

In presenting this dissertation as a partial fulfillment of the requirements for an advanced degree from the Georgia Institute of Technology, I agree that the library of the Institution shall make it available for inspection and circulation in accordance with its regulations governing materials of this type.

I agree that permission to copy from, or to publish from this dissertation may be granted by the professor under whose direction it was written, or, in his absence, by the Dean of the Graduate Division when such copying or publication is solely for scholarly purposes and does not involve potential financial gain.

It is understood that any copying from, or publication of this dissertation which involves potential financial gain will not be allowed without written permission.

/ //

VERTICAL-TAKE-OFF AIRCRAFT
AND
LONG-RANGE URBAN PLANNING CONSIDERATIONS

A THESIS

Presented to
the Faculty of the Graduate Division
by
Walter R. Hunziker

In Partial Fulfillment
of the Requirements for the Degree
Master of City Planning

Georgia Institute of Technology

May, 1958

112
127

VERTICAL-TAKE-OFF AIRCRAFT
AND
LONG-RANGE URBAN PLANNING CONSIDERATIONS

Approved _____

[Handwritten signature and scribbles]

Date approved by Chairman: May 29, 1958.

ACKNOWLEDGMENTS

The author gratefully extends thanks for the assistance he has received from his thesis advisors: Howard K. Menhinick, Regents' Professor of City Planning; Malcolm G. Little, Jr., Assistant Professor of City Planning; and Donald W. Dutton, Professor of Aeronautical Engineering.

Gratitude is extended to all other teachers at the Georgia Institute of Technology who contributed indirectly to the writing of this thesis.

The author also wishes to thank the representatives of the aircraft industry and the various planning agencies for their interest and assistance in securing valuable reference material.

Finally, the author thanks his wife for her continuous help and encouragement throughout the writing of this thesis.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	ii
LIST OF ILLUSTRATIONS	v
ABSTRACT	vi
 Chapter	
I. INTRODUCTION	1
II. NEW TRENDS IN AIRCRAFT DEVELOPMENT	4
<div style="margin-left: 40px;"> The Helicopter Predicted New VTO Aircraft Forecast of VTO Aviation </div>	
III. HISTORIC PREVIEW OF URBAN TRANSPORTATION	18
<div style="margin-left: 40px;"> The Era before the Advent of Inanimate Energy The Invention of the Steam Engine and Advent of the Railroad Urban Transit The Private Automobile Findings </div>	
IV. PLANNING CONSIDERATIONS	30
<div style="margin-left: 40px;"> Traffic Ways Comprehensive Transportation Efforts Federal Airways and VTO Operation Transition from Air to Surface Transportation Land-Use Considerations The Influence of VTO Access on Land-Use Policies The Need for Total Land-Use Planning Changes in Land-Use Planning Methods of Implementing Land-Use Policies </div>	

Page

Economic Considerations	
Mass Production of VTOs	
Consumption or Conservation	
Economic Effects of Increased Transportation	
Efficiency	
Economic Expansion	
Social Problems	
New Urban Growth Pattern	
Social Behavior	
Transition Problems	
Government	
Changing Needs in Urban Government	
National Transportation Policy	
Air Transportation Policy	
V. SUMMARY AND CONCLUSIONS	54
BIBLIOGRAPHY	57

ILLUSTRATIONS

Figure		Page
	New Trends in VTO Design	14
1	Tailsitter	
2	Tiltwing	
3	Tilt Propeller	
4	Deflected Slip Stream	
5	Ducted Fan	
6	Ducted Fan Type Private VTO	
7	Convertiplane	
	Historic Review of Urban Growth	22
8	Growth of Railroad Commuter Towns	
9	Growth along Mass Transit Routes	
10	The Private Automobile - Urban Sprawl	
11	Freeways - Starshaped Urban Region	
12	Urban Development with VTOs	

ABSTRACT

The purpose of this study is to explore the future of urban life as it will be affected and shaped by the use of VTO (vertical-take-off) aircraft.

Present trends in the development of VTOs were described, based on information received from major helicopter and VTO industries, helicopter operators and from associations and government agencies interested in the development of VTOs.

The predicted private and commercial versions of VTOs will expand urban mobility to such an extent that the influence of the automobile may be dwarfed. VTOs will introduce a new form of common access to land by air and their increased travel speeds will bring most of the earth's habitable parts under urban influences.

Urban transportation history was searched for past innovations which could be compared with the predicted VTO development. This research revealed that progress in a vehicle's performance is not equivalent with progress in transportation as a whole.

Urban transportation reflects the complexity and interdependency of modern city life and shows the need for comprehensive planning if VTO transportation is to become an asset to the urban community.

