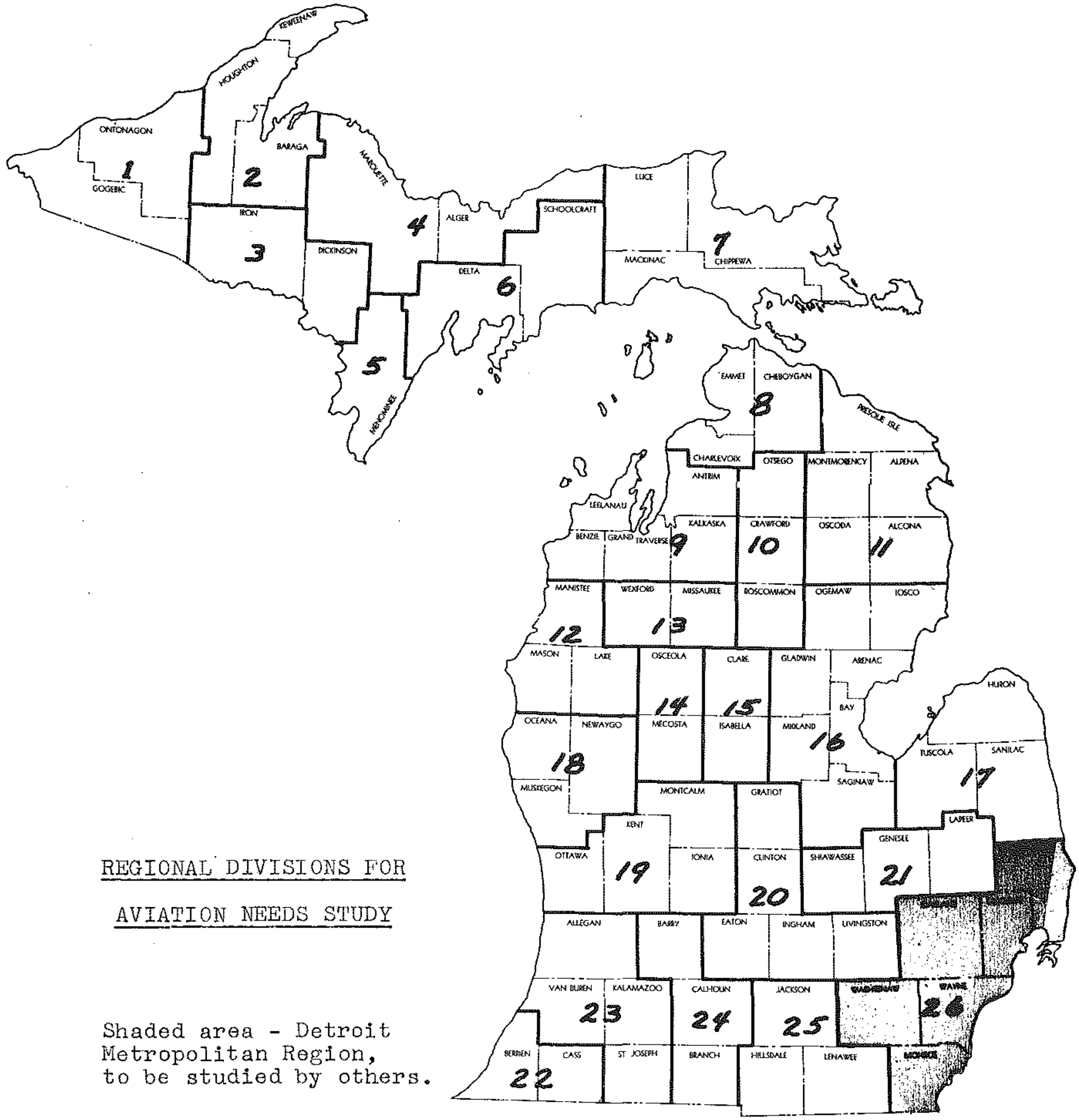


Figure 1

Table 1

AVIATION AREAS OF MICHIGAN
Counties and Principal Communities

(Major city in area denoted by capital letters. * indicates inclusion in Field Survey described in Part II of this report.)

Area No.	Land Area sq. mi.	Counties	Communities
UPPER PENINSULA			
1	2433	Gogebic Ontonagon	IRONWOOD Ontonagon
2	2478	Baraga Houghton Keweenaw	L'Anse HOUGHTON-HANCOCK
3	1954	Dickinson Iron	IRON MOUNTAIN* Iron River, Crystal Falls
4	2754	Alger Marquette	Munising MARQUETTE*
5	1032	Menominee	MENOMINEE (Marinette, Wisconsin)
6	2379	Delta Schoolcraft	ESCANABA Manistique
7	3508	Chippewa Luce Mackinac	SAULT STE. MARIE (Soo) Newberry St. Ignace
NORTHERN LOWER MICHIGAN			
8	1600	Charlevoix Cheboygan Emmet	Charlevoix Cheboygan, Mackinaw City PETOSKEY, Pellston
9	2170	Antrim Benzie Grand Traverse Kalkaska Leelanau	Mancelona Frankfort TRAVERSE CITY* Kalkaska Leland
10	1614	Crawford Otsego Roscommon	GRAYLING Gaylord* Houghton Lake, Roscommon

Table 1, cont.

Area No.	Land Area sq. mi.	County	Communities
11	3019	Alcona	Harrisville
		Alpena	ALPENA*
		Montmorency	Atlanta
		Oscoda	Mio
		Presque Isle	Rogers City
12	1623	Lake	Baldwin*
		Manistee	Manistee
		Mason	LUDINGTON*
13	1128	Missaukee	Lake City
		Wexford	CADILLAC
14	1144	Mecosta	BIG RAPIDS
		Osceola	Reed City*
15	1144	Clare	Clare
		Isabella	MT. PLEASANT
SOUTHERN MICHIGAN			
16	3760	Arenac	Standish
		Bay	Bay City*
		Gladwin	Gladwin
		Iosco	Tawas City
		Midland	Midland*
		Ogemaw	West Branch
		Saginaw	SAGINAW*
17	2599	Huron	("Thumb" Area)
		Sanilac	Bad Axe*, Port Austin
		Tuscola	Marlette, Sandusky
			CARO, Cass City, Vassar
18	2997	Muskegon	MUSKEGON
		Newaygo	Fremont, Newaygo
		Oceana	Hart, Shelby
19	2713	Ionia	Ionia
		Kent	GRAND RAPIDS*
		Montcalm	Greenville
		Ottawa	Holland, Grand Haven
20	2837	Clinton	St. Johns
		Eaton	Charlotte, Eaton Rapids
		Gratiot	Alma*, St. Louis
		Ingham	LANSING
		Livingston	Howell

Table 1, cont.

Area No.	Land Area sq. mi.	County	Communities
21	1843	Genessee	FLINT
		Lapeer	Lapeer
		Shiawassee	Owosso
22	1068	Berrien	BENTON HARBOR, St. Joseph, Niles*
		Cass	Dowagiac, Cassopolis
23	2511	Allegan	Allegan
		Kalamazoo	KALAMAZOO
		St. Joseph	Sturgis, Three Rivers
		Van Buren	South Haven, Paw Paw
24	1764	Barry	Hastings
		Branch	Coldwater*
		Calhoun	BATTLE CREEK*, Marshall, Albion
25	2070	Hillsdale	Hillsdale, Jonesville
		Jackson	JACKSON
		Lenawee	Adrian, Tecumseh*
SOUTHEASTERN MICHIGAN METROPOLITAN AREA			
26	4029	Macomb	Mt. Clemens, Romeo, Utica
		Monroe	Monroe
		Oakland	Pontiac
		St. Clair	Port Huron
		Washtenaw	Ann Arbor, Ypsilanti
		Wayne	DETROIT

Aviation Area No. 1, for example, comprises Gogebic and Ontonagon Counties. The latter unit, on the basis of highway traffic divisions, was almost equally oriented toward Gogebic County to the south and to Houghton County to the north, and could well have been split between Areas No. 1 and No. 2. With the statistical base as the county unit, however, the assignment of portions of a county to different areas was not practical, and a decision in favor of Area No. 1 was finally made even though justification was not strong.

Another example of the difficulties, inadequate information in this instance, is in Area No. 13 made up of Missaukee and Wexford Counties. While Wexford had apparent ties to Osceola County to the south, its inclusion in Area No. 14, along with Mecosta County, seemed to develop an abnormally long north-south dimension and to isolate Missaukee County which was tied by traffic to an east-west link with Wexford. In this case, it was finally decided to indicate a separate area made up of the two counties which might later be re-assigned if additional information so warranted.

A somewhat unusual case was presented in the traffic pattern for Allegan County. The dominant flow of highway traffic was north-south on U.S. 31 along the Lake Michigan edge of the county, but the remaining pattern was oriented towards Kalamazoo to the southeast. Much of the U.S. 31 traffic, it was ascertained, was made up of long-distance movements beyond adjacent areas (Chicago, Grand Rapids, Muskegon, and northern Michigan) and could be considered to exert little local area influence. Accordingly, the ties to Kalamazoo County were judged most important and Allegan County was assigned to Area No. 23.

The most perplexing questions, perhaps, were those affecting the assignment of Arenac, Gladwin, Iosco, and Ogemaw Counties. These are all oriented to the Saginaw-Bay City-Midland complex, but are somewhat more distant from the central core than usual; Iosco County, to the north of Saginaw Bay, is particularly remote. Highway connections and traffic patterns did not support their grouping in a separate area, such as Missaukee and Wexford Counties had. Almost by default, then, they were included in Area No. 16 which, thus, became one of the most extensive aviation areas of the State.

Area Characteristics

With the division of the state into these 26 tentative areas, or "communities of aviation interest," the companion step in the planning process was the assembly of such statistical information as might reveal the general characteristics of these areas and provide a basis for an evaluation of aviation demand. From official sources, there proved to be relatively little comprehensive data, even on a county basis, which was sufficiently current to be of value.

Basic population, geographic and aviation data are displayed in Tables 2 and 3. The figures were derived from individual county data which is included in the Appendix, together with an indication of sources and definitions. Thus, new data can be incorporated as it becomes available, and area figures can be revised

Table 2

POPULATION CHARACTERISTICS OF MICHIGAN AVIATION AREAS

Area No.	Principal Community	Population 1960 Census	Percent Of State	Population Density (Persons per sq. mi.)	Population Change, 1950-60
1	Ironwood	34,954	0.4%	14	6.3% decrease
2	Houghton-Hancock	45,222	0.6	18	10.8 "
3	Iron Mountain	41,101	0.5	21	3.4 "
4	Marquette	65,404	0.8	24	13.4 increase
5	Menominee	24,685	0.3	24	2.4 decrease
6	Escanaba	43,251	0.6	18	2.9 increase
7	Sault St. Marie	51,335	0.7	15	10.0 "
8	Petoskey-Pellston	43,875	0.6	27	0.2 "
9	Traverse City	65,400	0.8	30	7.5 "
10	Grayling	19,716	0.2	12	19.3 "
11	Alpena	55,896	0.7	19	18.1 "
12	Ludington-Manistee	46,309	0.6	28	4.6 "
13	Cadillac	25,250	0.3	22	3.2 decrease
14	Big Rapids-Reed City	34,646	0.4	30	5.8 increase
15	Mt. Pleasant-Clare	46,995	0.5	41	19.8 "
16	Saginaw-Bay City-Midland	396,058	5.2	106	25.0 "
17	Caro-Bad Axe	109,625	1.4	42	7.2 "
18	Muskegon	190,690	2.4	96	19.7 "
19	Grand Rapids	540,833	6.9	199	25.4 "
20	Lansing	469,685	4.8	132	22.9 "
21	Flint	469,685	6.0	254	33.1 "
22	Benton Harbor-St. Joseph	186,797	2.4	175	29.9 "
23	Kalamazoo	318,168	4.5	127	28.0 "
24	Battle Creek	205,499	2.6	117	16.0 "
25	Jackson	244,525	3.1	118	19.6 "
26	Detroit	4,143,121	52.7	1030	24.9 "
Total Michigan		7,823,194	100.0%	137	22.8% increase

Table 3

AIRCRAFT AND GROUND FACILITIES IN THE AVIATION AREAS

Area No.	Principal Communities	Aircraft Number Active-Based	Aircraft Per 10,000 Pop.	Aircraft Per 1000 Sq. Mi. Area
1	Ironwood	9	2.6	0.37
2	Houghton-Hancock	12	2.6	0.49
3	Iron Mountain	13	3.1	0.66
4	Marquette	18	2.7	0.65
5	Menominee	3	1.2	0.29
6	Escanaba	13	3.0	0.55
7	Sault Ste. Marie	21	4.1	0.60
8	Petoskey-Pellston	27	6.1	1.69
9	Traverse City	19	2.9	0.88
10	Grayling	12	6.1	0.74
11	Alpena	23	4.1	0.76
12	Ludington-Manistee	22	4.8	1.35
13	Cadillac	9	3.5	0.80
14	Big Rapids-Reed City	33	9.8	2.99
15	Mt. Pleasant	33	7.0	2.99
16	Saginaw (Tri-City)	100	2.5	2.65
17	Caro-Bad Axe	70	6.4	2.69
18	Muskegon	60	3.1	3.01
19	Grand Rapids	168	3.1	6.17
20	Lansing	217	5.8	7.65
21	Flint	181	3.9	9.83
22	Benton Harbor	82	4.4	7.41
23	Kalamazoo	174	5.5	6.92
24	Battle Creek	79	3.8	4.46
25	Jackson	138	5.6	6.67
26	Detroit	1192	2.9	29.60
Total Michigan		2728	3.5	4.78

Table 3, continued

Area No.	Principal Community	Aviation Ground Facilities - Civilian: Airline Airports	Other Lic. Airports	Landing Fields	Limited Use Fields	Emergency Strips	Total Facilities
1	Ironwood	1	0	0	1	1	3
2	Houghton-Hancock	1	1	0	0	2	4
3	Iron Mountain	1	0	0	1	3	5
4	Marquette	1	0	1	0	2	4
5	Menominee	1	0	0	0	0	1
6	Escanaba	1	0	1	2	0	4
7	Sault Ste. Marie	1	1	0	0	6	8
8	Petoskey-Pellston	1	1	4	0	3	9
9	Traverse City	1	0	1	1	5	8
10	Grayling	0	2	1	1	4	8
11	Alpena	1	0	1	2	8	12
12	Ludington-Manistee	0*	1	1	1	2	5
13	Cadillac	0	2	0	0	0	2
14	Big Rapids-Reed City	1	1	0	1	4	7
15	Mt. Pleasant	0	2	•	0	2	5
16	Saginaw (Tri-City)	1	3	2	3	4	13
17	Caro-Bad Axe	0	1	3	1	3	8
18	Muskegon	1	2	0	0	5	8
19	Grand Rapids	1	2	3	2	4	12
20	Lansing	1	5	2	4	3	15
21	Flint	1	5	0	1	0	7
22	Benton Harbor	1	2	1	0	0	4
23	Kalamazoo	1	6	1	1	5	14
24	Battle Creek	1	3	0	0	0	4
25	Jackson	1	3	1	1	4	10
26	Detroit	5	13	2	6	6	32
Total Michigan		25	56	26	29	76	212

to adjust to any regrouping as subsequent studies point to modification of the original division.

As previously noted, the appendix also includes a series of charts displaying county data compiled by Dr. C. L. Jamison, of the University of Michigan School of Business Administration, who investigated the economic characteristics of the state as they might relate to local aviation planning. Because county data from official sources was no more recent than the 1954 Census of Manufactures, it was decided to defer any aviation-area compilations and retain, instead, the individual county information until such time as it might be supplemented by later official figures to yield more useful economic indicators for the areas. This lack of current economic data for all counties is a serious handicap in any objective study of transportation needs, and should be overcome by intensive research to develop adequate local data.

An economic indicator of transportation potential, not yet sufficiently understood to sustain conclusions stronger than rough implications, is the tabulation of the estimated retail sales volume by aviation areas. This data, displayed in Table 4, was derived from records of the Michigan Department of Revenue by the Research Division of the Economic Development Department. While the figures are for 1958 (fiscal), they do represent an available guide to the relative economic activities of the aviation areas.

Table 4

RETAIL SALES VOLUMES - MICHIGAN AVIATION AREAS
Fiscal Year - 1958

Area No.	Principal Community	Annual Retail Sales - Total	Percent of State Total	Retail Sales Per Capita
1	Ironwood	$37,497,000	0.38%	$1020
2	Houghton-Hancock	45,579,000	0.46	1100
3	Iron Mountain	48,408,000	0.49	1160
4	Marquette	65,017,000	0.66	1070
5	Menominee	17,605,000	0.18	675
6	Escanaba	43,240,000	0.45	1060
7	Sault Ste. Marie	60,749,000	0.62	1220
8	Petoskey-Pellston	61,421,000	0.63	1430
9	Traverse City	83,601,000	0.85	1270
10	Grayling	32,355,000	0.33	1750
11	Alpena	62,182,000	0.63	1200
12	Ludington-Manistee	50,798,000	0.51	1080
13	Cadillac	28,630,000	0.29	1120
14	Big Rapids-Reed City	31,352,000	0.32	980
15	Mt. Pleasant	48,581,000	0.49	1160
16	Saginaw (Tri-Cities)	480,478,000	4.86	1270
17	Caro-Bad Axe	117,054,000	1.17	1070
18	Muskegon	216,268,000	2.18	1130
19	Grand Rapids	684,048,000	6.92	1320
20	Lansing	459,755,000	4.66	1240
21	Flint	574,155,000	5.80	1230
22	Benton Harbor-St. Joseph	212,890,000	2.15	1140
23	Kalamazoo	370,831,000	3.75	1170
24	Battle Creek	238,476,000	2.41	1150
25	Jackson	275,018,000	2.77	1130
26	Detroit	5,539,989,000	56.04	1340
	MICHIGAN	$9,887,299,000	100.00%	$1270

Area Classifications

All of these tabulations - Tables 2, 3, and 4 - emphasize the extraordinary role of the Detroit, or Southeastern Michigan, Metropolitan Area - No. 26 in the tentative classification. Possessing practically 53% of the state's population, accounting for 56% of its retail sales volume, and basing 44% of its active aircraft as well as including the largest airports and being Michigan's only major air traffic hub, this six-county metropolitan region so dominates any analysis that it must be considered separately if a balanced view is to be maintained. As often indicated, that consideration was assigned to others and has been included in this study only as it relates to the state-wide aspect.