The following phase of the study includes the effect of VTOs on trafficways, land-use, the economy, social conditions and government organization. Although this topic may seem a premature subject for studies, considering the status of the VTO development, the planning considerations show the need for immediate recognition of the VTO potential in long-range urban plans.

Finally the study recommends the re-establishment of a National Resources Planning Agency which would plan for future growth and also provide the much needed coordination within our present government structure. VTOs point up the need for an increase of efficiency in the total national transportation effort and the establishment of a federal agency for urban affairs to assist and guide urban development in now rural areas, which are not equipped to handle the new urban problems.

CHAPTER I

INTRODUCTION

Under the title, "America, an Experiment in Transportation," Erich W. Zimmermann (1) discusses the handicap of excessive space which faces the United States and how it is being neutralized with every improvement, invention and discovery which makes transportation and communication more efficient.

The United States is now on the verge of such an innovation which will affect both the national economy and the urban scene. The new transportation medium is the vertical-take-off-and-landing aircraft, in brief VTO. VTOs are a family of many configurations, of which the helicopter is the most commonly known. These aircraft, which will be described in more detail later, have a flight regime which permits them to take off and land vertically, to hover and to fly at very high speeds, depending on jet or propeller propulsion.

VTO air transportation will reach into and out of the city center and the new three dimensional freedom in urban movement will expand the sphere of influence around our cities from the present 20- to 100-mile radius to one of 100 to a 1000 miles, i. e. there will no longer be individual spheres of influence for each city. Regional urban systems

of transportation will tie together existing cities both socially and economically. The New York - Philadelphia - Baltimore region already shows such an inter-dependent regional character as a result of the use of automobiles.

This change will not come about at once. The transition from the horsedrawn bus to the automobile was not accomplished overnight. We can therefore not relax and wait until the final ideal aircraft is produced but we will have to live through successive developmental stages. Until now most developments in urban growth have been the result of laissez faire, the belief that all problems find their own solution. This philosophy may have worked in pre-industrial days when cities grew slowly and with the benefit of much past experience. But today new dynamic developments call for advance planning in all phases of our complex society.

Advance planning is based on forecasts of future development and should have as wide a base as possible. The expected development of VTO transportation in urban areas cannot be predicted from projections of existing VTO operations because of their special and experimental nature. However, the potential force of VTOs can be analyzed and transplanted into the future, based on an understanding of past developments in transportation. The resulting forecast helps the planner to detect and safeguard the long-range interests of the people.

Advance planning can help cities that are contemplating helicopter or VTO service to avoid repeating past mistakes which occurred when .

they gave a franchise to some transit operator without any knowledge of the future of that operation.

It is hoped that this study will throw light on the expected development of VTO transportation and that the planning considerations set forth may contribute to the going discussions on the subject, encourage new thinking and finally demonstrate the need for advance planning at the beginning of the coming urban air age.

CHAPTER II

NEW TRENDS IN AIRCRAFT DEVELOPMENT

"The trends of aircraft development are not dictated by civilian requirements but are solely dependent on military procurement." (2)

This quotation from the president of one of the larger helicopter and VTO companies underlines the present economic status of the United States aircraft industry with its absence of a commercial mass market. The aircraft industry has grown up under military contracts and has become one of the biggest industries in the country. How does its future look?

If the potential of air transportation were restricted to bigger and faster airplanes, then commercial mass production could never be established, considering the fact that fewer, faster and larger planes can carry more people. But long-distance flights are only a small segment of the total future air transportation field. There is a real mass-market potential in the short-haul and intermediate-length runs. While the long-distance flights have an important time-saving advantage over any other form of transportation, the below-200-mile-range flights have a smaller time-saving ratio, due to the relatively time-consuming shuttle to the airport. They compete with private cars which offer more

comfort, privacy, choice of itinerary, more luggage space and freedom from time schedules. This mass-transportation market is based on the activity sphere of a man's daily work. Man likes to go home at night. Any improvement in transportation that will increase the productivity of man's daily effort will find a mass market.

VTO aircraft that can land vertically on small lots will be able to expand air transportation in many ways. They will provide service into the center of cities increasing the travel-distance to travel-time ratio. They will, in the form of private vehicles, bring the advantages of the private car and its mass-market potential into the air-transportation field.

Although the new interstate highway system may increase the competitive ability of the private car, it is certain that present-day average speeds on highways cannot be increased much over 60 miles per hour. VTO speeds can reach 400 to 500 miles per hour with propeller propulsion and will reach supersonic levels with jet propulsion.

Two assumptions are possible. Either the military will be first to develop an economical VTO that can be adapted to civilian use, or the commercial VTO market will be originated by the government and private pioneer efforts. These two approaches will not change the technology of VTOs, but will affect the timing of their mass use considerably. Purely military considerations in a period of calm would tend to restrict research efforts to long-range projects. In a period of

unrest, efforts are centered on production of the best existing aircraft, e.g. during the Korean conflict the helicopter was in that latter stage and was used immediately on a wide basis. Forecasts at that time predicted its widespread use in form of 40-passenger urban air buses. The end of the Korean conflict abruptly stopped development of such multi-passenger helicopters (3). Instead, research was centered on new VTOs which offer the added advantage of great speed. The best equipment operated today by helicopter lines are commercial 12-passenger versions of a military helicopter, the VERTOL 44 and the SIKORSKY S-58.

Non-military-type government aid is contributed either by subsidizing operations with uneconomical helicopters or by financing aeronautical research projects through the National Advisory Commission for Aeronautics. Much of the operational subsidy comes in the form of mail contracts from the United States Post Office. The airways system is financed and operated by the Civil Aeronautics Administration without a user charge. Today there are no government efforts to develop VTO aircraft designed to meet civilian requirements.

Private pioneering in this country has accounted for almost all early aircraft ventures. Unfortunately, military procurements lure practically all aircraft designers away from commercial development and have created the situation which was described in the quotation at the beginning of this chapter. For some unknown reason the military has not yet realized that it may need an economical aircraft that the

civilian market can also afford. Its research efforts are always centered on performance at any cost. A large share of military transportation needs would benefit from more economical operation. Therefore, the development of economic VTOs could be part of military objectives.

The complexity of aeronautical science and the enormous financial needs of modern research make it increasingly difficult for individual pioneers to produce successful results. But there is a branch of the transportation industry which is able to enter the VTO field, namely the automobile industry. Although the auto industry knows how to produce for military needs, it is primarily a peace-time commercial development. It is well versed in economical production, in marketing, servicing and financing.

Long-range planning in the automotive field must consider the eventual competition of private VTOs with private cars and therefore eventual VTO aircraft production. In this connection it is interesting to note that already De Lackner Helicopters, Inc. is powering its one-man helicopter with a mass produced Mercury outboard motor (4).

The timing in the use of VTOs will depend on many factors, such as military considerations, government policy, private pioneering ventures and the economic status of the nation.

Following is a description of VTO configurations and a discussion of their merits.

The helicopter. -- The helicopter is the most commonly known aircraft in the family of VTOs. It originated in Leonardo da Vinci's mind, but the first prototype to leave the ground was built in 1907 by the Frenchman Louis Breguet. The first practical helicopter was developed in 1939 by Igor Sikorsky who introduced the small anti-torque airscrew which is mounted on the tail boom of the single-rotor craft. Since then many types of helicopters have been developed, with tandem rotors, with counter-rotating rotors, with stubwings, propellers and with retractable rotors. All of these new designs try to improve the helicopter's stability, reliability and maximum speeds. Since the rotors of the helicopter are primarily lifting devices, the helicopter probably will never achieve forward operating speeds much above 200 miles per hour, except in combination with some other means of forward thrust or sustension. A further difficulty stems from the compressibility losses on the forward turning of the rotor blade and the stall on the retracting blade.

The slow forward speeds and the excessive maintenance cost of helicopters coupled with the hope of developing VTOs with better characteristics in forward speed and maintenance have deflated the extreme hopes which were held for the helicopter's future. Nevertheless, helicopters are today the only VTO aircraft in production certificated for commercial use. Therefore, the future of helicopters depends on the rapidity with which other VTOs will become available on the market. The rate of growth of helicopters and their potential as mass carriers

are the subjects of many research projects. Basic research and forecasts on helicopter transportation undertaken by the New York Port Authority (5) have become standard guide material for many other cities in forecasting helicopter traffic.

The preface of the New York Port Authority forecast included certain assumptions, e.g. the existence of a commercial 30-seat helicopter by 1958 and the continued support by the government in its liberal policy of aiding commercial air transport and of providing aid for heliport construction. The aircraft industry has not produced a 30-seat commercial helicopter by 1958. Instead the industry has other VTOs either in the test stage or on the drawing boards. The New York Port Authority study did not mention VTOs. The government policy of subsidizing helicopter lines has been restricted to Chicago, New York and Los Angeles, and opposition to government subsidy of airlines and especially helicopters has increased considerably (6). Whatever the success of the newer VTOs may be, the helicopter will always be used as a hovering device, in which capacity it is most efficient. In the immediate future, before the introduction of other more versatile VTOs, the helicopter will be used for all vertical-take-off needs that can pay its high price. In urban centers, with the new interstate highway system, there is no great need for relatively slow short-haul helicopter transportation. But where there are physical obstacles, such as mountains, deserts, water surfaces, or where time is at a premium

as with police work, hospitals, fire fighting and highly paid executives, helicopters provide a valuable service which is expected to grow considerably in the next few years.