For the remaining areas, an examination of the assembled data obviously indicates a distinct pattern although there is some "shading" from one group to another. Roughly, as an initial effort, the 25 aviation areas have been classified into the following groups: Urban Industrial-Commercial; Balanced Rural-Urban; Rural Industrial-Recreational-Agricultural; and Rural Recreational-Agricultural.

(1) Urban Industrial-Commercial Areas. Areas 16, 19, 20, 21, and 23 all have populations ranging from over 300,000 to slightly more than 500,000, and are all located in southern Michigan, i.e., below the traditional "line" extending across the state from Bay City to Muskegon. These areas accounted for the major population gains, outside the Detroit Metro-

politan Area, in the 1950-60 decade; in every case, the percentage increase was above the state-wide average. Cities included in these areas are Grand Rapids, Lansing, Flint, Saginaw-Bay City-Midland, and Kalamazoo, which obviously seem to belong in this category on the basis of general impressions alone.

From an aviation standpoint, these "urban" areas show an average of 168 aircraft each, or 4.2 per 10,000 population and 15 planes per ground facility. In the Detroit Metropolitan Area, No. 26, by contrast, there are 1192 aircraft, or 2.9 per 10,000 population, and 37 planes per ground facility. The higher ownership per capita and lower density are the expected results of the substantial prosperity, greater convenience and lower cost of plane ownership in the urban areas which are less congested than Detroit.

(2) Balanced Rural-Urban Areas, (agriculture-dispersed industry-recreational-and-resort activities). Areas 18, 22, 24, and 25, which include Muskegon, Benton Harbor-St. Joseph-Niles, Battle Creek-Albion-Marshall-Coldwater, Jackson-Adrian-Hillsdale, exhibit populations ranging from just over 185,000 to 245,000 people. Except for the Benton Harbor area which grew by almost 30% (second in the state), these areas showed ten-year population gains between 16% and 20% at slightly less than the State's average of 22.8%.

Population densities cluster near the 100 persons per square-mile level and reflect the excellent highway network upon which reasonably balance dispersion depends. The Benton Harbor area is an established fruit-growing region, and the other areas maintain a reputation for agricultural production.

These areas, geographically, fit into the spaces around those in the first category and "fill out" Southern Michigan.

Another area, No. 17 - the three northern counties of "The Thumb" - is apparently in a transitional state. It seems to be absorbing some industry from the Detroit, Flint, and Saginaw Valley areas to balance its former rural status in which agriculture and recreation were predominant. Its relatively small rate of population increase, only 7.2% from 1950-60, would indicate slow change. Because its 110,000 population places it well above the largest areas in the remaining categories, and because of its changing status, it is classified as a "Balanced" area; it is one which deserves much more thorough study of its potential.

Although the average number of aircraft in each of these "balanced" areas is 86, as compared to 168 in the "urban" area, the per-capita ownership of 4.7 aircraft per 10,000 persons is the highest of any grouping. Planes per ground facility drop to slightly under 10 to reflect the lower density of development in a "balanced" area.

(3) Rural Industrial-Recreational-Agricultural. Upper Peninsula Areas 4 and 7 - Marquette and Sault Ste. Marie - along with northern Lower Peninsula Areas 9, 11, 12, and 15 - including Traverse City, Alpena, Ludington-Manistee, and Mt.

Pleasant-Clare - exhibit populations ranging from over 46,000 to 65,000 persons. While they are extensive in land area and indicate relatively low population densities over-all, they all include some industrial concentrations largely oriented to natural resource development-mining, quarrying, basic materials.

Additionally, these areas include much of the resort activity along the shore lines of the Great Lakes, and inland as well. Mackinac Island, the Michigan sand dunes, and the Soo Locks are a few of the recognized tourist attractions lying within these areas. Many summer homes are maintained, and winter sports development is widespread.

Agricultural activities are diverse, but locally specialized except for forestry, which is here broadly included under the agricultural heading.

With the relatively smaller populations, the educational institutions of Northern Michigan College at Marquette, and the Central Michigan University at Mt. Pleasant, along with the unique Interlochen institutions near Traverse City become significant characteristics. Similarly, the Air Force installations at Kinross (Area 7) and Sands (Area 4) are major factors in local civilian aviation, as well as possessing military importance.

Four of the six areas showed population increases of 10% or more, although they were all below the state-wide average. The two low areas, No. 9 (Traverse City) and 12 (Ludington-Manistee), recorded 7.5% and 4.6% gains, respectively, to lag behind; these small gains are in large part the result of the area make-up in which the "growing" portion is more than offset by the inclusion of outlying sections which are largely rural-recreational, open lands.

As might be expected after consideration of the population and geographic characteristics of the "rural" aviation areas, plane ownership averages only 23 - a substantial drop from the 86% of the "balanced" areas - But on a per capita basis of 4.2 aircraft per 10,000 population, its level is identical with the "urban" areas. The low density, normal in the "rural" scene, is indicated by the average of only 3 planes per ground facility.

(4) Rural Recreational and Agricultural. The remaining aviation areas, which comprise some 27% of the total area of the state, are 1, 2, 3, 5, 6, 8, 10, 13, and 14 - all of the Upper Peninsula except for the Marquette and Soo areas, and the central areas of northern Lower Michigan. Populations range from 45,000 downward to just under 20,000 (Area 10 - Grayling) which is the smallest in the State. Five of the nine areas showed net losses in population ranging from 2.4% to more than 10.8% decreases from 1950; except for the 19.3% increase in the Grayling area, the increases ranged from 0.2% to only 5.8% and indicated no vigorous growth.

It was this demonstrated lack of vigor which prompted the classification of such mining-industrial areas as No. 2 (Houghton-Hancock) and No. 3 (Iron Mountain) into this fourth, rather than the third, category. The characteristics of these areas were, it was felt, more generally rural-recreational today, even though the industrial mark persists, often as a tourist attraction such as an old copper mine at Hancock.

A major recreational-resort feature is the Houghton Lake-Higgins Lake development in Roscommon County, and their extension northward along the rapidly improving U.S. 27 into Otsego County. This highway link was the principal tie for grouping these counties into Area No. 10.

Area No. 5 (Menominee) constituted a special problem because of its isolation and apparently strong orientation to Wisconsin. It fitted neither with the Iron Mountain nor with the Escanaba areas, and yet, standing alone, it has relatively little significance.

The relatively lower densities and population of the "Rural-recreational-agricultural" areas apparently does not affect the per capita ratio, which is maintained at 4.2 per 10,000 population, although the average number of aircraft based in each of these areas is only 14, as compared to 86 in a "balanced" area and 168 in the "urban" area, and 1192 in the Detroit area. At ground facilities, however, the same density of 3 planes per facility is maintained as in the third group.

Finally, it must be again emphasized that these classifications are not rigid and are subject to revision. They are based upon the limited, though basic, data assembled in the foregoing tables, and upon the field survey information dexcribed in Part II of this report. The objective, always implied if not always stated, is the development of a set of guides by which the probable transportation needs, particularly aviation needs, can be assessed for any discrete area of Michigan.

AREA AVIATION DEMANDS

The second step in the planning process should, both ideally and practically, develop an indication of those demands over reasonable future time periods for facilities needed to serve air traffic. These demands for air transportation which should dictate the planning of facilities are derived from three sources:

(1) Existing Air traffic which may expand through normal growth,

(2) Existing surface traffic which may be diverted to air for greater convenience and economy to the users,

(3) New traffic which will be generated by the development of new activities in the areas as a result of improved accessibility by air.

Area characteristics must be analyzed and eventually measured in terms of factors directly related to these traffic demands, and then translated into plans for specific ground facilities which can effectively serve the indicated needs.

At the federal level, this planning is exemplified by the procedures which formulate the FAA National Airport Plan, issued annually with up-dated revisions. Two distinct plans are actually followed: air commerce, both passenger and cargo although emphasis has been on the passenger, as performed by the scheduled airlines serving the cities authorized by the Civil Aeronautics Board; and general aviation which is broken down into its usual four categories - business, commercial, instructional, and pleasure - for individual consideration. The airports needed to serve "the National interest" are identified and their apparent needs for improvement, replacement, or new facilities described in some detail along with combined estimates of total cost.

Over recent years, the FAA, through extensive research, has established an almost routine approach to this planning, although modifications are introduced as new factors can be brought to bear. Air traffic trends, along with aircraft characteristics, population, and its distribution, and personal income, have been the influential considerations in planning for air commerce. Active based aircraft, along with the foregoing factors, is considered a major influence in general aviation plans.

Need for Local Approach

As these planning factors were applied to the aviation areas of Michigan, it became obvious that, for many areas, they were not sufficiently positive to afford any substantial base. If population and economic trends, as best they could be established for these smaller areas, showed declines, as Tables 3 and 4 do reveal, for some areas, a conclusion could be quickly reached that new facilities were un-needed, and that some retirements, even, of existing facilities could be in order. With declining or static populations and an apparent shrinkage in the local economies in 9 of the 26 aviation areas of Michigan, unimaginative approaches along conventional lines would produce negative demands in some areas and inflate, perhaps, the real demands in other areas. To achieve better balance in planning, measure of potential forces which would generate air traffic were obviously necessary.

Two potentials were immediately recognized: the first, and most substantial though most difficult to identify, is the opportunity for new industries - industrial development - within the areas under study; and the other, much more elusive potential is the so-called "tourist business" which is considered comprehensively as the recreational resources of the areas, including vacation facilities, hunting and fishing, water sports, winter sports, and scenic attractions. The realization of these potentials depends in large measure upon accessibility which, properly achieved, can be a powerful force contributing to the essential economic growth of all Michigan areas.

Aviation, it was reasoned, could be, through its abilities to enhance accessibility, the most important single stimulant to this urgently needed progress. Much of the research effort of this study, therefore, has been devoted to an exploration of the possible relationships of aviation - both scheduled airline and general - to these potentials of industrial development and recreational and tourist resources. While these studies have covered much ground, unfortunately, they have not been successful in finding quantitative bases for planning; much is needed in basic data formulation and the refinement of new techniques for translation into definite plans.

Aviation and Industrial Development

A widely quoted statement attributed to the U.S. Department of Commerce, although no specific reference can be identified, claims that 30% of the new industrial plants are being located in or near cities of less than 10,000 population. And numerous authorities point to improved air accessibility, both by the extension of local airline services and through the use of executive-type aircraft, as a major reason for this desirable dispersion.

Certainly, air accessibility has become an important selling point in the currently intense competition among states for new industries. One southern state last year, for example, offered in its industrial development advertising, appearing in a national magazine, to arrange with its aeronautics commission to provide suitable paved air strips in any community selected by a new industry, and not already possessing adequate aviation facilities. Direct inquiry to officials of that state, however, produced no definite information. Another state, which has been almost painfully successful in luring away Michigan industry, features its air transportation in its promotional efforts. Here in Michigan, this resource has, apparently, not been exploited.

Industrial development potentials of the Michigan aviation areas were studied as a part of the effort to postulate growth factors for aviation. For the state as a whole, which was considered in Part III of this report, these individual differences were assumed to "average out" and have no significant influence upon the total trend. For the local areas, though, these differences become critical with respect to their influence upon traffic, and, at the same time, investment in aviation facilities may make for significant difference in industrial development.

Basic statistics available at the local level, and which could be combined for area data, were studied by Dr. Jamison, who finally reported that very little reliable and useful information exists. Supplementing his investigation, a search for factors, as employed in the "Curtis" study, was made for Michigan local areas, and proved to require far more talent than was available for this research project. Much more extensive efforts will be needed to establish planning criteria based upon industrial development potentials.

This situation is commented upon by Raymond Vernon, Director of the New York Metropolitan Region Study, in "The Changing Economic Function of the Central City," (Committee for Economic Development, New York, 1959):

> "Of course, the development of air travel may be read two ways. For the availability of such air travel opens up the possibility of stationing key corporate offices in the field, yet being able to summon them to headquarters on a few hours' notice. But the odds seem heavy the the increased mobility among executives will not be exploited by dispersing them to the field, but rather by gathering them in to central points; that in the rival pulls for more face-to-face contact among top executives and more face-to-face contact with plant managers, the former pull will be the stronger. This, too, suggests that 'central office cities may grow more so, at the expense of the lesser regional centers. But it would be comforting if hard data could be brought to bear to test these conjectures."

The serious impact for Michigan and its aviation planning is evident.

Where, in Michigan, is industry most likely to be attracted and what inducement will be afforded by air transportation service, or airport facilities? What aviation demands will such industry likely impose, and how can facilities best be planned to meet these demands?

It is suggested that research jointly undertaken by the Department of Aeronautics and the Michigan Economic Development Department is both necessary and desirable to provide answers to these questions which are basic to aviation planning.

Aviation and Recreational Resources

The second promising economic potential for growth in Michigan's aviation areas, which otherwise have shown no marked trend which might warrant airport development, is their recreational resource. For the state as a whole, Michigan statistics have been compiled by the Michigan Tourist Council and indicate its ranking as among the top four vacation states in the nation; it is estimated to produce an income of some $700 million annually to the Michigan economy.

Aviation contributes to this "vacation" economy in several ways:

The scheduled airlines provide regular transportation to the established resort areas; traffic to and from Pellston airport is markedly increased by the resort activities at Mackinac Island and on Lake Michigan at Charlevoix. Some sportsmen use the scheduled airlines on their way to favorite hunting and fishing camps, and some businessmen commute to and from summer homes. Isolated and "spot" examples of such traffic were cited from the findings of the field surveys in Part II.

Corporation planes in the general aviation fleet, as well as chartered flights flown by the scheduled airlines and by the commercial operators in general aviation transport company personnel and families to vacation lodges and camps maintained in employee relations programs. The airport at Baldwin, as described in Part II, enjoyed a substantial use by traffic of this character.

Individual pleasure aircraft are slown into tourist and vacation areas for the same reasons, and also as desirable destinations for flights made for the trip itself. In a sense, these flights correspond to the weekend drives of earlier automobile history when improving roads extended his range of destinations; just as the auto-owner graduated from the "Sunday-afternoon drive," so is the private pilot likely to extent his local flight to an itinerant one, provided attractive destinations and suitable ground facilities become available.

As a part of this study, the research effort was made to discover some measure of the tourist and resort potentials of the individual areas as they might generate air traffic. Dr. R. W. McIntosh, Extension Specialist, Tourist and Resort Program, Cooperative Extension Service of Michigan State University, was consulted and suggested several approaches, though he had not developed techniques for such measurements as might be required for aviation planning.

None of the findings, as a result of these approaches, has yielded any optimistic conclusions about the role of "vacationland" in generating any sustained and consistent increase in air traffic.

Basically, it was found that most vacation travel, except for the convention-bound traveler on an expense account and the weekend commuter in the upper executive brackers, is by family automobile. The economics of group travel by car, the need for the automobile in the vacation area (though this can be offset by car rentals), and the penetration of the expressway network into the northern Michigan areas, all tend to indicate that highway travel will continue to dominate the vacation travel in this state.

Some claims for winter air-travel to ski centers have held out considerable promise. Close investigation with the scheduled airlines has failed to develop any feeling for a substantial market, largely because of weather uncertainties, and the economy of group travel by car over the relatively short distances involved to Michigan winter resorts. It is only the world famous ski resorts - Aspen, the Alps, and the like - that draw air travel. North Central and Capital Airlines indicated an interest in such traffic, but noted that their efforts to promote it had not been particularly successful.

There is, unquestionably, some traffic to be developed among sports-conscious, private fliers. The use of Gaylord and Boyne City airports reflects such flights, but as yet has no statistical base upon which sound estimates can be drawn. A suitable ground facility in association with an attractive resort will attract some personal air traffic; much more intensive marketing studies are necessary to determine the potential.

A disturbing factor in the Michigan sports scene is the decline in fishing license sales in this state, in contrast to the steadily rising national trend. Fishing licenses and collection of federal excise taxes on fishing tackle, according to the Sport Fishing Institute, have risen since 1946 at an average rate of 3%, with minor fluctuations. In Michigan, however, Department of Conservation figures shown a downward trend since 1954 when over 878,000 resident, and 309,000 non-resident licenses were issued. Last year, resident licenses issued declined to 756,000, or 14%, and non-resident licenses dropped to 208,000, or nearly 33%, below their 1954 peak. Just what significance this decrease has for aviation growth in the various local areas can be determined only through more extensive studies.

Included in such studies should be consideration of the limits of tourist development, beyond which a vacation resource loses its attraction. For many, a major asset in a vacation spot is not its accessibility, but its inaccessibility. Several areas, once prosperous as resorts, have shifted economic levels, often lower, as they passed this still intangible limit. Conceivably, the Mackinac Bridge could change the character of at least part of the Upper Peninsula to make it less attractive to vacationers and to produce fewer tourist dollars as it becomes more crowded.

Such problems suggest again the need for much more penetrating studies by all State agencies, not just the Department of Aeronautics. Air transportation, after all, is a service which is determined ultimately by the demands of the users, even though they may be indirectly expressed. In this relationship of the tourist industry to aviation, it would seem essential that both the Michigan Tourist Council and the Economic Development Department collaborate in the necessary research to identify and measure the recreational resources of the State.

Based Aircraft Demands

Aircraft based at an airport create their specific demands upon aviation facilities, and have long been a measure of need. The surveys of general aviation activity conducted by the old CAA established certain relationships between numbers of based aircraft, classified by types, and flight patterns. Additionally, the Curtis report (Vol. IV) attempted to develop methods for forecasting general aviation movements, but their application to areas such as those in Michigan was not established.

The estimation of general aviation demand in the various local areas of the state, as derived from forecasts of active aircraft based in those areas, suffers from the same handicap that applied to the use of local population and economic trends. Those areas which exhibit growth apparently justify their priorities at the expense of the declining or static areas. Airports do not exist, however, to serve only their own based aircraft and must now be developed on a broader base.