The Civil Aviation and Federal Airways forecast for 1960 - 1970 by the United States Department of Commerce, Civil Aeronautics Administration (7), questions the ability of a commercial multipassenger helicopter to penetrate the short-haul travel market effectively. It shows that as trip-distance decreases, the proportion of air travelers to total common-carrier passengers decreases also.

Table 1.

Air Passenger Percentage of All Common Carrier Passengers	Trip Distance in Miles
2	0 - 100
9	101 - 250
25	250 - 500
44	501 - 1000
66	1001 - 1500
83	1500 and up

The above table does not include private-car travelers which would show a further reduction of the prospective helicopter market. The same forecast also considers general aviation activity (all flying except commercial and military carriers) and shows that while in 1955 there were only 1,400 commercial airliners in the United States, there were 62,000

general aviation aircraft. For comparison, 48 million passenger cars were registered during the same year. The largest growth in general aviation comes from business flying. It is expected that an increasing share of new business craft will be helicopters.

Predicted new types VTO aircraft. --Many methods of vertical ascent have been proposed. Some methods may be outdated, others may seem utopian and still others may appear promising today. The race is not far enough along yet to permit definite conclusions. The following review of possible VTO flight methods will help to form a usable idea of what flight regime will be at our disposal in a few years.

The "lighter than air" (gas filled dirigible) with its excessive bulk was discarded early in the quest for efficient VTO transportation. However, it should not be forgotten that it is economical and relatively quiet.

Ballistic propulsion has been proposed for mail transportation. This idea has never been developed, since the means of control when the vehicle is on its way are rather complex and expensive. Outside of the circus, it has never been used for human transportation.

The idea of an electro-magnetic force for vertical movement has been brought into disrepute by overuse in science fiction. However, as an endeavor to create a magnetic dynamic field to transport people and goods, it seems to be the utmost in air transportation, since it would be noiseless and unaffected by the weather (8). No

specific projects are known in this field. However, advanced philosophical and mathematical suggestions by Einstein may be followed up and may lead to the realization of a "Dream VTO" in the long-range future.

Propeller, jet and rocket propulsion are the leading methods of vertical ascent that will be used for VTOs. However, propulsion is not the only important thing in flight.

Aircraft are typical examples of the complexity and interdependence of modern life. An airplane is made up of a multitude of parts, the total coordinated action of which decides its success. At the outset of the development the engine was the weak point. The Wright Brothers were able to fly because of the increased efficiency of their gasoline-powered engine. Improvements in wing design, fuselage structure, engine thrust-to-weight ratios, and fuel quality were constantly balanced out economically between important operational factors such as speed, safety, comfort and length of runway. In the last few years new engines, fuels and design concepts have reduced the empty-weight to useful-load ratio to the extent that VTO aircraft became a reality.

The variety of designs which are found in the present VTO developments create a problem for the City Planner. He is trying to prepare his city for the VTO age, and he wants to know how much land has to be set aside for VTO operations. These questions have been answered for the helicopter, but considering the long-range development of urban

air transportation it appears that these standard heliport requirements may exceed or fall short of the requirements of other VTOs which are likely to be introduced shortly.

The planner's problem therefore is not to plan for one type VTO but to plan for a succession or a group of VTO vehicles. To that end it is necessary that he should understand the possible solutions to the urban air transportation needs. Considering the need of making VTOs roadable to penetrate existing cities, the planner may actually influence the selection of the most promising urban VTO design. Following is a description of current promising VTO designs (9).

A first distinction is made between the tailsitter and the other VTOs with horizontal fuselages. The tailsitter (Fig. 1) changes its main axis from a vertical position at take off to a horizontal position in forward flight, creating a certain inconvenience for both pilot and passenger. It is possible to create VTOs with a fuselage remaining in horizontal position by the following methods:

Tilting wings and propellers or jets (Fig. 2)

Tilting propellers, jets or ducted fan (Fig. 3)

Flexible wing deflecting slipstream of
propeller or jets (Fig. 4)

An outgrowth of the helicopter principle is further found in the ducted fan VTO (flying manhole) which consists of a horizontal propeller within a duct (Fig. 5). This concept reduces the danger of the free

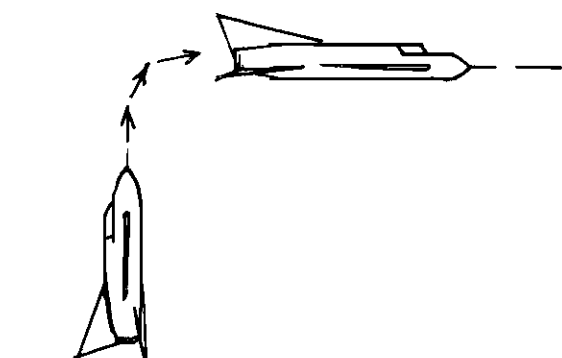


Fig. 1 Tailsitter

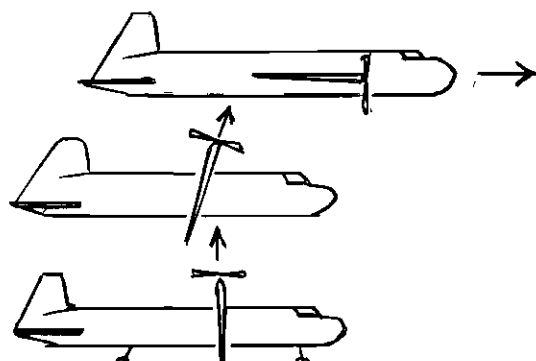


Fig. 2 Tiltwing

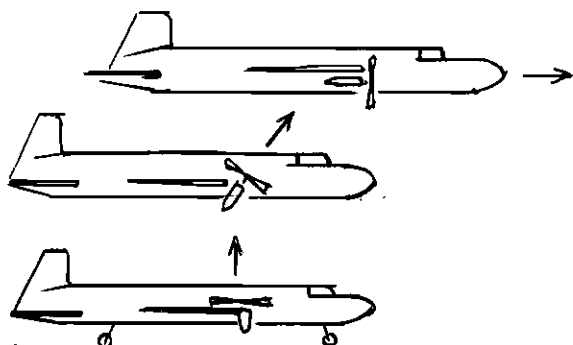


Fig. 3 Tilt propeller, jet or ducted fan.

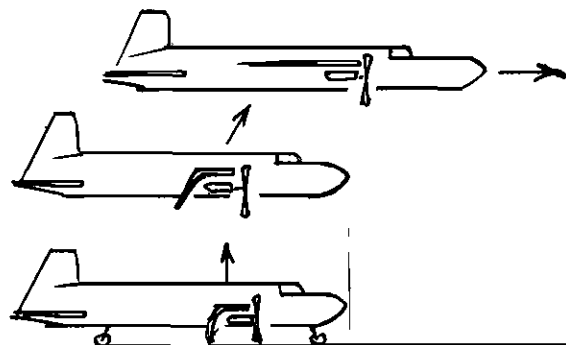


Fig. 4 Deflected slipstream

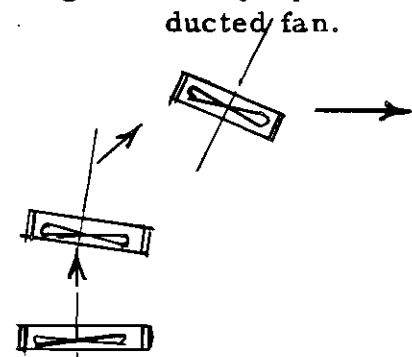


Fig. 5 Ducted Fan

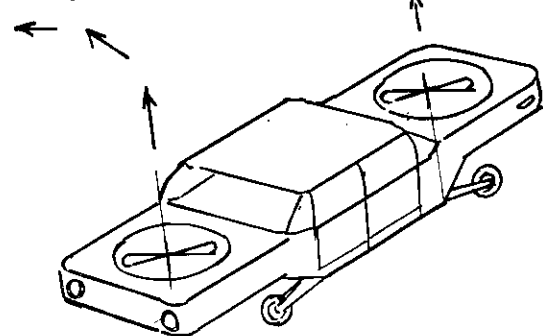


Fig. 6 Hiller design for ducted fan type private VTO

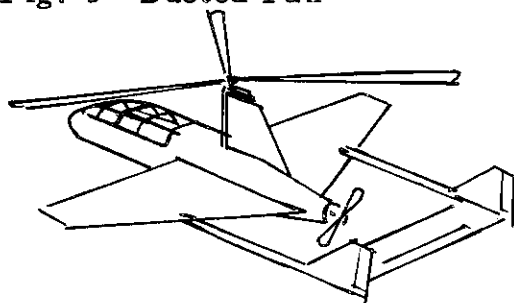


Fig. 7 Convertiplane

wheeling helicopter blades and it still uses the same principle of inclined propeller planes to create a forward movement. Again the ducted fan, like the helicopter, is basically a hovering device. There we find a great many designs of combination of various lifting and forward propulsion methods. The convertiplane (Fig. 7) is a combination of helicopter and fixed wing plane. Retractable helicopter blades have been proposed to raise forward speeds. The combination of forward and vertical flight with the exception of the tail sitting jet VTO necessitate compromises. It is too early to know which of these designs will be most efficient, practical and economical for commercial use.