A study of the FAA records of active civil aircraft from 1952 through 1960 reveal that 29 of Michigan's 83 counties showed a decrease in total aircraft; 10 counties showed no change, and 44 accounted for the gain in the State's total. 12 counties, each having 50 or more active based civil aircraft, account for 1826, or 67% of the 2728 planes registered in 1960; the remaining 71 counties base the other 902 planes including two counties which show no active civil aircraft last year.

Table 5 shows the aviation areas of the state ranked in order of active based aircraft, not including any military aircraft assigned to military agencies, and Table 6 shows the change from the 1952 registration as reported by the FAA. It will be noted that the based aircraft are concentrated in the urban areas of the State, principally in the Southeastern Michigan Metropolitan Area and in the Urban-Industrial Areas across the southern portion of the state. Also, significance attaches to the fact that the substantial increases in the general aviation fleet took place in those same areas, although the largest percentage gains were recorded in spot areas outside the urban counties.

Of the business and utility aircraft fleet, the larger numbers are also based in the same counties, and, unlike the smaller, personal aircraft, these planes are used primarily for itinerant flights requiring an "outer" airport at which to terminate.

Table 5

RANK ORDER OF AVIATION AREAS BY ACTIVE BASED AIRCRAFT

Rank	Area	Principal Community	Active Based Civil Aircraft (1960)	Change in Total 1952 to 1960	Percent Change
1	26	Detroit	1192	+213	+22%
2	20	Lansing	217	+ 27	+14
3	21	Flint	181	+ 54	+42
4	23	Kalamazoo	174	+ 23	+15
5	19	Grand Rapids	168	+ 20	+13
6	25	Jackson	138	+ 5	+ 4
7	16	Saginaw-Bay City	100	+ 1	+ 1
8	22	Benton Harbor-St. Joseph	82	+ 2	+ 2
9	24	Battle Creek	79	- 31	-28
10	17	Bad Axe-Caro	70	+ 18	+35
11	18	Muskegon	60	+ 16	+36
12	15	Clare-Mt. Pleasant	33	+ 12	+57
13	14	Big Rapids-Reed City	33	+ 16	+94
14	8	Petoskey-Pellston	27	- 1	- 4
15	11	Alpena	23	+ 3	+15
16	12	Ludington-Manistee	22	+ 10	+83
17	7	Sault Ste. Marie	21	No Change	0
18	9	Traverse City	19	- 1	- 5
19	2	Houghton-Hancock	19	- 4	-20
20	4	Marquette	18	+ 2	+13
21	6	Escanaba	13	- 2	-13
22	3	Iron Mountain	13	- 14	-52
23	10	Gaylord	12	- 2	-14
24	13	Cadillac	9	+ 2	+28
25	1	Ironwood	9	- 1	-10
26	5	Menominee	3	- 5	-63
	TOTALS		2728	+355	+15%

Table 6

DISTRIBUTION OF ACTIVE BASED AIRCRAFT

Area	Active Based Aircraft 1952	1960	Change 1952-1960	Percent Change
Detroit Metropolitan Area	979	1192	+213	+22%
Urban Industrial Counties	715	840	+125	+17
Balanced Counties	419	425	+ 6	+ 2
Rural Industrial Counties	111	133	+ 22	+19
Rural-Agri. Rec. Counties	149	138	- 11	- 8
Total - State	2373	2728	+355	+15%

without such destination fields available, the usefulness of such planes disappears, and along with that loss goes the need. Thus, the mere fact of location of based planes can be a misleading determinant.

At one of the smaller airports in the state, for example, it was gloomily reported that the impending merger of a local industry would result in the transfer of the locally-based executive aircraft to the parent company's centralized base of operations. It was predicted that the loss of the planes would mean the virtual closing of the airport. Careful analysis revealed, however, that the proposed shift would in reality mean more flight activity as company business from headquarters increased travel.

As business flying continues to grow, and all forecasts indicate it will be a much larger portion of general aviation activity, the number of based aircraft in an area becomes a much less reliable planning guide. Traffic flow patterns are far more useful and essential items, though numbers of based aircraft will continue as a needed factor for airport design.

Area Air Traffic Patterns

Coordinate in importance with the specific factors generating demand in the aviation areas of the state, an accurate picture of the air traffic flow is a vital element in the planning process. While some information is available at airports having control towers, and at other airports having scheduled airline service, it is inadequate for determining the origins and destinations of flights and the flow of traffic between the many ground facilities. For an isolated airport, available data can be so modified as to serve for design purposes, but it provides no basis for planning a state-wide network in which mutual relationships are significant to the achievement of balance.

This data situation, it must be remarked, would have been materially improved had there been general compliance with Section 5.23 of the Rules and Regulations of the Michigan Aeronautics Commission. That section stipulates that, at each licensed airport or landing field, the airport manager "shall be responsible for the keeping of an airport register book showing arrivals and departures of aircraft, setting forth the number of airmen and passengers, and such other pertinent information as may be required." At only a few of the airports visited in the field surveys of Part II was there found to be any reasonably consistent recording, and no meaningful data could be established either locally or in the Department files. Scattered, interrupted information, even though widely collected, is no use in establishing a flow diagram for planning purposes.

It is strongly recommended that the Michigan Department of Aeronautics, through administrative action, achieve substantial compliance with its rules for airport record-keeping and undertake the development of state-wide air traffic patterns which are basic to sound planning for air transportation.

DEVELOPING A STATE-WIDE PLAN

Ideally, the development of a well-balanced plan for aviation facilities - airports, primarily - in all areas of Michigan should proceed logically from measured requirements of the individual areas in terms of their comprehensive resources and needs for economic growth. Research into the bases for such objective planning has, unfortunately, as the earlier analyses of this part of the report discussed, not progressed to the stage where the eminently desirable, more scientific, and sophisticated techniques can be applied to discrete regional areas. Past public policy, too, has placed emphasis upon somewhat arbitrary "local" considerations rather than upon the individual airports as elements of a comprehensive, interrelated system. An ideal planning approach cannot yet be established or even attempted.

Until area resource, aviation demand relationships, and air traffic flows can be more accurately identified and measured, planning for airports and related ground facilities must continue as a subjective process in which personal judgments and local pressures are more influential than available facts. And, as a practical approach, planning for scheduled airline service can be most effectively considered apart from general aviation needs; while these two segments of civil aviation are interdependent and can, to a large degree, utilize the same facilities, they are subject to considerably different forces which affect their planning. Therefore, airports for air commerce and for general aviation are separately discussed.

Airports for military needs, it should be noted, have not been entirely ignored. The planning of military aviation and considerations of military aspects of national defense are, however, beyond the capabilities of any civilian planners and can be coordinated only at the very highest national levels. Military requirements for civilian transportation, though, constitute a factor in demand which is reflected in the analytical work. Well-planned civilian facilities will serve such military traffic, and can accommodate a variety of military aviation needs which closely parallel civilian activities. In the subjective approach, they are covered by the usually generous allowances for growth.

Airports for Air Commerce

The plan of airports to meet the needs of air commerce in Michigan is in large measured derived from the actions of the CAB rather than directly from any local transportation planning. Exercising its statutory authority to regulate routes and services, the CAB is actually the dominant force in planning for scheduled airline facilities, although it is recognized that the local arguments can influence the decisions of this national body.

Michigan's present pattern of air commerce routes is still in the stages of adaptation to the changes made by the Great Lakes Service decision which became effective in 1960. With the transfer of some routes from trunk to local carrier status, and the additions of new services which introduce new community air-relationships, it is likely to be some time before any firm conclusions can be drawn. Nevertheless, the overall pattern can be delineated in terms of the existing airports which serve the scheduled airlines, and certain future requirements can be determined.

Table 7 lists the airports for Michigan air commerce by the aviation areas of the state and shows not only the existing facilities but the improvements recommended by the FAA for the immediate future. Except for the Southeastern Michigan Metropolitan Area, which has been the subject of a much more intensive study by other agencies, the active population centers of the state are at least provided with air carrier service and airports of minimum or better adequacy.

Only three of the 26 tentatively established areas of the state do not enjoy direct airline service, either by trunk, local carrier, or both. Table 3 and Figure 1 in Part I of this report outline the areas which are not presently receiving service to airports within 25 miles of airline airports. The corridor of Isabella, Clare, Roscommon, Crawford, and Otsego Counties lying along U.S. 27 in the center of the state, and Sanilac, Huron, and Tuscola Counties in the northern tip of the "Thumb" are the principal counties excluded.

On the basis of demonstrated experience, as evidenced by a detailed month-by-month traffic record made available through the courtesy of North Central Airlines, and in the face of the consistently held "Use it or lose it" policy of the CAB demanding at least a five-passenger daily minimum average traffic to retain service, there seems little prospect of justifying airline service to these areas in the next ten years. A possible exception, which might develop with better understanding of resort travel

Table 7

AIRPORTS FOR MICHIGAN AIR COMMERCE - NATIONAL AIRPORT PLANS, 1959 AND 1960

Area	Location	Airport	Class*	Longest Runway Existing	Longest Runway Recommended**	Notes
1	Ironwood	Gogebic County	L	3900'	4600'	
2	Hancock	Houghton County	L	5200	5200	
3	Iron Mountain	Ford	L	3800	5200	
4	Marquette	Marquette County	L	5000	4700	
5	Menominee	Menominee County	L	4100	4700	
6	Escanaba	Municipal	L	4500	4800	
7	Sault Ste. Marie	New	T	--	5600	New airport proposed, to replace pr.. use at Kinross Air Force field.
8	Pellston	Emmet County	T	5400	5600	
9	Traverse City	Traverse City	T	5199	5500	
10	-----	-----	-	--	--	No scheduled airline service to this area.
11	Alpena	Phelps Collins	L	5030	4300	See General Aviation Table.
12	Manistee	Blacker	L	3600	3600	Currently (1961) being prepared for local service
13	Cadillac	Municipal	-	3700	--	Now served via Reed City - Area No. 14.
14	Reed City	Miller Field	-	5000	--	Service began on trial, December 1960.
15	-----	-----	-	--	--	No scheduled airline service to this area.
16	Saginaw	Tri-City	T	5662	5600	
17	-----	-----	-	--	--	No scheduled airline service to this area.
18	Muskegon	Muskegon County	T	5000	5700	
19	Grand Rapids	Kent County	T	--	5800	New airport under construction.
20	Lansing	Capital City	T	5000	5700	
21	Flint	Bishop	T	4999	5600	
22	Benton Harbor	Ross	T	5042	5000	Service initiated, December 1960.
23	Kalamazoo	Municipal	T	4000	5300	
24	Battle Creek	W. K. Kellogg	T	7000	5800	
25	Jackson	Reynolds	T	4300	5300	
26	Detroit	City	T	4500	5700	See Landrum and Brown Report for details.
	Detroit	Metropolitan	I	10500	11600	Included here only to indicate statewide
	Detroit	Willow Run	C	7300	7300	picture, including Detroit Metro. Area.
	Pontiac	Municipal	L	4000	6300	See General Aviation Table.
	Port Huron	St. Clair County	L	3900	4200	See General Aviation Table.

* Ultimate FAA Classification in accordance with categories defined in TSO-N6b; L - Local Service; T - Trunkline Air Carriers with "turbine" aircraft; C - Continental Service with some "jet" aircraft; I - Intercontinental Service with long-distance "jet" aircraft.

** Recommended length of longest paved runway, as indicated in FAA National Airport Plans for 1959 and 1960. Based upon considerations of longest non-stop flights expected, types of aircraft, and TSO-N6b standards with corrections for elevation, runway gradient and other factors, to nearest 100 ft. For design purposes, each airport requires further engineering study to develop required runway lengths.

demands, is Area No. 10 which includes Houghton, Higgins and Otsego Lakes. A warrant for summer service might eventually be found, though no basis for judgment presently exists.

The exclusion of several communities, such as Holland, South Haven, and the up-grading of others to justify trunk rather than local service, might well have been avoided had plans been developed at other than the local level, as past national policy has dictated. Where intensely local support was necessary, narrowly-based decisions were obviously to be expected with the result that the more extensive needs of areas, such as those proposed in this report as basic units, were never seriously considered. Now, with substantial investments made or committed, improvements will necessarily be long delayed.

A case in point is the new Kent County Airport under construction at a site on the eastern side of Grand Rapids and somewhat remote from the population concentrations along Lake Michigan from Muskegon to Holland. While the location of the new airport at Cascade makes sense from a local viewpoint, a regional concept (had there been any mechanics for initiating it realistically) might well have indicated a warrant for a more important facility, more centrally located for the regional population.

A similar situation, which cannot be resolved locally, exists in the Kalamazoo-Battle Creek areas. In the present plan, both communities will continue to have local service only to airports less than 25 miles apart. With modern highway ground connections, a mutually convenient single airport serving the much larger combined populations might warrant an up-grading of the air carrier service with better transportation for the two areas than they will separately enjoy.

Inception of such regional planning, however, cannot take place until there is realization that local approaches are unsuited to intelligent transportation system planning. A ray of hope lies in the financial pressures of the air carriers themselves; in the long run, as self-sufficiency is imposed upon local as well as trunk carriers, demand and supply of airline transportation will be adjusted automatically through CAB actions. Resulting situations, it is believed, will require that the Department of Aeronautics introduce regional or area-wide considerations that may materially affect plans five to ten years hence.

These forces, without the modifying elements of understanding of air traffic potentials, cannot be presently evaluated. In the light of present knowledge, it can only be concluded that the plans for air commerce airport development, as they are displayed in the annually up-dated National Airport Plan, are adequate to the needs of Michigan.

Airports for General Aviation

Any comprehensive plan of general aviation airports is even more difficult to establish and evaluate because there is no consistent and organized expression of need as provided by the commercial airlines and the CAB for air commerce facilities. The diffuse and still largely un-measured characteristics of the local needs of general aviation make it necessary that planning standards be based upon general assumptions and broad criteria rather than precise analysis of demand.

Examination of general aviation needs broadly revealed that the most important requirement for continued development is a widely spread system of airports capable of serving business or executive air traffic and itinerant commercial and pleasure flights. In contrast to local flying where active based aircraft have well established certain rough criteria for airport needs, itinerant general aviation activities have had relatively little attention; yet the growth of aviation, it has long been recognized, will largely take place in this area.

Certain respected authorities on aviation have long advocated its expansion through the promotion of small airports or flight strips in virtually every local community. They have stressed the relatively simple, inexpensive improvements required for a turf-surfaced strip of minimum dimensions of roughly 2500 feet in length and 200 feet in width and with clear approaches at both ends. With such a strip, a community becomes "air accessible," and the expansion of general aviation is thus encouraged, the argument goes.

Michigan communities, with technical cooperation from the Department of Aeronautics, responded enthusiastically for several years after World War II and constructed an extensive number of ground facilities. In numerous areas, particularly in the suburbs of the larger cities and at certain resorts, privately owned air strips were established. The results of these activities are tabulated in Table 8 which shows all of the recorded airports, landing fields, and emergency strips licensed or listed by the

Table 8

GENERAL AVIATION AIRPORTS FOR MICHIGAN - NATIONAL AIRPORT PLANS, 1959 AND 1960

Area	Location	Field	1960 Situation: MDA Class	1960 Situation: Longest Runway	1960 Situation: Runway Surface	1960 Situation: Lights	1960 Situation: Radio Fac.	FAA Recommendations: Aeronautical Requirements	FAA Recommendations: Longest Runway	FAA Recommendations: Other	Notes
1	Ironwood	Gogebic	A	3900'	Bit.	Yes	Yes	Air Comm. L	4600'	---	See Table 7.
	Ewen (Topaz)	Big Bear	LU	2600	Turf	No	No	---	--	---	Private Ownership
	Marenisco	Marenisco	E	?	?	?	?	?	?	?	No detailed info.
	Ontonagon	Ontonagon County	--	--	--	--	--	Comm.	2800	New	
	Simar	Simar	E	2000	Turf	No	No	---	--	---	
2	Hancock	Houghton County	A	5200	Bit.	Yes	Yes	Air Comm. L	5200	---	See Table 7.
	Houghton	Houghton Sands	A	4000	Sand	No	No	---	--	---	Private
	Baraga	Baraga	E	2600	Turf	No	No	---	--	---	Private
	Sidnaw	Prickett-Grooms	E	1600	Turf	No	No	---	--	---	
3	Crystal Falls	Iron County	E	3700	Bit.	No	No	Comm.	3700	---	
	Crystal Falls	Phelan's	E	1770	Turf	No	No	---	--	---	Private
	Iron Mountain	Ford	A	3800	Bit.	Yes	Yes	Air Comm. L	--	---	See Table 7
	Ralph	Ralph	E	2000	Turf	No	No	---	--	---	
	Stambaugh	City	LU	2000	Turf	No	No	---	--	---	
4	Au Train	Au Train	E	1900	Gravel	No	No	---	--	---	Private
	Grand Marais	Grand Marais	E	4400	Turf	No	Yes	---	--	---	
	Marquette	Marquette County	A	5000	Bit.	Yes	Yes	Air Comm. L	4700	---	See Table 7
	Munising	Hanley	L	2800	Turf	No	No	Exec.	4300	---	
5	Menominee	Menominee County	A	4100	Bit.	Yes	No	Air Comm. L	4700	---	See Table 7
6	Blaney Park	Blaney Park	L	2250	Turf	No	No	---	--	---	Private
	Escanaba	Municipal	A	4500	Bit.	Yes	Yes	Air Comm. L	4800	---	See Table 7
	Gulliver	Gulliver	LU	3400	Turf	No	No	---	--	---	
	Manistique	Schoolcraft County	LU	2800	Turf	Yes	No	Comm.	2500	---	
7	Brevort	Brevort	E	2300	Turf	No	No	---	--	---	
	Drummond Island	Drummond Island	E	2500	Turf	No	No	---	--	---	Private
	Engadine	Hiawatha	E	2150	Turf	No	No	---	--	---	
	Hessel	Hessel	E	2800	Turf	No	No	---	--	---	
	Newberry	Luce County	E	3000	Turf	No	No	---	--	---	
	Point Aux Pins	Bois Blanc	E	2600	Turf	No	No	---	--	---	
	St. Ignace	Mackinac County	A	3200	Bit.	Yes	Yes	Comm.	3200	---	
	Sault Ste. Marie	Municipal	A	3300	Gravel	No	Yes	Comm.	3000	---	Also Consider new air commerce airport to permit shift from Kinross see Table 7.
8	Beaver Island	Beaver Island	L	3500	Turf	No	Yes	---	--	---	
	Boyne City	Municipal	L	3200	Turf	No	Yes	Comm.	2500	Pave	
	Charlevoix	Municipal	L	3000	Turf	No	Yes	Comm.	2400	Pave	
	Cheboygan	Marx	L	2400	Turf	No	No	---	--	---	Private
	East Jordan	East Jordan	E	2500	Turf	No	No	---	--	---	
	Harbor Springs	City	A	2000	Turf	Yes	Yes	---	--	---	
	Indian River	Calvin Campbell	E	2000	Turf	No	No	---	--	---	
	Mackinaw City	City	E	2200	Turf	No	No	---	--	---	
	Pellston	Emmet County	A	5400	Bit.	Yes	Yes	Air Comm. T.	5600	Lighting	See Table 7.

Table 8, continued

Area	Location	Field	1960 Situation: MDA Class	1960 Situation: Longest Runway	1960 Situation: Runway Surface	1960 Situation: Lights	1960 Situation: Radio Fac.	FAA Recommendations: Aeronautical Requirements	FAA Recommendations: Longest Runway	FAA Recommendations: Other	Notes
9	Bellaire	Antrim County	L	3980	Turf	Yes	Yes	Comm.	2400	Pave	
	Empire	Empire	LU	2300	Turf	No	No	---	--	---	
	Frankfort	Municipal	E	2800	Turf	No	No	Comm.	2400	---	
	Interlochen	Interlochen	E	3000	Turf	No	No	---	--	---	
	Mancelona	Municipal	E	3000	Turf	No	No	Comm.	2500	---	
	Northport	Woolsey	E	2650	Turf	No	No	---	--	---	
	Thompsonville	Thompsonville	E	2500	Turf	No	No	---	--	---	
	Traverse City	Traverse City	A	5199	Bit.	Yes	Yes	Air Comm. T.	5500	Misc.	See Table 7
10	Gaylord	Otsego County	A	3500	Bit.	Yes	Yes	Comm.	3500	---	
	Grayling	Army	L	5000	Concrete	Yes	?	---	--	---	
	Grayling	Mason's	E	3900	Turf	No	No	---	--	---	Private
	Houghton Lake	State	E	2700	Turf	No	No	---	--	---	
	Prudenville	Roscommon County	A	2500	Turf	No	No	---	--	---	
	Roscommon	Conservation	E	4200	Turf	No	No	---	--	---	
	St. Helen	St. Helen	E	2600	Turf	No	No	---	--	---	
	South Branch	Timer's Sky C.	LU	2200	Turf	No	No	---	--	---	Private
11	Alpena	Phelps Collins	A	5030	Concrete	Yes	Yes	Exec.	4300	Misc.	Also Air Comm. L (Table)
	Atlanta	Atlanta	E	2200	Turf	No	No	---	--	---	
	Hammond Bay	State	E	?	?	?	?	?	?	?	No info., Inactive?
	Harrisonville	Harrisville	E	1550	Turf	No	No	---	--	---	
	Hillman	Hillman	E	2100	Turf	No	No	---	--	---	
	Hubbard Lake	R. J. Gehrke	LU	2300	Turf	No	No	---	--	---	Private
	Lewiston	Lewiston	E	3000	Turf	No	No	---	--	---	Private
	Luzerne	Lost Creek	L	2500	Turf	No	No	---	--	---	Private
	Mio	Mio	E	3000	Turf	No	No	---	--	---	
	Onaway	Black River	E	2600	Turf	No	No	---	--	---	Private
	Onaway	Onaway	E	2100	Turf	No	No	---	--	---	
	Rogers City	Presque Isle Co.	LU	3000	Bit.	Yes	No	Comm.	3000	Widen	
12	Baldwin	Municipal	LU	3100	Turf	No	Yes	Comm.	2500	Pave-Light	
	Ludington	Mason County	L	2500	Bit.	No	Yes	Comm.	2500	Light	
	Manistee	Blacker	A	3600	Bit.	Yes	Yes	Comm.	3600	Resurface	Also Air Comm. L (Table 7)
	Scottville	Scottville	E	No information.- - - - - - - -				---	--	---	Private
	Wellston	Orchard Grove	E	1800	Turf	No	No	---	--	---	Private
13	Cadillac	Municipal	A	3700	Bit.	Yes	Yes	Comm.	3700	Misc.	Air Comm. via Reed City
	Lake	Home Acres	A	2600	Turf	No	No	---	--	---	Private
14	Barryton	Barryton	E	1800	Turf	No	No	---	--	---	
	Big Rapids	Robin Hood	A	2500	Bit.	Yes	No	Comm.	4000	Misc.	
	Evart	Evart	LU	2200	Bit.	Yes	Yes	---	--	---	
	Mecosta	Mecosta	E	1800	Turf	No	No	---	--	---	
	Reed City	Miller	A	5000	Bit.	Yes	Yes	---	--	---	Private, also Air Comm.
	Remus	Johnson's	E	2400	Turf	No	No	---	--	---	Private
	Remus	Municipal	E	1800	Turf	No	No	---	--	---	
15	Clare	McKoy	E	4750	Turf	No	No	---	--	---	Private
	Clare	Municipal	A	2600	Turf	No	No	Comm.	2500	Returf	
	Harrison	Harrison	L	3300	Turf	No	No	---	--	---	

Table 8 , continued

Area	Location	Field	1960 Situation					FAA Recommendations			Notes
			MDA Class	Longest Runway	Runway Surface	Lights	Radio Fac.	Aeronautical Requirements	Longest Runway	Other	
	Lake	Scott	E	1740	Turf	No	No	---	--	---	Extending to 2700'
	Mt. Pleasant	Municipal	A	3000	Bit.	Yes	Yes	Comm.	3000	Misc.	
16	Au Gres	Au Gres	E	2000	Turf	No	No	---	--	---	
	Bay City	James Clements	A	2600	Bit.	No	Yes	Exec.	4200	---	
	Chesaning	Chesaning	LU	2360	Turf	Yes	No	---	--	---	
	East Tawas	Iosco County	LU	2600	Turf	No	No	Comm.	3500	---	
	Gladwin	Municipal	LU	3500	Turf	Yes	Yes	Comm.	2500	Pave	
	Midland	Jack Barston	A	3200	Turf	No	Yes	Comm.	3200	---	
	Pinconning	Sportsman	E	2600	Turf	No	No	---	--	---	Private
	Saginaw	Muehlenbeck	L	2100	Cin. Gr.	No	No	---	--	---	
	Saginaw	Municipal	A	3300	Shale Gr.	No	No	---	--	---	
	Saginaw	Tri-City	A	5660	Concrete	Yes	Yes	Air Comm. T.	5600	Tower	See Table 7
	Standish	Dudley	E	2500	Turf	No	No	---	--	---	Private
	West Branch	Gentry's	E	4100	Turf	No	No	---	--	---	Private
	West Branch	Gustafson's	L	2500	Turf	No	No	---	--	---	Private
17	Bad Axe	Huron County	A	2350	Bit.	Yes	Yes	Comm.	2500	---	
	Caro	Municipal	LU	2350	Gravel	Yes	No	---	--	---	
	Croswell	City	L	2500	Turf	No	No	---	--	---	Private
	Deckerville	Naumann	E	2400	Turf	Yes	No	---	--	---	Private
	Harbor Beach	Harbor Beach	E	2000	Turf	No	No	---	--	---	Private
	Marlette	Marlette	L	2250	Turf	Yes	No	---	--	---	Private
	Port Hope	Air Port Hope	E	2000	Turf	No	No	---	--	---	Private
	Sandusky	Williams	E	1900	Turf	No	No	Comm.	2500	---	Private (New Public Airport?)
	Sebewaing	Sebewaing	L	2500	Turf	No	No	Comm.	2500	Pave?	
18	Fremont	Fremont	A	3500	Bit.	Yes	Yes	Comm.	3500	---	
	Grant	Municipal	E	2500	Turf	No	No	---	--	---	Private
	Hart	Hart-Shelby	E	1800	Bit.	No	No	Comm.	2700	---	
	Montague	Ottiger	E	2600	Turf	No	No	---	--	---	Private
	Muskegon	Muskegon County	A	5000	Bit.	Yes	Yes	Air Comm. T	5700	New?	See Table 7
	Newaygo	Village	A	3200	Turf	No	No	---	--	---	
	North Muskegon	Northside	E	2800	sand-Turf	No	No	---	--	---	Private
	White Cloud	White Cloud	E	1800	Turf	No	No	---	--	---	
19	Ada	Somerville	E	2600	Turf	No	No	---	--	---	Private
	Belding	Belding	E	2600	Turf	No	No	---	--	---	Private
	Belmont	Pigorsh	E	1900	Turf	No	No	---	--	---	Private
	Byron Center	Wilson	LU	2200	Turf	No	No	---	--	---	Private
	Grand Haven	Memorial Air Park	A	3000	Bit.	Yes	Yes	Comm.	2400	Misc.	
	Grand Rapids	Kent County	A	5700	Concrete	Yes	Yes	Air Comm. T.	5800		New airport under const. (Table 7)
	Greenville	Greenville	LU	2500	Turf	No	No	Comm.	4100	Pave-Light	
	Holland	Park Township	L	2650	Gravel	Yes	Yes	Comm.	2400	Pave-Light	
	Ionia	Ionia County	L	2475	Bit.	Yes	No	Comm.	2500	Misc.	
	Lakeview	Lakeview	L	2500	Turf	Yes	No	Comm.	2700	Misc.	
	Lowell	Lowell	E	1750	Turf	No	No	---	--	---	
	Sparta	Sparta	A	2200	Bit.	No	Yes	Comm.	2500	Lights	
20	Alma	Municipal	A	2500	Bit.	Yes	Yes	Exec.	4300	Gen'l. Exp.	
	Brighton	Hyne	LU	1900	Turf	No	No	---	--	---	Private

Table 8, continued

Area	Location	Field	1960 Situation					FAA Recommendations			Notes
			MDA Class	Longest Runway	Runway Surface	Lights	Radio Fac.	Aeronautical Requirements	Longest Runway	Other	
	Charlotte	Fitch H. Beach	A	2400	Turf	No	No	Comm.	2500	Pave-Light	
	East Lansing	Davis	A	2270	Turf	No	Yes	---	--	---	Private
	Eaton Rapids	Miller's	L	2600	Turf	No	No	---	--	---	Private
	Fowlerville	Newton	LU	2400	Turf	No	No	---	--	---	Private
	Grand Ledge	Abrams	A	2600	Turf	No	No	---	--	---	
	Gregory	Richmond	LU	2300	Turf	No	No	---	--	---	Private
	Howell	City	L	1800	Turf	Yes	Yes	---	--	---	
	Lansing	Aero Manor	L	2700	Turf	No	No	---	--	---	Private
	Lansing	Capital City	A	5000	Bit.	Yes	Yes	Air Comm. T.	5700	Tower	
	Leslie	McMath Memorial	E	2200	Turf	No	No	---	--	---	Private
	Mason	Jewett	LU	2200	Turf	No	No	---	--	---	Private
	Riverdale	Lippert	E	2360	Turf	No	No	---	--	---	Private
	Vermontville	Gehman	E	2100	Turf	No	No	---	--	---	Private
21	Almont	Almont	A	2250	Gravel	No	No	---	--	---	Private
	Clio	West's	A	1900	Turf	No	No	---	--	---	Private
	Fenton	Aero Acres	LU	2500	Turf	No	No	---	--	---	Private
	Flint	Bishop	A	5000	Concrete	Yes	Yes	Air Comm. T.	5600	ILS Tower	
	Flushing	Dalton	A	2600	Turf	No	No	---	--	---	Private
	Lapeer	Dupont-Lapeer	A	3600	Turf	No	Yes	---	--	---	Private
	Owosso	City	A	3000	Bit.	Yes	Yes	Comm.	3000	---	
22	Benton Harbor	Ross	A	5000	Bit.	Yes	Yes	Air Comm. T.	5000	---	See Table 7
	Dowagiac	Cass County	A	3000	Bit.	Yes	No	Comm.	3000	Misc.	
	Niles	Jerry Tyler	A	3300	Bit	No.	Yes	Exec.	4300	Gen'l. Exp.	
	Watervliet	Watervliet	L	1800	Turf	No	No	Comm.	2400	---	
23	Allegan	Padgham	A	2600	Turf	Yes	Yes	Comm.	2500	Pave	
	Breedsville	Bangor	E	1800	Turf	No	No	---	--	---	Private
	Fennville	Noble	E	- -No details available - - - -				---	--	---	Private
	Gobles	Wesler	E	1750	Turf	No	No	---	--	---	Private
	Kalamazoo	Austin Lake	A	2580	Turf	No	Yes	---	--	---	Private
	Kalamazoo	Municipal	A	4000	Bit.	Yes	Yes	Air Comm. T.	5300	---	
	Lawrence	Boothby	E	2100	Turf	No	No	---	--	---	Private
	Lawton	Marks	L	2500	Turf	No	No	---	--	---	Private
	Plainwell	Otsego-Plainwell	A	2600	Turf	No	No	---	--	---	
	Shelbyville	Lapham	E	2500	Turf	No	No	---	--	---	Private
	South Haven	South Haven	A	2400	Bit.	Yes	Yes	Comm.	2500	---	
	Sturgis	Kirsch Municipal	A	3250	Bit.	Yes	Yes	Comm.	3250	---	
	Three Rivers	Dr. Haines	A	2800	Bit.	Yes	Yes	Comm.	2900	---	
	Wayland	Municipal	LU	1980	Turf	No	No	Comm.	2500	---	
24	Battle Creek	W. K. Kellogg	A	7000	Concrete	Yes	Yes	Air Comm. T.	5800	LF Tower	
	Coldwater	Branch County	A	3500	Bit.	Yes	No	Comm.	3500	---	
	Hastings	Hastings Air Park	A	3000	Bit.	No	No	Comm.	3000	---	
	Marshall	Brooks	A	2850	Turf	Yes	Yes	Comm.	2500	---	
25	Adrian	City	A	2500	Bit.	Yes	Yes	Comm.	3300	---	
	Blissfield	Betz	E	2500	Turf	No	No	---	--	---	Private
	Brooklyn	Brooklyn Memorial	E	2000	Turf	No	No	---	--	---	Private
	Hillsdale	Municipal	LU	2000	Turf	Yes	No	Comm.	2600	New?	

Table 8, continued

Area	Location	Field	1960 Situation: MDA Class	Longest Runway	Runway Surface	Lights	Radio Fac.	FAA Recommendations: Aeronautical Requirements	Longest Runway	Other	Notes
	Jackson	Reynolds Mun.	A	4350	Bit.	Yes	Yes	Air Comm. T	5300	---	
	Jonesville	Merchant	L	2100	Turf	No	No	---	--	---	Private
	Morenci	Morenci	E	2100	Turf	No	No	---	--	---	Private
	Napoleon	Belford-Maule	A	2900	Turf	No	No	---	--	---	Private
	Tecumseh	Tecumseh	A	2600	Bit.	Yes	No	---	--	---	Private
	Tecumseh	Tecumseh Products	E	3300	Bit.	Yes	No	---	--	---	Private
26	Ann Arbor	Municipal	A	3500	Bit.	Yes	Yes	Exec.	4300	---	
	Ann Arbor	Young's	E	2980	Turf	No	No	---	--	---	Private
	Belleville	Larsen's	LU	1620	Turf	No	No	---	--	---	Private
	Birmingham	Berz	A	3200	Bit.	Yes	No	---	--	---	Private
	Detroit	City	A	4500	Concrete	Yes	Yes	Air Comm. L and new Exec?			See Table
	Detroit	Metropolitan	A	10500	Concrete	Yes	Yes	Air Comm I	11600	Tower	See Table
	Detroit	Willow Run	A	7500	Conc. Bit.	Yes	Yes	Air Comm. C		Tower	See Table
	Dundee	Brewer Farm	E	2200	Turf	No	No	---	--	---	Private
	Flat Rock	Nan-Bar	A	2400	Turf	No	No	---	--	---	Private
	Fraser	McKinley	A	2375	Bit	Yes	Yes	---	--	---	Private
	Lambertville	Wagon Wheel	A	2900	Turf	No	No	---	--	---	Private
	LaSalle	Price	E	1900	Turf	Yes	No	---	--	---	Private
	Marine City	Marine City	LU	2100	Turf	No	Yes	Comm.	2400	New Airport Proposed	
	Milan	Milan	A	2500	Turf	No	Yes	---	--	---	Private
	Milan	Talladay	E	2400	Turf	No	No	---	--	---	Private
	Monroe	Custer	L	2600	Bit.	Yes	Yes	Comm.	2600	---	
	Monroe	Marshall	L	2100	Turf	No	No	---	--	---	Private
	New Baltimore	Kendall	E	1800	Turf	No	No	---	--	---	Private
	New Haven	Macomb	A	2200	Turf	No	No	---	--	---	Private
	New Hudson	New Hudson	LU	2500	Turf	No	No	---	--	---	Private
	Plymouth	Mettetal	A	2235	Bit.	Yes	No	Exec.	4300	New?	Private (New-Public?)
	Plymouth	National	A	2800	Turf	No	No	---	--	---	Private
	Pontiac	Allen	A	2600	Turf	No	Yes	---	--	---	Private
	Pontiac	Municipal	A	4000	Bit.	Yes	Yes	Exec.	4300	---	Also Air Comm. L (Table)
	Port Huron	Bakers	LU	2700	Turf	No	No	---	--	---	Private
	Port Huron	St. Clair County	A	3900	Bit.	Yes	Yes	Comm.	4200	---	Also Air Comm. L (Table)
	Romeo	Romeo	A	3200	Turf	Yes	Yes	---	--	---	Private
	Romeo	Kuntsman	E	2600	Turf	No	No	---	--	---	Private
	Troy	Big Beaver	A	2400	Turf	No	Yes	---	--	---	Private
	Wixom	Spencer	LU	2600	Turf	Yes	No	---	--	---	Private
	Yale	Yale	LU	2350	Turf	No	No	---	--	---	Private
	Ypsilanti	McEnnon	A	2300	Turf	Yes	Yes	---	--	---	Private

Notes: 1. "MDA Class" refers to the classification of airports as defined in The Rules and Regulations of the Michigan Aeronautics Commission, and is not to be confused with FAA terms:

"A" - Licensed Airport - meeting all minimum standards for facilities and services, as well as landing area.