From a city planning point of view, there is still another combination desired. That is the convertibility of the VTO to regular road traffic, which is imperative if we are to continue using present-day urban facilities.

A wingless VTO aircraft of the ducted fan type has been conceived to answer this need. The proposed aircraft is roadable and its dimensions resemble those of cars. This would mean that the existing central-city transportation system with its roads, parking lots, etc. could be used by VTOs (Fig. 6).

VTO aircraft with wings do not seem to lend themselves easily to roadability. They may be more suitably used for inter-city common-carrier service and could operate out of existing airports, carrying higher payloads on horizontal take offs from runways and also for VTO operations into new city-center landing fields.

Forecast of VTO aviation. --If logical development and reasonable governmental interest are assumed, the following forecast can be made:

1. Development of multipassenger and cargo VTO aircraft, similar to present airliners. They will take advantage of increased engine and fuel efficiency for VTO operation, thus widening the present air transportation market with planes that can operate from existing run-way-type airports and also from down-town VTO ports. Down-town VTO ports will not need as much space as present airports but will still have to be of considerable size. These aircraft will initially be propeller-driven tiltwing or deflected-slip-stream types and will fly at sonic speeds. Development of jet propelled VTOs will follow later and will eventually eliminate the use of aircraft using runways.

2. The multi-passenger VTO will not be able to penetrate the short-haul market except in feeder operations. The advantages of the private car operating on the new interstate highway network will outweigh the services of common carrier air transportation for trips up to 150 miles.

3. A four to six passenger VTO will make inroads on private automobile transportation and increase the one-hour travelling distance from 60 miles to 200 miles and higher, depending on the type of propulsion. The private VTO will compete with common air carriers and restrict their short-haul market.

4. There will probably always be a place for a minimum public air-transportation system comparable to today's urban transit systems.

5. VTO air freight will offer completely new concepts for the shipping and handling of merchandise. Weight limitations and restrictions on the size of packaged goods may no longer be necessary.

6. Current development of guided missiles and space rockets will greatly speed the introduction of mass VTO transportation for the following reasons:

- a. development of more efficient propulsion methods;
- b. development of automatic electronic flight controls; and
- c. development of an immense industrial production capacity for defense purposes which may also serve the potential civilian VTO market.

CHAPTER III

HISTORIC REVIEW OF URBAN TRANSPORTATION

A definition of "Urban Transportation" is necessary in order to avoid the pitfalls of the common belief that the improvement of a vehicle's performance is equivalent to progress in transportation in general. "Urban transportation" is a term covering a multitude of aspects of which the vehicle is only one part. Urban transportation affects most phases of urban life and is closely interknit with its social, economic and physical conditions.

While methods have been developed to measure performance of vehicles, such as speed, power consumption and cost per seat-mile, the field of urban-transportation analysis is still in the process of evolving measuring techniques. Modern methods of traffic-analysis have developed considerably in the last few years. From traffic counts and origin and destination studies they have now developed to include studies of social and economic conditions in order to forecast future needs for transportation on a comprehensive basis (10). We have now reached the point where modern planners attempt to evaluate the total function of transportation as it follows the daily movements of each urbanite and the route of every item of merchandise from the producer to the consumer.

Although no workable answer to the ever growing urban traffic needs has yet been found, the new VTOs threaten already to extend urban traffic chaos into the skies. The challenge is how to integrate VTO air transportation into a comprehensive urban-transportation system.

Planning considerations for the introduction of VTOs must be based on an understanding of the impact that past transportation innovations had on their development up to their point of obsolescence. It should then be possible to avoid repeating past mistakes and benefit from past experience.

The era before the advent of inanimate energy. --In pre-industrial days, transportation was improved at an extremely slow pace. Nevertheless there were innovations and achievements equal in scope to any modern transportation development.

The Romans, in their endeavor to protect themselves from the Germanic people, built military establishments along the northern slopes of the Alps. Several good transportation routes had to be built to provide access and service to this defense line. These military roads, parts of which can still be recognized today, were built at a tremendous cost, but they were uneconomical for commercial use. It was not until the 13th century when the Swiss opened the Gotthard Pass by building a passage through the "devil's gorge" that economic commercial land transportation between northern and southern Europe was established.

The Roman roadbuilders had not found the Gotthard Pass where the Alps could be crossed through only one pass (11). All along the new route new towns thrived from the commerce between Venice and northern Germany. It is difficult to conceive what would have happened if the Romans had built one of their roads across the Gotthard Pass a thousand years earlier!

Napoleon, another great road builder, may serve as a contrast to the Romans. While the Roman roads were abandoned as soon as the soldiers left their military outposts, the roadbuilding program of Napoleon was of war-time as well as peace-time value. His thinking was comprehensive. A single governmental department was created to deal with both road and waterway construction. Another important feature of the French road- and canal-construction program was the planting of trees on both sides of all major routes. These trees not only prevented soil erosion of road and canal banks but also provided protection from the sun, kept the roads dust free and thus indirectly increased the distance of a day's travel.

The transportation network of Napoleon showed that military expenditures for transportation can be made to pay for themselves by planning them for eventual commercial use, and it further showed that transportation efficiency besides being a technical problem, has to deal with human fatigue which, in this case was greatly reduced by tree planting.

The invention of the steam engine and the advent of the railroad. -- The use of inanimate energy to propel vehicles and ships marked the beginning of a transportation revolution which greatly affected our world and which led to man's entry into space.

The early railroads were built to provide transportation between existing cities. However, the potential of railroads to create new towns and develop land was soon realized and a period of dynamic growth followed. Entire continents were opened up for settlement. In existing urban centers new growth was channeled over the railroads to suburban settlements within commuting distance of the central employment areas (Fig. 8).

A clear difference can be noted between European cities which existed before the advent of railroads and the American cities which were built because of railroads. While in European cities railroad stations and tracks are conveniently located at the fringe of the Central Business District, in American cities railtracks go through the middle of the Central Business District. At great cost the larger cities have bridged these tracks, which were serious obstacles to development.

Railroad companies had a very great influence on the development of regions and cities. They were naturally more interested in immediate financial returns than in the long-range future of cities and regions. The governments, at that time, often failed to realize the long-lasting effects