"L" - Licensed Landing Field - meeting all minimum standards except for those for hangars, and mechanical and repair services, and telephone facilities.

"LU" - Licensed Limited Use Field - deficient in one or more standards for airports and landing fields, but providing "adequate" runway for normal take-off.

"E" - Fields without services, and with a minimum of maintenance. "Pilots may use these fields, but do so at their own discretion.

Table 8, continued

2. FAA Aeronautical Requirements for General Aviation Airports, as defined in National Airport Plan - 1960, and based upon expected predominant use:

   "Exec." - Executive - "accommodates a considerable volume of intercity flights by corporate aircraft of similar types providing passenger and cargo transportation for hire. Aircraft engaged in such flying range from post-war single-engine planes (four-place and over) to multi-engine types."

   "Comm." - Commercial- "Serves local aviation activities primarily, including instructional flying under licensed supervision. The intercity itinerant flying is usually performed in single-engine aircraft of less than four-places."

   The other two categories - "Industrial" and "Special" - were not required in any area of Michigan.

3. Recommended runway length is based upon the requirements of the aircraft expected to be predominant in the use of the airport, with corrections for runway gradient and elevation above sea level.

4. Radio Facilities refer to all communication facilities, ranging from UNICOM to ILS. At the large majority of airports having facilities as indicated by "Yes," the equipment is UNICOM. Only airline airports, ordinarily, have more elaborate facilities.

Table 9

MICHIGAN AIRPORTS AND LANDING FIELDS
By Length of Longest Runway
(1960)

Area No.	No. of Airports Having Longest Runways (in feet) Under 2500'	2500'-3200'	3201'-4200'	4200'-6000'	6001'-7500'	Over 7501'	Total
1	1	1	1(L)	--	--	--	3
2	1	1	1	1(L)	--	--	4
3	3	--	2(L)	--	--	--	5
4	1	1	1	1(L)	--	--	4
5	--	--	1(L)	--	--	--	1
6	1	1	1	1(L)	--	--	4
7	2	6	--	--	--	--	8*
8	4	3	1	1(L)	--	--	9
9	1	5	1	1(L)	--	--	8
10	1	3	3	1	--	--	8
11	6	5	--	--	--	1(L)	12
12	2	2	1(L)	--	--	--	5
13	--	1	1	--	--	--	2
14	5	1	--	1(L)	--	--	7
15	1	2	1	1	--	--	5
16	3	6	3	1(T)	--	--	13
17	6	2	--	--	--	--	8
18	2	4	1	1(T)	--	--	8
19	5	6	--	1(T)	--	--	12
20	10	4	--	1(T)	--	--	15
21	2	3	1	1(T)	--	--	7
22	1	1	1	1(L)	--	--	4
23	6	6	2(L)	--	--	--	14
24	--	2	1	--	1(L)	--	4
25	4	4	1	1(L)	--	--	10
26	14	12	3	1(L)	1(C)	1(I)	32
Totals	82	82	28	16	2	2	212

Letters refer to airline service types. (L) - Local, 3201'-4200' runway required; (T) - Trunk, 4201-6000; (C)-Continental, 6001-7500; (I)-Intercontinental, 7501-10,500.

*No adequate civilian airport; temporary service at military field.

Michigan Department of Aeronautics in 1960. For convenience in analysis, these are grouped by aviation areas and runway lengths in Table 9.

It will be noted that airline airports have been included in these tabulations of general aviation airports. With the possible exception of Detroit Metropolitan Airports which conceivably will develop heavy commercial traffic with jet aircraft predominant, the other airports, it is believed, will not discourage their use by general aircraft. Several of the airline airports actually have a longer runway than required for their present class of traffic; in some instances, the transfer of CAB routes to local service carriers down-graded the requirements, while conversion of former military fields provided runway lengths in excess of current requirements. All of the airline airports will accommodate the larger executive-type aircraft.

Runway Length Requirements. As a rule-of-thumb, the minimum length of runways for executive or business aircraft can be conservatively set at 2500 feet. Shorter runways may, in the future, be adequate for STOL (Short Take-Off and Landing) aircraft as described in Part III of this report, but will not be adequate for the popularly current models used for business flying. A DC-3, still employed by many business fliers, requires runways in the local airline (L) category of 3201 to 4200 feet, and several of the multi-engine, heavier business aircraft favored by large corporation fleets also fall within this length requirement for normal operations.

Reviewed by aviation areas, 130 of the 212 listed facilities have runway lengths adequate to business aircraft. The 82 smaller fields are almost all in the "Emergency" classification and are utilized by locally-based pleasure craft rather than business planes. There seems to be a rather wide distribution of the 2500'-3200' category inasmuch as all but two of the 26 areas have one or more such runways; these two exceptions are in the Upper Peninsula and do afford longer runways at airline airports. On runway lengths, existing and included in the FAA National Airport Plan, Michigan would seem to be in good shape.

Length of runway, however, is not a sufficient basis for judging adequacy for planning purposes. In the longer run, it is the conclusion of this study that an all-weather surface, presumably bituminous pavement, and lights for after-dark landings are also essential standards.

<u>Runway Paving Standards</u>. A permanent runway surface is believed essential on several counts, despite the good performance of turf on many runways. Business flying, which is considered to be the principal general aviation activity in itinerant flight-hours, takes place the year around and requires that runways be cleared of snow within reasonable periods after storms; turf, except under unusual circumstances, will not withstand repeated snow removal.

Also, the potentially heavier wheel loads of business aircraft will, on repeated use, cut up the turf and cause deterioration of the exposed soil surface. At certain times of the year, unless unusually good soil and drainage conditions exist, the turf surface may be too weak to support any but the lightest personal craft.

Even more important than snow removal and structural considerations, perhaps, is pavement's contribution to a permanent status for the airfield. Part I analyzed the decline in number of facilities, particularly in the metropolitan areas, and pointed to the need for retention of facilities in the face of growing pressures upon existing airports as available tracts of land for profitable real estate developments. Once paved, there is sufficient investment involved and an obvious degree of permanence displayed that there may be much less tendency to abandon airports which will be sorely needed to serve the enlarged fleets of 1970 and 1975.

Lighting Standards. A further consideration in evolving minimum criteria for general aviation airports is lighting for night landings. Although there is some difference of opinion about the need for lighting, it is the conclusion of this study that adequate markers and runway lighting in accordance with FAA standards is a minimum requirement along with a 2500-foot minimum length and bituminous surfacing.

Again, business flying is the principal reason. Such flights, if they are to serve business purposes, cannot be severely limited to arrival times during hours of adequate daylight. Such flying takes place throughout the year and not on summer weekends when conditions are ideal. If an airport is to serve business flying, there must be reasonable expectation of its readiness to accept aircraft at all but the few times of adverse weather throughout the year.

Adequacy. As a tentative standard of overall adequacy of a general aviation airport, the preceding standards have been combined into a number of groups into which the airports have been classified by aviation areas. Table 10 shows the numbers of airports and landing fields in each of five groups as defined in the tabulation.

The standard of adequacy, corresponding to Group I, includes a minimum length of runway of 2500 feet, a bituminous-surfaced or paved landing strip, lighting for after-dark landings, and radio communication facilities. Only 47 of the 212 recorded facilities apparently meet these standards and, for purposes of this study, are considered "adequate."

Three airports are of ample length and are paved, but have neither lighting nor radio. With a minimum of expense, these facilities could readily be up-graded to adequate standards.

Of the remaining 162 airports and landing strips, almost exactly 50%, or 80, seemingly have runways longer than minimum requirements but lack, principally, surfacing or paving. In addition, most would require lights and some 65 would also require radio facilities. 82 do not meet minimum standards for runways, although six are paved and completely equipped with lights and radio.

Table 10

GENERAL AVIATION AIRPORTS IN MICHIGAN
meeting minimum study standards

Area	Number of Airports				
	Group I	Group II	Group III	Group IV	Group V
1	1	--	1	--	1
2	1	--	2	--	1
3	1	1	--	--	3
4	1	--	2	--	1
5	1	--	--	--	--
6	1	--	2	--	1
7	1	--	5	--	2
8	1	--	4	--	4
9	1	--	6	--	1
10	2	--	5	--	1
11	2	--	3	--	5
12	1	--	2	--	2
13	1	--	1	--	--
14	2	--	--	1	4
15	1	--	3	--	1
16	1	1	8	--	2
17	0	--	2	1	6
18	2	--	4	--	2
19	2	--	5	1	4
20	2	--	3	--	10
21	2	--	3	--	2
22	3	--	--	--	1
23	3	--	4	1	6
24	2	1	1	--	--
25	4	--	2	--	4
26	8	--	12	2	12
Totals	47	3	80	6	76

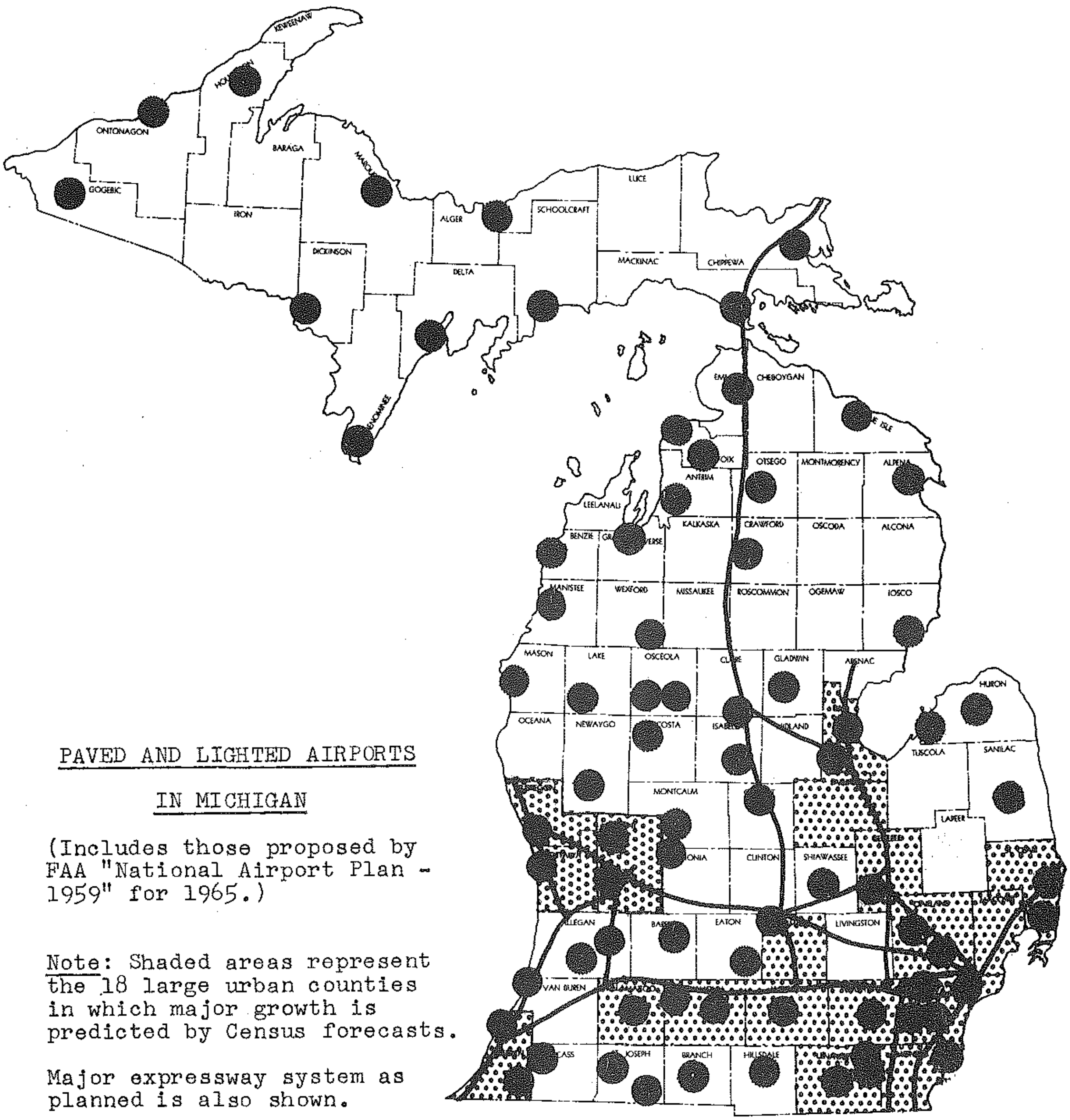
Group I. Airports having 2500' or longer runway, paved surfaces and lighting.

Group II. Airports having 2500' or longer, paved runways, but no lighting.

Group III. Airports having 2500' or longer runways, but lacking paving or lighting or both.

Group IV. Airports paved and light, but less than 2500' runways.

Group V. Airports failing to meet any study standard.



PAVED AND LIGHTED AIRPORTS

IN MICHIGAN

(Includes those proposed by FAA "National Airport Plan - 1959" for 1965.)

Note: Shaded areas represent the 18 large urban counties in which major growth is predicted by Census forecasts.

Major expressway system as planned is also shown.

Figure 2

GENERAL AVIATION AIRPORT SERVICE AREAS
(2500 Ft. Min. Runways, Paved, Lighted)

LEGEND

Areas More Than 15 Miles From Airports

Area Within 15 Miles of Airports

Detroit Metropolitan Regional Area to be Studied by Others

Existing and Proposed Expressways

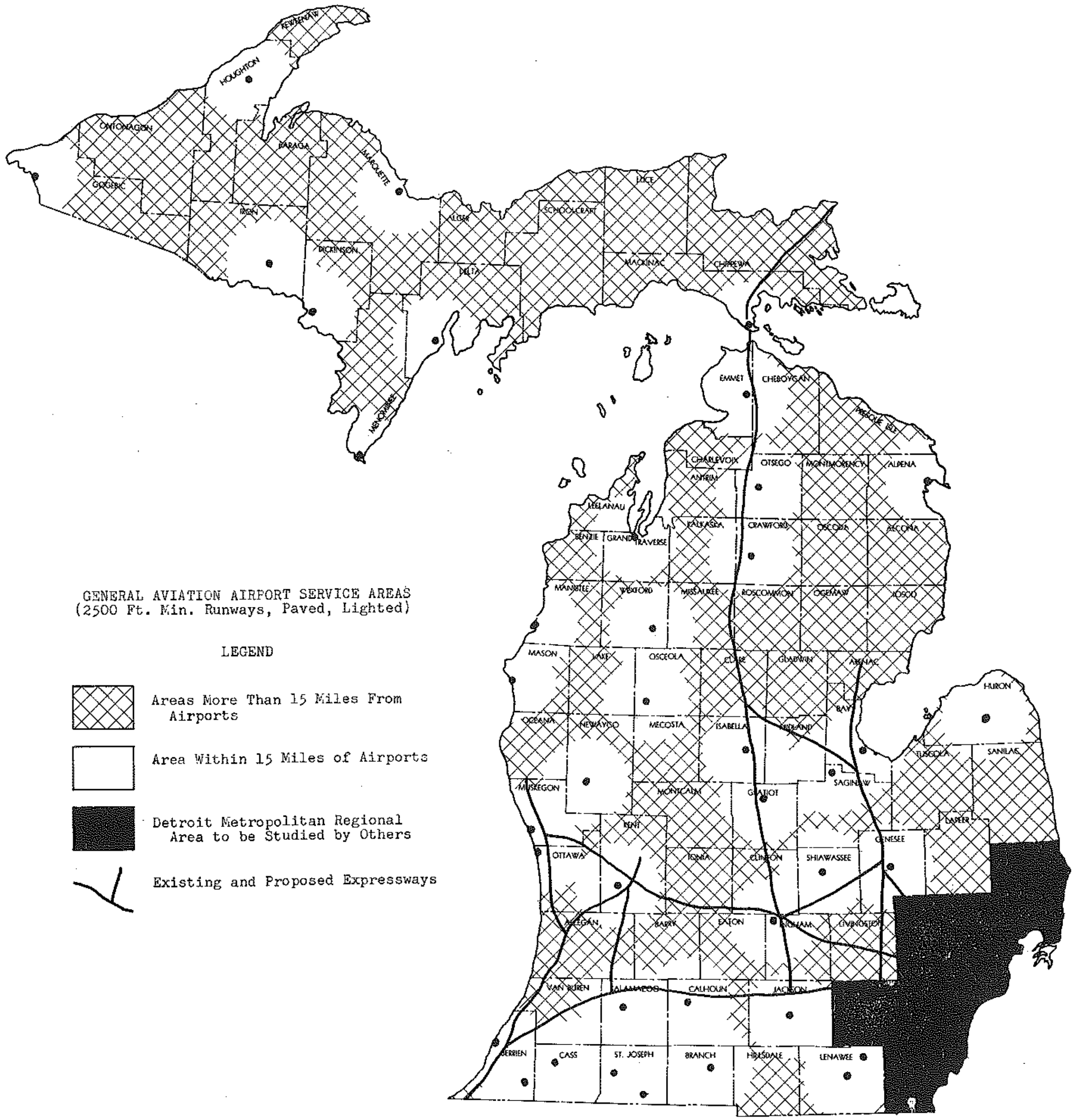


Figure 3

Ownership As A Planning Factor

Coordinate with the tabulation of adequacy, ownership of the various ground facilities was studied. Table 11 summarizes the findings as nearly as the facts of direct control or ownership could be ascertained from the records. Some questions about classification of the Army field at Grayling, and Detroit Willow Run were settled by designating them as "State of Michigan"; two of the emergency air strips in the Upper Peninsula were also assigned to the state although their status was indefinite.

It is significant that the largest single group of adequate airports are the locally owned, chiefly by minicipalities, while the largest group of inadequate facilities are privately owned. The larger municipalities, the counties, and the state all have more extensive resources with which to finance improvements, while the smaller cities and private airport operators are probably in marginal financial positions and unable to afford substantial expansion or improvements.

Inherently, there is a contradiction in local ownership because an airport by its very nature has regional impact. Even the smaller general aviation airport was found, in the Transportation Institute survey described in Part I, to have an area of influence of an approximately 15-mile radius, and the airline airport roughly one of 25-miles. Resources more extensively drawn than from a small city or township, or by a private operator in most urban and balanced counties, would seem both essential and desirable.

Table 11

OWNERSHIP OF MICHIGAN AIRPORTS

Agency	Group Category (See Table 10) I	II	III	IV	V	Totals
State of Michigan	2	0	2	0	2	6 (Note)
Counties	16	1	9	2	1	29
Local Governments*	25	2	33	2	266	88
Private	4	0	36	2	47	89
	47	3	80	6	76	212

*Includes Tri-City agency administering Tri-City Airport at Saginaw (Freeland).

Note: Totals for state may not include certain emergency strips of currently uncertain status.

Source: Michigan Department of Aeronautics

In planning, particularly, local initiative seems as weak as the financing in many areas. While it has been stated national policy to encourage airport development at the local level, and to offer national "assistance" and "coordination," it would seem desirable to plan at a more inclusive level than that of a single airport. Airports form parts of a complex system into which they must be fitted if aviation is to provide transportation service; even if local ownership is retained, it seems urgent that major planning responsibility be assumed, not just coordinated, at the state level in the Michigan Department of Aeronautics. The 177 local and private airport owners pose a real problem of planning coordination, otherwise.

PLANNING SUMMARY

In the foregoing pages, a wide range of factors influencing the planning of aviation facilities in Michigan has been developed. Because of the numerous influences and because each area presents problems which may have been obscured in the efforts to compare these influences, Table 12 has been prepared to summarize significant information and to indicate priorities for desirable planning studies in depth. Also utilized in establishing these priorities was Figure 3 which shows the areas of the state conveniently served by "adequate" general aviation airports.

While airline airports are of equal importance in planning, it is probable that the urgent demands of the commercial airlines and their numerous patrons will gain attention as their situation warrants. General aviation, in contrast, directly affects relatively few citizens and contributes so diffusely to the economy that the planning initiative must be generated continuously by a central agency such as the Department of Aeronautics which, alone in the state, has the scope to supply the balanced view.

As a possible guide to needed planning studies, Table 12 and Figure 3 were considered carefully along with supporting information not directly recast here. First attention, it would seem, should go to those areas having urban and balanced characteristics, a growing population and economy which is putting the pressure on open land, as well as creating a transportation demand, and where active based aircraft are large in number. Second priority seemed warranted in those areas where the economy and population were static or declining, and aviation might be a useful device for stimulating industrial growth or recreational development; the need for research first, however, dictates some postponement of active planning studies until its results can be usefully applied. And third priority is assigned to those areas where no substantial changes seem urgently necessary.

Two areas deserve particular mention because of special problems. The first is Area No. 7, made up of Chippewa, Luce, and Mackinac Counties, where no adequate civilian airport for airline service is available; although the military field at Kinross is presently used, the provision of a new public airport to serve the area deserves accelerated planning.

The second area is No. 17, comprising Huron, Sanilac, and Tuscola Counties at the tip of the "Thumb." Although the Huron County Airport at Bad Axe is paved and lighted, its length is substandard; no other paved and lighted airport exists in the area so it is without an "adequate" airport, even for general aviation. With 70 based planes, this area seemingly warrants immediate and detailed study. The effect of improvement at Bad Axe is noted on Figure 3 by outlining the area served.

Finally, it will be noted that some 77 airports, well distributed throughout the state, are included in the current National Airport Plan. The recommendations of that plan yield a basis for further study because many of the elements of need have been considered by the FAA offices, both in the field and in the Airports Division in Washington. All in all, six areas having "A" priority include 16 of the airports of the FAA plan; 10 areas of "B" priority

Table 12

PLANNING NEEDS - GENERAL AVIATION

Area	Apparent Growth (Population & Economy)	Area Characteristic (See Text)	Based Aircraft	Adequate Airports*	In Nat'l. Plan	Study Priority
1	Minus	Rural-Agricultural	9	1	2	B
2	Minus	Rural-Agricultural	12	1	1	B
3	Minus	Rural-Agricultural	13	1	2	B
4	Plus	Rural-Industrial	18	1	2	C
5	Static	Rural-Agricultural	3	1	1	B
6	Static	Rural-Agricultural	13	1	2	B
7	Plus	Rural-Industrial	21	1	3	A
8	Static	Rural-Agricultural	27	1	3	B
9	Plus	Rural-Industrial	19	1	4	C
10	Plus	Rural-Agricultural	12	2	1	C
11	Plus	Rural-Industrial	23	2	2	C
12	Plus	Rural-Industrial	22	1	3	C
13	Minus	Rural-Agricultural	9	1	1	B
14	Plus	Rural-Agricultural	33	2	1	C
15	Plus	Rural-Industrial	33	1	2	B
16	Plus	Urban-Industrial	100	1	5	A
17	Plus	Balanced-Urban-Rural	70	0	3	A
18	Plus	Balanced-Urban-Rural	60	2	3	B
19	Plus	Urban Industrial	168	2	7	A
20	Plus	Urban Industrial	217	2	3	A
21	Plus	Urban Industrial	181	2	2	A
22	Plus	Balanced Urban-Rural	82	3	4	C
23	Plus	Urban Industrial	174	3	6	B
24	Plus	Balanced Urban Rural	79	2	4	B
25	Plus	Balanced Urban Rural	138	4	3	C
26	Plus	Major Metropolitan Area	1192	8	7	Special
			2728	47	77	

A - Top priority B - Second Priority C - Third priority include 26 airports; and the 10 areas of "C" priority cover the remaining 35 "National Plan" airports, including several which are classified as having national interest but requiring no improvement during the planning period.

The Southeastern Michigan Metropolitan Area, containing the only major air traffic hub in the state, is recognized as a special problem which deserves exclusive study, not directly related to other areas of the State.

CONCLUSIONS

Aviation planning in Michigan requires a much more sophisticated approach than existing knowledge of the state's resources and transportation needs now permits. Intensive research on the industrial and recreational potentials of the sub-areas of the state is urgently needed to establish transportation, particularly aviation, potentials. Without such relationships, planning can continue only in the subjective manner of the past.

The review of Michigan airport facilities with respect to tentatively established areas of aviation interest reveals no critically acute shortage or need, but does indicate a number of areas which warrant immediate planning studies.

Such studies, contrary to established national policy, should not be carried on at the local level but should be the responsibility of the Michigan Department of Aeronautics. This agency can mobilize the resources and maintain a sufficiently comprehensive objective that a well-balanced state-wide plan can be developed; it cannot achieve that desirable balance by attempting to coordinate numerous local efforts which would be largely independent and narrow.

Under such auspices, it is possible for more objective planning techniques to be applied to aviation in the state and gain an even greater return to the Michigan economy than is now enjoyed.

REFERENCES - PART IV

Air Transport Facts and Figures. 19th Edition, 1958. Official publication of the Air Transport Association of America.

Air Traveler's Destination Directory, June 1958. American Aviation publication.

American Automobile Association. Profile of the American Tourist. 1960.

______________. The Travel Habits of the A.A.A. Members. 1960.

Barnes, Leslie O. The Future of Air Service At Intermediate Cities. Talk given at a meeting of the Johnstown Chamber of Commerce and other aviation interests. Johnstown, Pennsylvania, 1953.

______________. What Aviation Means to Our Cities. Given at the annual meeting of the League of Cities of the Third Class in Pennsylvania. Pennsylvania, 1953.

Burnard, E. Thomas. "The Airport Operator in the Jet Age." In Proceedings, American Society of Civil Engineers, No. 2133, July 1959.

Cherington, Paul W. The Status and Economic Significance of the Airline Equipment Investment Program. A report prepared for E. R. Quesada, Pres. Eisenhower's Special Assistant for Aviation. June 30, 1958.

Civil Aeronautics Administration. Airline Airports. Washington D.C.: Government Printing Office, 1958.

______________. Airport Accounting, Budgeting and Insurance. Washington, D.C.: U.S. Government Printing Office, 1949.

______________. National Airport Plan for 1958. Washington, D.C.: U.S. Government Printing Office, 1958.

______________. A Program of Charges for the Use of the Federal Airways System. Washington, D.C.: Government Printing Office, 1953.

______________. City to Airport Highways. Washington, D.C.: U.S. Government Printing Office, 1953.

______________. International Air Commerce Traffic Pattern: U.S. Flag Carriers, 1957. Washington, D.C.: U.S. Government Printing Office, 1958.

_______________. Jet Age Planning. A progress report as of January, 1958. Washington, D.C.: U.S. Government Printing Office, 1958.

_______________. Upstairs Neighbors. Washington, D.C.: U.S. Government Printing Office, 1957.

_______________. U.S. Active Civil Aircraft by State and County. Washington, D.C.: U.S. Government Printing Office, 1960.

_______________. Office of Air Traffic Control. Terminal Locations for Planning Purposes. Washington, D.C.: U.S. Government Printing Office, 1957.

_______________. Planning and Development Office. Federal Airways Air Traffic Activity. Washington, D.C.: U.S. Department of Commerce, 1958.

Civil Aeronautics Board. Aeronautical Statutes and Related Material. Revised, 1957. Washington, D.C.: U.S. Government Printing Office, 1957.

_______________. Great Lakes Local Service Investigation: Initial Decision of Barron Fredricks, Hearing Examiner. Docket 4251 before the CAB, September 1959.

_______________. Jet Age Planning. A Report of progress and developments as of July 1957. Washington D.C., U.S. Government Printing Office, 1957.

_______________. Office of Carrier Accounts and Statistics. Monthly Report of Air Carrier Traffic Statistics. May 1958.

_______________. Quarterly Report of Air Carrier Financial Statistics. March 1958.

Copeland, Lewis C. Travelers and Arkansas Business, 1948 to 1956.

Cresap, McCormick, and Paget. Survey of Travel Agency Business. New York: American Society of Travel Agents, Inc., 1955.

Curtis Publishing Company. Research Department. The Travel Market of the United States. Fourth National Survey, April 1952-March 1953.

_______________. Vacation and Travel Survey - The Dynamics of Travel. Philadelphia: Independence Square, 1956.

Detroit Metropolitan Aviation Authority. Airports for the Detroit Region. September 1948.

Federal Aviation Agency. FAA Air Traffic Authority. Calendar Year 1958 (Fiscal 1959).

______________. General Aviation Aircraft Use - 1957. September 1959.

______________. Small Airports. Washington, D.C.: Government Printing Office, 1959.

______________. Some ABC's of Air Traffic Management. April 1959.

______________. FAA Statistical Handbook of Aviation, 1960.

______________. Statistical Study of U.S. Civil Aircraft as of January 1960.

______________. U.S. Active Civil Aircraft by State and County as of January 1960.

______________. Bureau of Facilities and Materiel. Airports Division. Air Commerce Traffic Pattern - Revised. April 1960.

______________. Model Airport Zoning Ordinance. July 1960.

______________. National Airport Plan - 1959. Washington, D.C.: U.S. Government Printing Office, 1959.

______________. Runway Strength and Dimensional Standards for Air Carrier Operations. (10-3-58) TSO-N6b.

______________. Segmented Circle Airport Marker System. Amendment No. 1, May 15, 1959. TSO-N5a.

General Aviation Facilities Planning Group. General Aviation Facilities Requirements Survey. Dallas, Texas: Flight Magazine, 1957.

Geuting, Joseph T., Jr. Airports and Community Air Accessibility. Remarks at the Michigan Aviation Legislative Dinner, sponsored by Aero Club of Michigan. Lansing, April 10, 1957.

Haber, William, Eugene C. McKean, and Harold C. Taylor. The Michigan Economy: Its Potentials and Its Problems. Kalamazoo: W.E. Upjohn Institute for Employment Research, 1960.

Kalamazoo. Chamber of Commerce. Air Service Committee. Exhibits in support of the Great Lakes Service Case for the City of Kalamazoo, Michigan. 1957.

Landrum and Brown. Air Transportation Requirements of Southeastern Michigan Metropolitan Area, 1960-75.

Lansing, John B. and Jung-Chao Liu. An Analysis of Interurban Air Travel. Research Seminar in Quantitative Economics, University of Michigan.

Leigh Fisher and Associates. Michigan Department of Aeronautics: Air Trade Forecasts, Recommended Lease Policy and Rates and Charges for the Airfield and Building Areas of Capital City Airport, October 1958.

Massachusetts. Legislative Research Council. Regional Airports and Aerial Approaches. Boston: Wright and Potter Printing Company, 1958.

McCall Corporation. Trends in Domestic Travel and Vacations. New York: McCall Corporation, 1955.

McIntosh, Robert W. Measuring the 1957 Tourist and Resort Business in Michigan's Upper Peninsula. Business Topics, Vol. 6, No. 1, July 1958. East Lansing: Michigan State University, 1958.

Michigan Airports, Michigan Board of Aeronautics. February 1944.

Michigan Department of Aeronautics. Great Lakes Local Service Investigation: Brief for Michigan Department of Aeronautics Submitted to Barron Fredricks, Esq., Examiner. Before the Civil Aeronautics Board.

______________. Michigan Airport Directory. 1960 Revision.

______________. Michigan Airports, Airfields, and Landing Areas. 1960.

Michigan. Department of Economic Development. Economic Data Sheets.

______________. Industrial Survey Bulletin Series.

______________. Michigan Industrial Facts.

______________. Industrial Development Fact Sheet Series.

Michigan Municipal League. Administration and Financing of Municipally Owned Airports in Michigan. Information Bulletin No. 63. Ann Arbor: League Headquarters, 1950.

Michigan State University. Bureau of Business and Economic Research. Hotels and Motels from the Guests' Viewpoint. East Lansing, Michigan State University, 1956.

______________. Michigan Park Users Survey, 1956. By Thomas L. Dahle.

______________. Michigan Tourist Survey, 1957. By Eli P. Cox.

Midland, Bay City, and Saginaw Chambers of Commerce. Great Lakes Local Service Investigation: Exhibits of the Midland, Bay City and Saginaw Chambers of Commerce. Proceedings before the Civil Aeronautics Board, 1957.

National Business Aircraft Association. Business Flying. Special Report SR #59-31, December 1, 1959.

Neil, Herbert E., Jr. and John B. Lansing. An Analysis of Non-Business Rail Travel. Research Seminar in Quantitative Economics, University of Michigan.

Ohio Aviation Board. Ohio Aviation Laws.

Pennsylvania. Aeronautics Commission. Brief of the Pennsylvania Aeronautics Commission before Examiner John A. Cannon, in the matter of the proceeding known as the Northeastern States Area Investigation, Docket 6436. Before the Civil Aeronautics Board, April 1958.

Redding, Robert E. Community Planning for Air Transportation. Washington, D.C.: National Association of State Aviation Officials, 1960.

Smith, Hinchman & Grylls, Inc. and Leigh Fisher and Associates. Proposed Northeast Airport. A report to the Detroit Aviation Commission.

Simmons, Harry B. and Robert Horonjeff. Financial Aspects of California Airports Served By Scheduled Air Carriers. Berkeley: University of California Press, 1951.

Taaffe, Edward J. The Air Passenger Hinterland of Chicago. Dissertation submitted to the Dept. of Geography for the Degree of Ph.D. Illinois: University of Chicago, 1952.

United Research, Inc. Economic and Air Trade Study and Master Plan Report for Reynolds Municipal Airport. July 1959.

U.S. Department of Agriculture. Number of Recreational Visits to National Forests. Washington, D.C.: U.S. Government Printing Office, Annual.

_______________. Research In Forest Recreation. By S. T. Dana. Washington, D.C.: U.S. Government Printing Office, 1957.

U.S. Bureau of Census. Hotels, Motels, and Tourist Courts, 1957. Washington, D.C.: U.S. Government Printing Office, 1959.

_______________. Travel Survey - 1957. Washington, D.C.: U.S. Government Printing Office, 1958.

U.S. Department of Commerce. Office of Area Development. Your Community Can Profit From the Tourist Business. Washington, D.C.: U.S. Government Printing Office, 1957.

U.S. Department of Interior. National Park Service. Prospectus for a National Survey of Outdoor Recreation Resources. Washington, D.C.: U.S. Government Printing Office, 1957.

_______________. Public Use, National Parks and Related Areas. Washington, D.C.: U.S. Government Printing Office, monthly.

_______________. Division of Recreation Resource Planning. State Park Statistics, 1954-1959. Published annually. Washington, D.C.: U.S. Government Printing Office.

_______________. Summary of Visitors By Modes of Transportation to areas administered by the National Park Service. Washington, D.C.: U.S. Government Printing Office, 1951.

U.S. Bureau of Public Roads. Division of Highway Transportation. Tourist Studies Participated in by the Bureau of Public Roads. Washington, D.C.: U.S.Government Printing Office, 1957.

University of Michigan. A Cross-Section Analysis of Non-Business Air Travel. By John B. Lansing. Ann Arbor: University of Michigan, 1955.

_______________. The Place of Air Travel in the Travel Market, 1955. By John B. Lansing. Ann Arbor: University of Michigan, 1956.

_______________. Survey Research Center. The Travel Market, 1955. By John B. Lansing and Ernest Lilienstein. Ann Arbor: University of Michigan, 1957.

________________. The Travel Market, 1956. Ann Arbor: University Of Michigan, 1957.

________________. The Travel Market, 1957. Ann Arbor: University of Michigan, 1958.

________________. The Travel Market, 1958. By John B. Lansing. Sponsored by Boeing Airplane Company and TIME Magazine. Ann Arbor: University of Michigan, 1958.

University of Wisconsin. The Wisconsin Tourist. A study of the Resort and Recreation Business of Wisconsin, 1949. By Victor H. Lanning. Wisconsin Commerce Studies, Vol. I, No. 3 (1950).

Virginia. State Corporation Commission. Division of Aeronautics. Aviation in Virginia. Richmond, Virginia.

Wisconsin. State Aeronautics Commission. A Decade of Progress in Aviation in Wisconsin, 1946-1956. Progress report published and submitted to Walter J. Kohler, Governor, 1956.

________________. Airport Benefits Survey Report. July 1959.

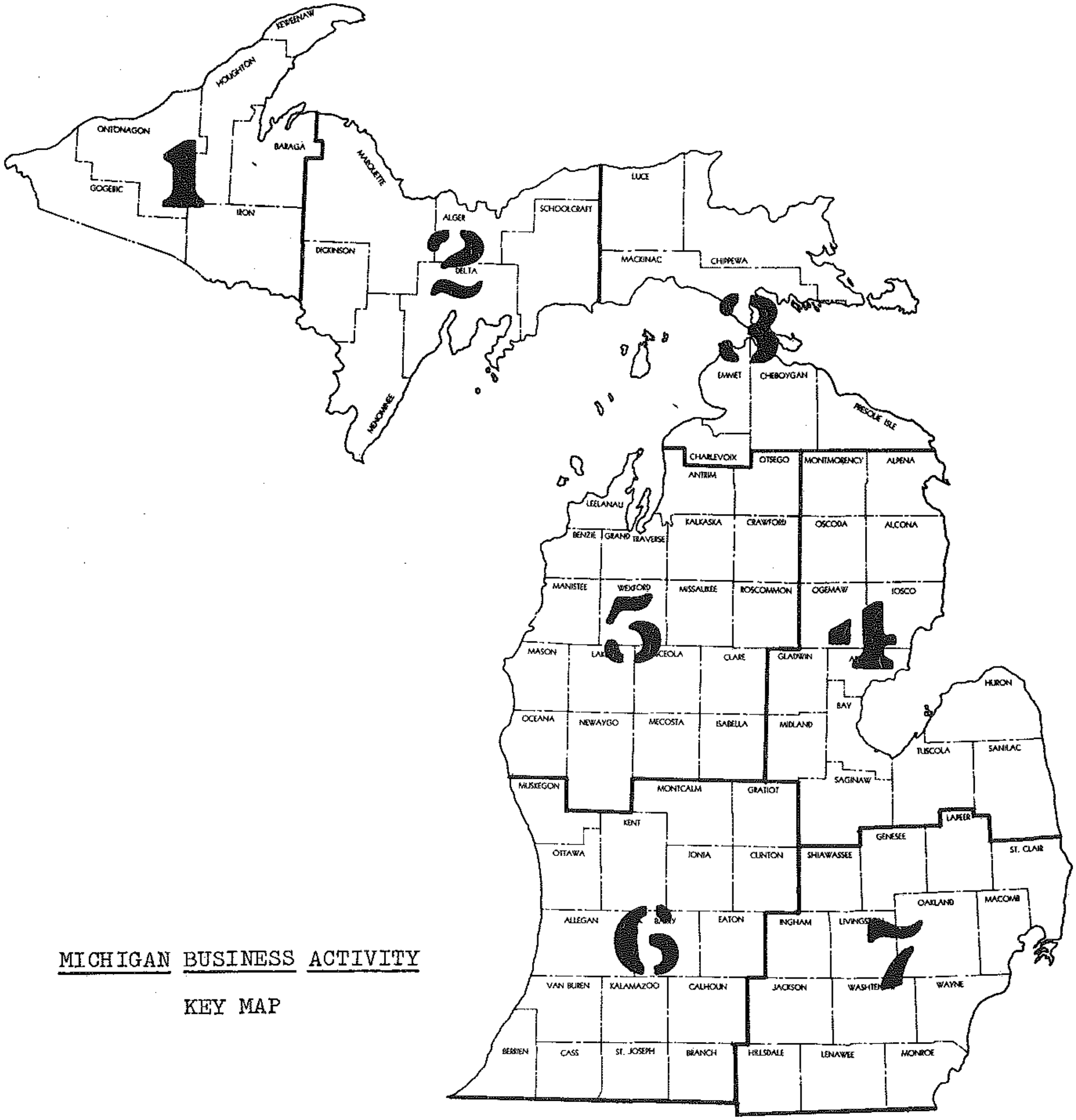
________________. Air Traffic in Northern Wisconsin, June-July 1956. Submitted to the Civil Aeronautics Administration, 1957.

APPENDIX - PART IV

Included in this appendix to Part IV are a table summarizing basic statistical data, county-by-county, from which the aviation area tables of the main body of the report were prepared, and a series of charts delineating the changes in the significant county statistics reported in the U.S. Census of Manufactures.

This data was compiled by Dr. C. L. Jamison, Professor-Emeritus of Business Policy of the School of Business Administration of the University, who was assigned as economic consultant to the project. Data from the 1957 Census of Manufactures had not yet been released at the time of preparation of this report, and thus did not permit even a close approach to up-dating official statistics. Without such up-dating, it was finally concluded that this information offered no direct planning help now, but that it could well serve, along with the results of economic development research, to provide a basis for long-range trend analysis in the aviation areas.

Accordingly, it has been retained on a county basis and is included in the Appendix for future reference. For convenience in later trend development, all data has been deflated to a 1939 constant dollar using U.S. Department of Commerce index factors.



MICHIGAN BUSINESS ACTIVITY

KEY MAP

Figure 1

B U S I N E S S   A C T I V I T Y

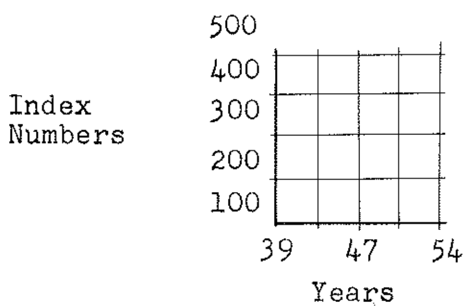
KEY

Value added by manufacture

Retail sales

Wholesale sales

Number of employees in manufacturing plants employing 10 or more-1958 Each square represents 5000 employees.



Sample of the grid system, showing horizontal and vertical scales.

<u>NOTE</u>: All values are deflated to 1939 dollars.

Figure 2

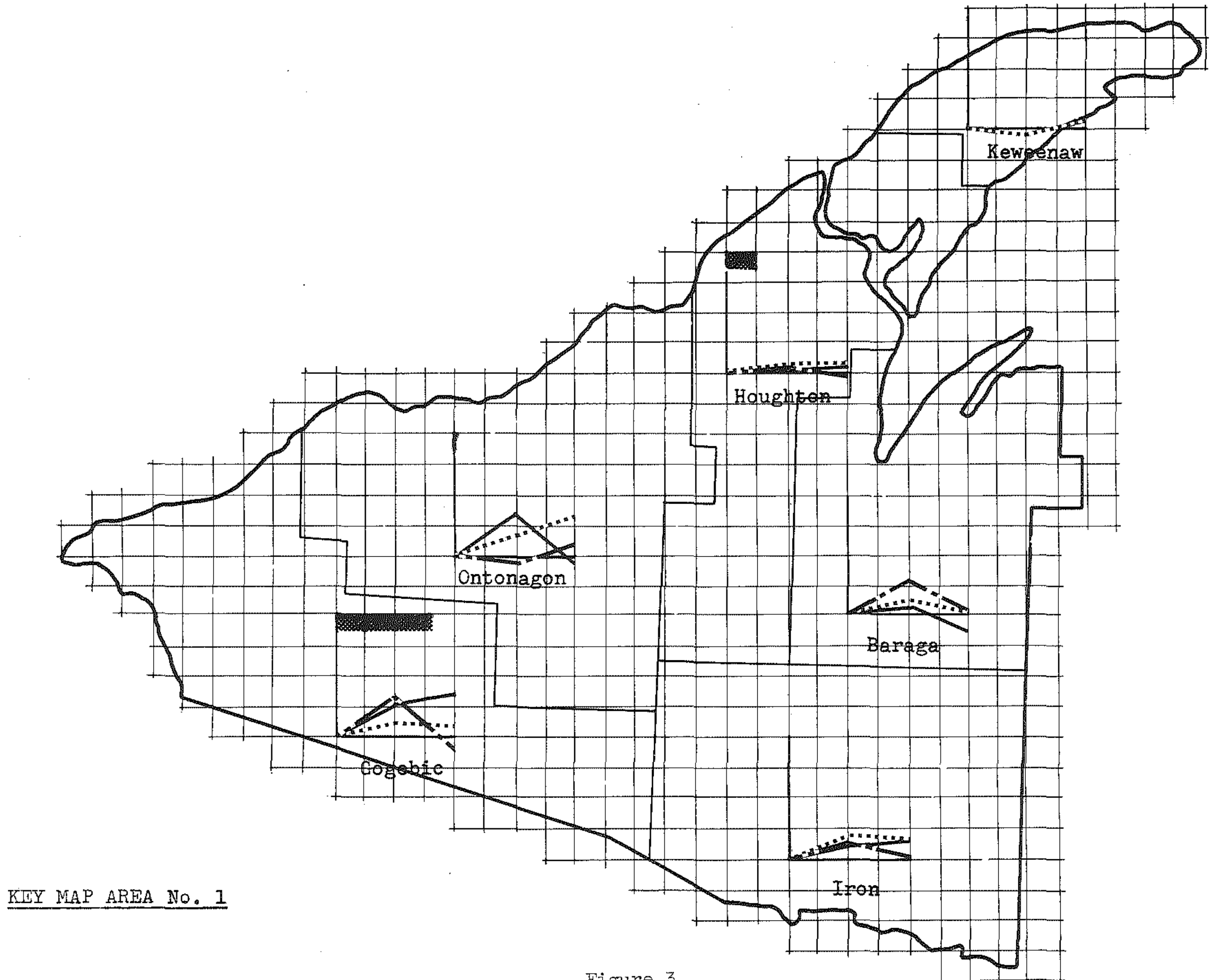
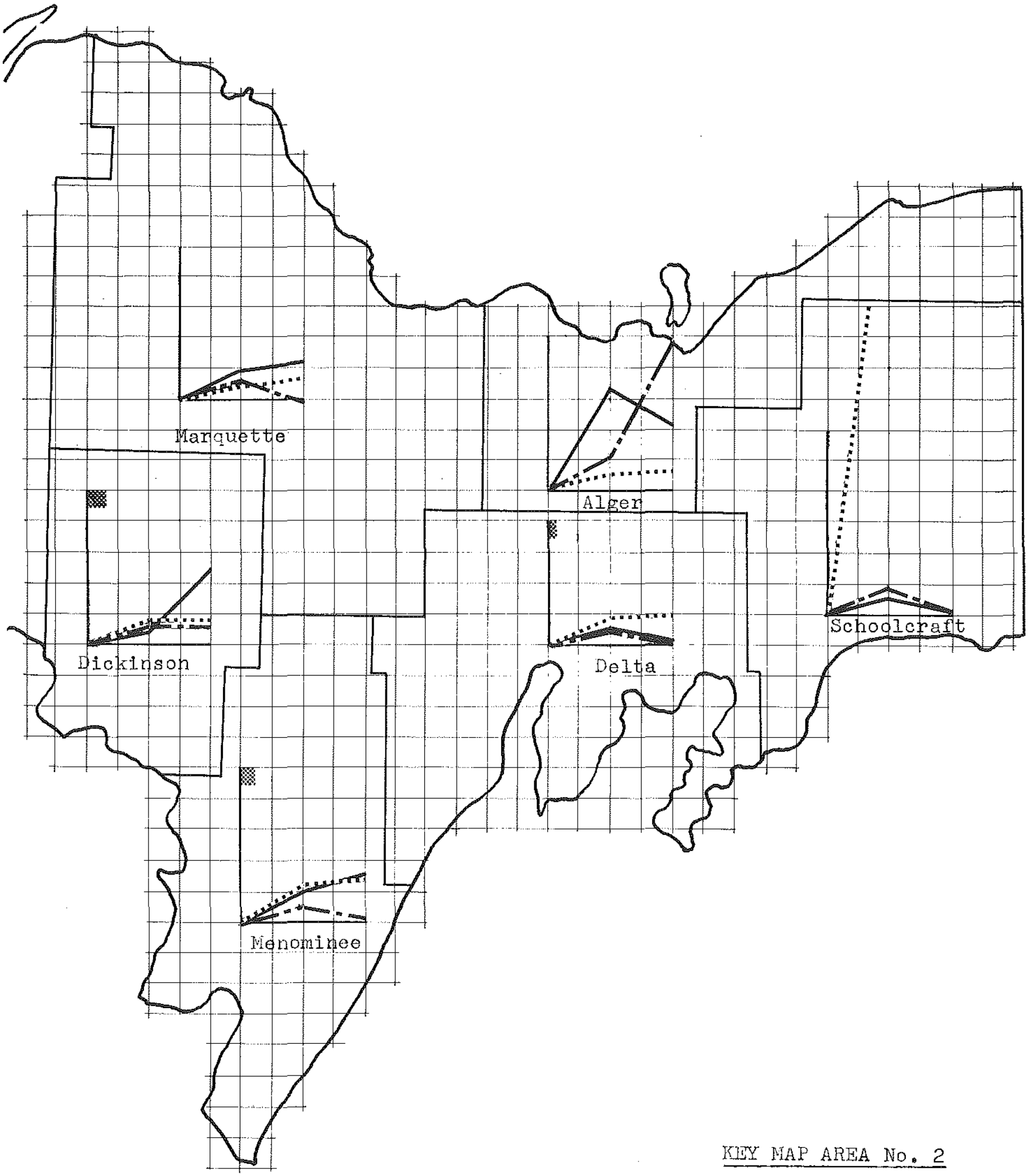

Keweenaw
Houghton
Ontonagon
Baraga
Gogebic
Iron
KEY MAP AREA No. 1

Figure 3



Marquette
Alger
Dickinson
Delta
Schoolcraft
Menominee
KEY MAP AREA No. 2

Figure 4

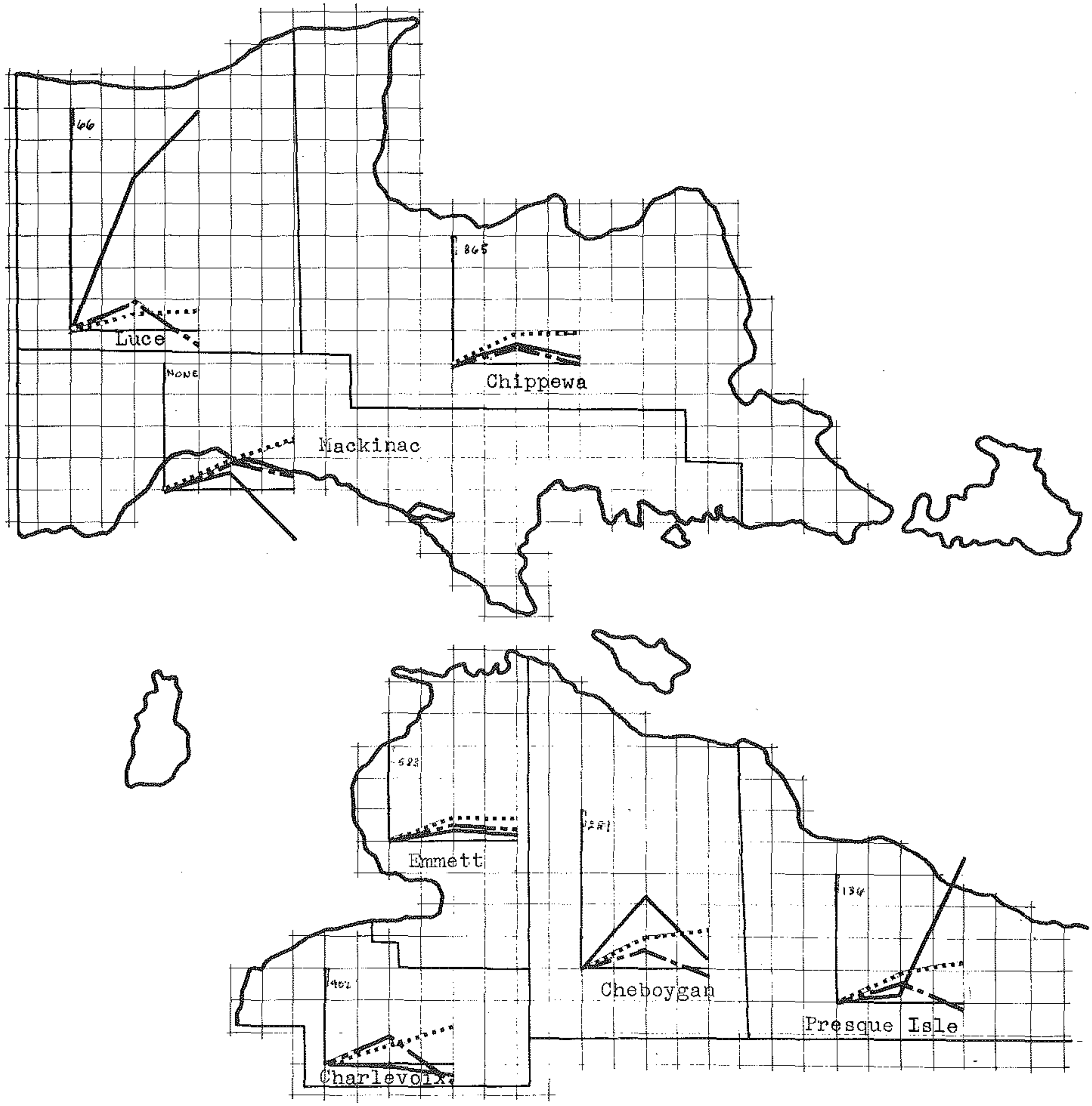

66
Luce
865
Chippewa
NONE
Mackinac
583
Emmett
Cheboygan
134
Presque Isle
Charlevoix

Figure 5

KEY MAP AREA No. 4

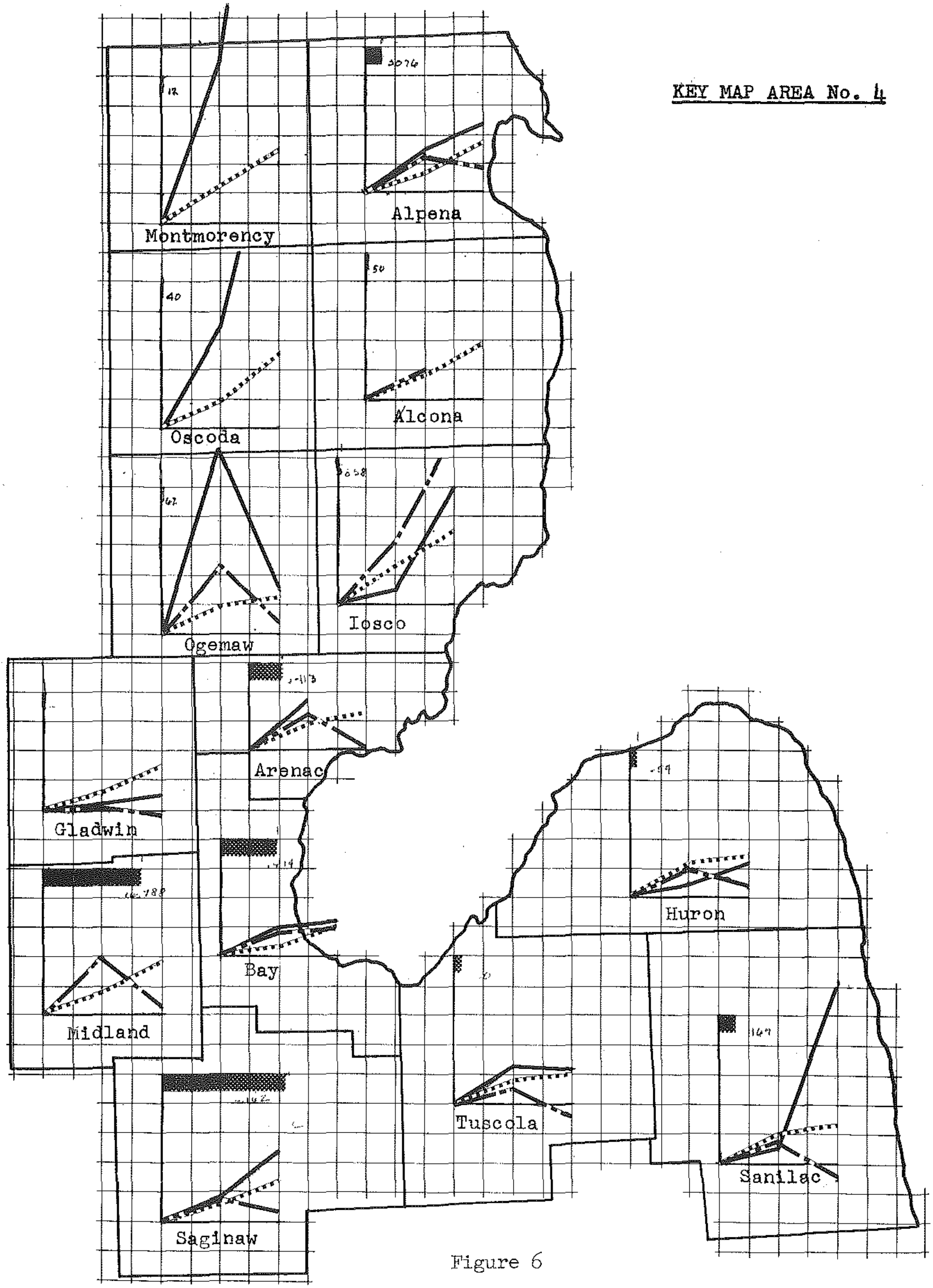
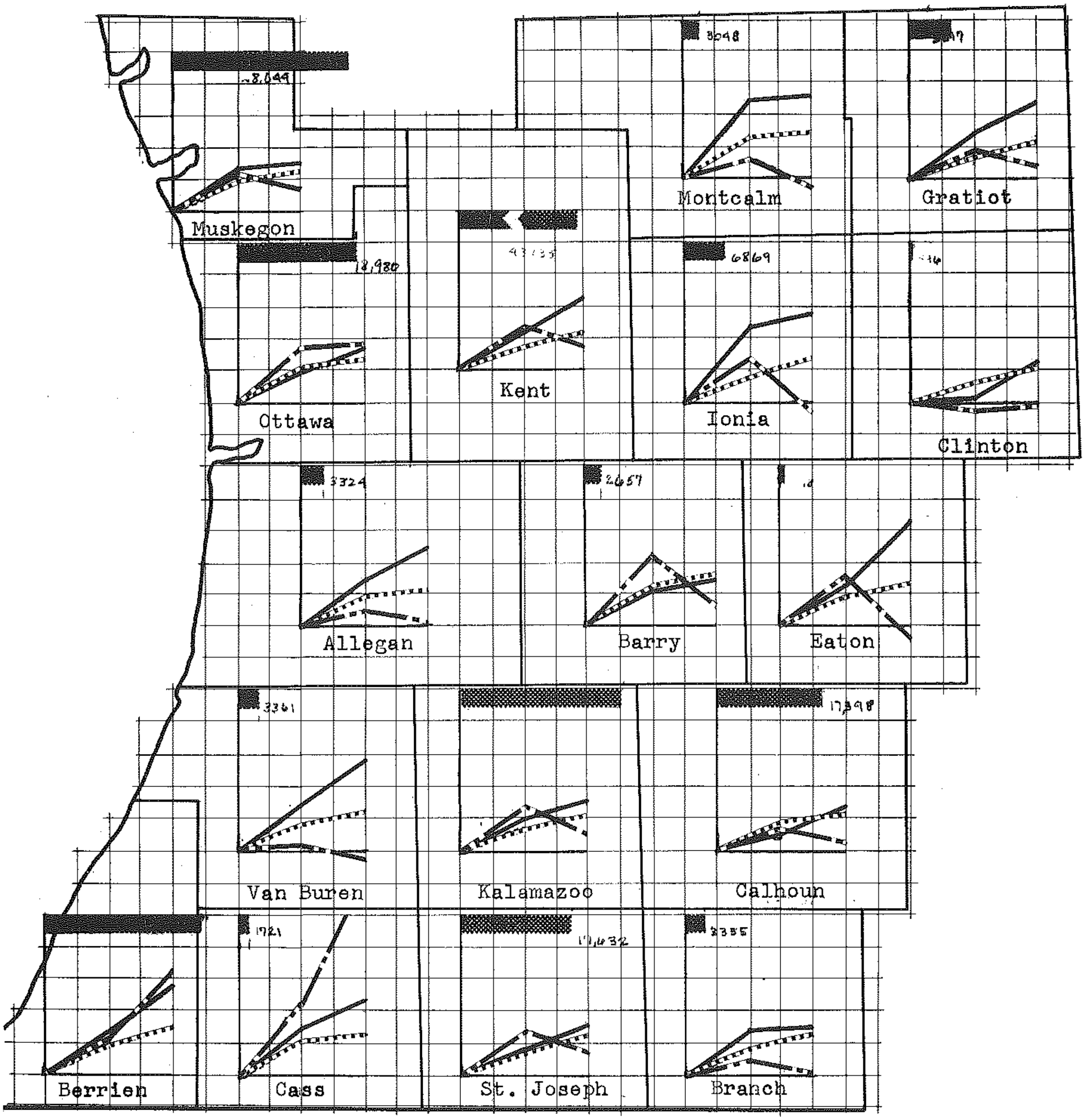


Figure 6

KEY MAP AREA No. 5

Figure 7



KEY MAP AREA No. 6

Figure 8

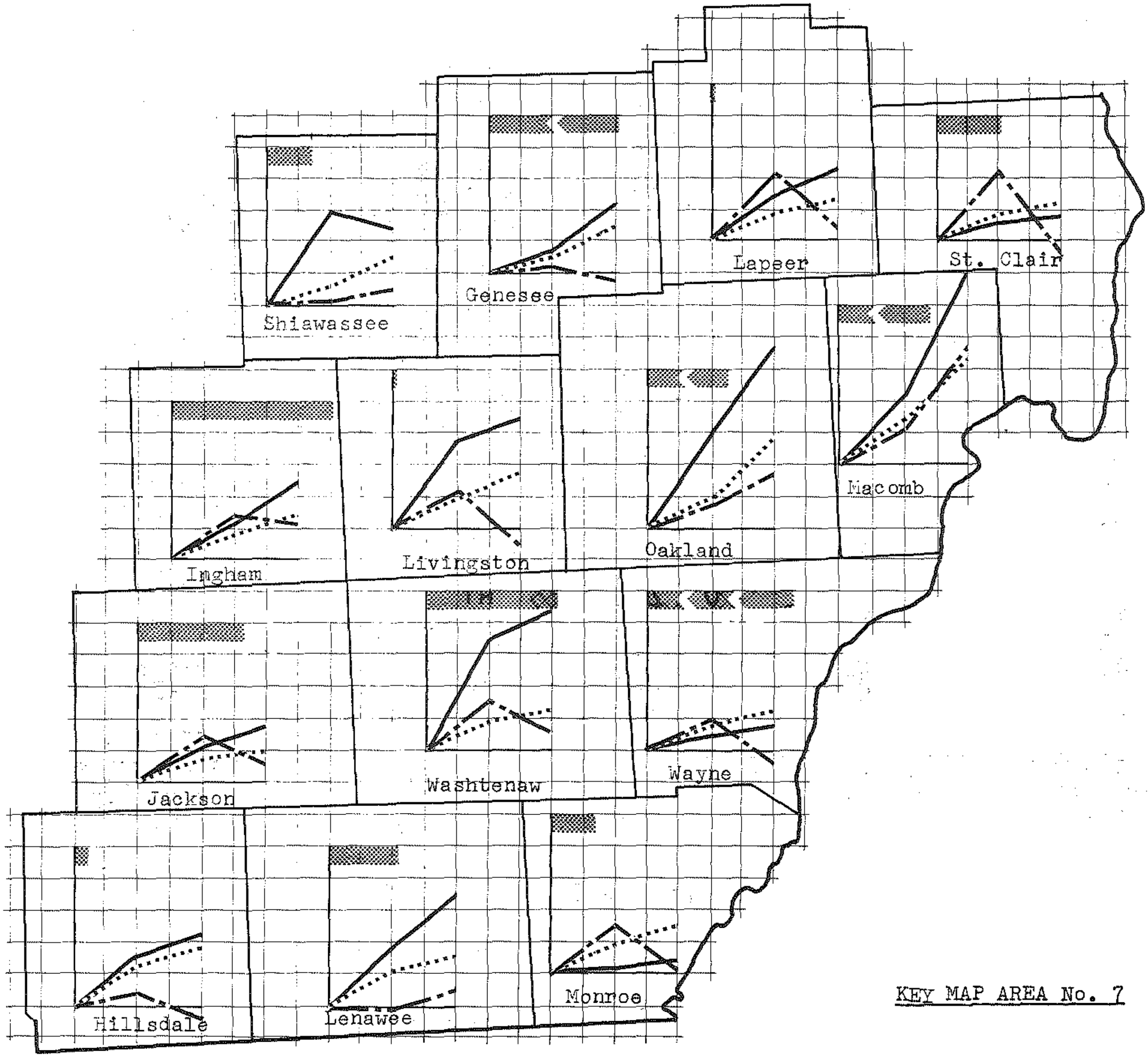

Shiawassee
Genesee
Lapeer
St. Clair
Ingham
Livingston
Oakland
Macomb
Jackson
Washtenaw
Wayne
Hillsdale
Lenawee
Monroe
KEY MAP AREA No. 7

Figure 9

APPENDIX - PART IV

Table 1

MICHIGAN COUNTY DATA - 1960

	County	(1) Population (1960 Census)	(2) Retail Sales 1958	(3) Land Area Sq. Mi.	(4) Registered Aircraft (FAA)	(5) Registered Aircraft (MDA)
1	Alcona	6,352	$ 5,411,000	677	2	3
2	Alger	9,250	8,863,050	913	5	2
3	Allegan	57,729	46,765,000	829	24	32
4	Alpena	28,556	35,214,000	568	11	15
5	Antrim	10,373	9,083,000	472	2	1
6	Arenac	9,860	11,557,000	368	2	3
7	Barraga	7,151	6,286,683	904	3	2
8	Barry	31,738	22,950,000	549	10	16
9	Bay	107,042	137,771,000	446	23	31
10	Benzie	7,834	8,579,000	316	5	1
11	Berrien	149,865	184,818,023	580	64	66
12	Branch	34,903	34,052,875	506	25	26
13	Calhoun	138,858	181,472,753	709	44	67
14	Cass	36,932	28,071,927	488	18	16
15	Charlevoix	13,421	15,750,000	414	14	18
16	Cheboygan	14,550	19,892,000	725	6	4
17	Chippewa	32,655	37,741,373	1580	14	12
18	Clare	11,647	15,245,000	572	11	12
19	Clinton	37,969	24,897,000	571	6	100 (?)
20	Crawford	4,971	6,805,000	563	0	0
21	Delta	34,298	41,732,221	1180	10	10
22	Dickinson	23,917	29,246,458	757	10	10
23	Eaton	49,684	40,760,000	570	16	14
24	Emmet	15,904	25,779,000	461	7	8
25	Genesee	374,313	480,940,000	644	131	137

Table 1, continued

County	(1) Population (1960 Census)	(2) Retail Sales 1958	(3) Land Area Sq. Mi.	(4) Registered Aircraft (FAA)	(5) Registered Aircraft (MDA)
26 Gladwin	10,769	12,628,000	503	14	9
27 Gogebic	24,370	27,712,121	1112	4	7
28 Grand Traverse	33,490	55,358,000	464	7	10
29 Gratiot	37,012	45,080,000	566	26	25
30 Hillsdale	34,742	29,912,000	601	12	15
31 Houghton	35,654	37,341,913	1030	8	6
32 Huron	34,006	38,211,000	822	16	19
33 Ingham	211,296	313,533,000	559	143	35
34 Ionia	43,132	39,693,000	575	10	13
35 Iosco	16,505	20,697,000	547	4	5
36 Iron	17,184	19,163,464	1197	3	3
37 Isabella	35,348	33,336,000	572	22	22
38 Jackson	131,994	164,344,000	705	70	73
39 Kalamazoo	169,712	226,501,000	567	93	84
40 Kalkaska	4,382	3,931,000	564	1	4
41 Kent	363,187	504,443,000	862	104	95
42 Keweenaw	2,417	1,949,927	544	1	0
43 Lake	5,338	4,209,000	572	1	0
44 Lapeer	41,926	35,775,610	659	28	33
45 Leelanau	9,321	6,650,000	349	4	7
46 Lenawee	77,789	80,762,000	754	56	58
47 Livingston	38,233	35,485,000	571	26	27
48 Luce	7,827	7,940,416	914	0	2
49 Mackinac	10,853	15,068,118	1014	7	11
50 Macomb	405,804	381,852,810	481	118	196
51 Manistee	19,042	21,392,000	558	13	14
52 Marquette	56,154	56,153,732	1841	13	14
53 Mason	21,929	25,197,000	493	8	10

Table 1, continued

County		(1) Population (1960 Census)	(2) Retail Sales 1958	(3) Land Area Sq. Mi.	(4) Registered Aircraft (FAA)	(5) Registered Aircraft (MDA)
54	Mecosta	21,051	18,953,000	563	14	15
55	Menominee	24,685	17,604,996	1032	3	2
56	Midland	51,450	52,665,000	520	23	20
57	Missaukee	6,784	4,780,000	565	2	3
58	Monroe	101,120	86,631,000	562	25	60
59	Montcalm	35,795	39,102,000	712	21	18
60	Montmorency	4,424	5,301,000	555	7	4
61	Muskegon	149,943	180,620,000	504	50	52
62	Newaygo	24,160	21,182,000	857	8	16
63	Oakland	690,259	847,587,965	877	300	380
64	Oceana	16,547	14,466,000	536	2	5
65	Ogemaw	9,680	11,229,000	564	5	6
66	Ontonagon	10,584	9,785,116	1321	5	2
67	Osceola	13,595	12,399,000	581	19	19
68	Oscoda	3,447	3,699,000	565	1	0
69	Otsego	7,545	12,344,000	530	8	9
70	Ottawa	98,719	100,810,000	564	35	38
71	Presque Isle	13,117	12,557,000	654	2	4
72	Roscommon	7,200	13,206,000	521	4	5
73	Saginaw	190,752	234,941,000	812	29	36
74	St. Clair	107,201	123,854,000	786	62	67
75	St. Joseph	42,332	49,670,661	508	21	19
76	Sanilac	32,314	39,116,671	961	33	30
77	Schoolcraft	8,953	1,508,253	1199	3	4
78	Shiawassee	53,446	57,439,000	540	22	27
79	Tuscola	43,305	39,726,000	816	21	22
80	Van Buren	48,395	47,893,855	607	36	40

Table 1, continued

County		(1) Population (1960 Census)	(2) Retail Sales 1958	(3) Land Area Sq. Mi.	(5) Registered Aircraft (FAA)	(6) Registered Aircraft (MDA)
81	Washtenaw	172,440	$ 202,243,000	716	93	105
82	Wayne	2,666,297	3,897,820,458	607	594	561
83	Wexford	18,466	23,850,000	563	7	6
	MICHIGAN	7,823,194	$9,887,298,631	57,022	2728	*2978

Sources:

(1) U.S. Bureau of the Census - Decennial Census of Population, 1960

(2) Research Division, Michigan Economic Development Department, from records of Michigan Department of Revenue.

(3) U.S. Bureau of the Census - Geographic Report Series

(4) Federal Aviation Agency - Civil Aircraft by State and County, 1960

(5) Michigan Department of Aeronautics - Annual Report, 1958-59. *(2978 including 10 out-of-state registrations.

Note: The lack of agreement between State and FAA Aircraft Registrations is explained by "differences in definition and time periods" but does not account for the apparently large difference in Clinton County. Because the FAA figures represent "active" aircraft, not just registration, they have been used in planning tabulations.