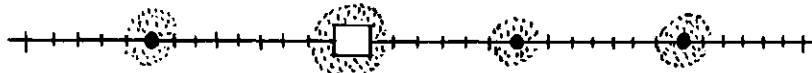


Fig. 8

Railroad
commuter towns

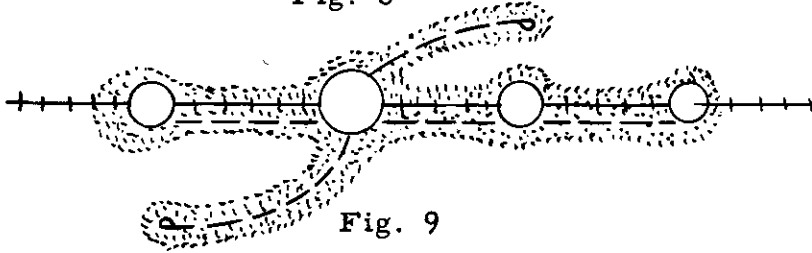


Fig. 9

Growth along
mass-transit
routes

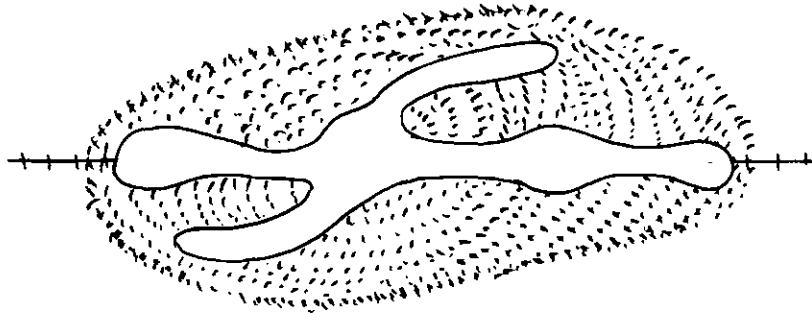


Fig. 10

The private
automobile -
urban sprawl

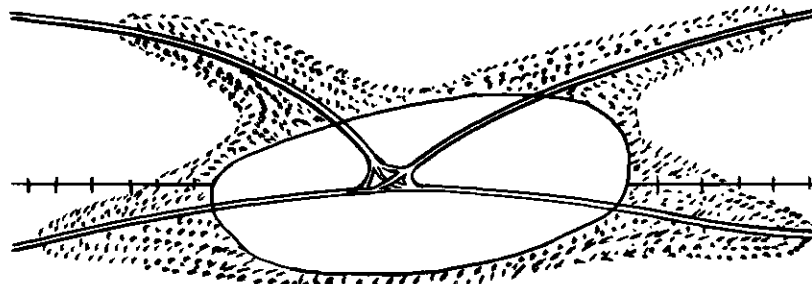


Fig. 11

Freeways -
starshaped urban
region

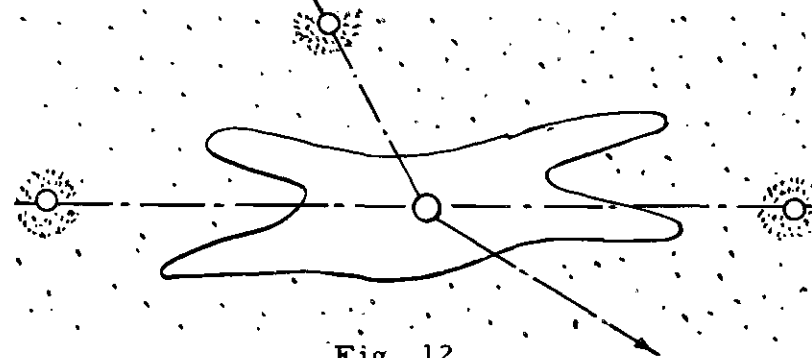


Fig. 12

Airways for
VTO mass-transit
and total access
for private VTOs

Diagram of History of Urban Development

of railroad development and were too quick in giving franchises, right-of-ways and in making unrestricted land grants to these companies. Following are two examples showing both the absence and presence of long-range thinking in government.

In Berkeley, California, the submerged lands on the waterfront were granted to the Santa Fe Railroad without restrictions at a time when it was commonly believed that all of the San Francisco Bay waterfront would be developed for industrial and harbor purposes. This never happened. Today, the City of Berkeley would like to develop its waterfront for recreational use, but the land grant is in the way of the public's wishes.

In the same city we find an example of wise government action. In 1929, a ferry company asked to build a pier to serve ferry operations to San Francisco. The city franchise included both a time limit for construction of the facility and a provision that the pier would revert to the city if the ferry operation was discontinued. The construction of the Oakland bridge killed the ferry operation and today the pier is a popular fishing spot and one of Berkeley's recreation facilities.

The early railroad ventures which made great profits from land development let many companies lose sight of their long-range obligations for public service. As soon as the booming land development period came to an end, many railroad systems found themselves too heavily capitalized and with obsolete equipment. Profits declined and

many companies were unable to perform their obligations. The government had to step in and either buy out the railroad companies or set up public-service commissions to control railroad operations. Neither solution was effective in undoing the early mistakes.

Government controls to protect the public and at the same time keep transportation operations up to date have increased greatly. Unfortunately, most of them are special-purpose controls, which may have dangerous side effects. Following is an example of long-range government policy on railroad transportation and a description of its effects.

United States Government policy has prevented the railroad companies from taking part in water, air and highway transportation. Since the government does not provide coordination between these various transportation means, there has developed competition among the various transportation branches which is often contrary to the interests of the nation (12). Let us have a look at the passenger transportation field. Originally an exclusive railroad market, passenger transportation has lately been taken over more and more by private cars, busses and airlines. As a consequence of anti-trust government policy the railroad industry has been indirectly prevented from taking part in the progress of passenger transportation. A further result is a lack of continuity in passenger transportation which has affected every Central Business District in the United States.

Passenger terminal activities are switching from spacious railroad stations to crowded and ill-located bus terminals and to airport-bus stops in front of hotels. This process has had an adverse effect on railroad stations and properties within their vicinity, which had been developed especially to provide for the needs of passengers. An example of smooth transition can be found in Paris, which is still influenced by Napoleon's comprehensive transportation policies. Paris has been able to convert one of its downtown railroad stations into an airport-bus terminal.

Urban transit. -- The advent of urban transit or mass transportation introduced a new phase in urban growth. Urban transit, being adaptable to existing street traffic, was able to provide quick transportation between places within the city. At the same time it was instrumental in developing new residential areas along its routes (Fig. 9).

The new transit lines and the land speculations created huge profits and the overly optimistic companies did not worry about the long-range future of urban transit and the time when the development profits would cease.

That critical period occurred at the end of World War I when many companies went into bankruptcy. This led to government action which helped to re-finance many companies, but also brought tighter public-service controls.

Government restrictions prevent urban transit companies from operating taxis, trucks, airport buses, or rental services and they cannot engage in real estate developments. Maximum service is expected of urban transit during the peak hours on five days of the week. During the rest of the time buses have to keep a schedule, whether there are customers or not. A further difficulty lies in the rapid pace of change in urban transportation needs and the quick obsolescence of transit equipment. A brief review of the many kinds of vehicles used in urban transit will illustrate the need for flexibility (13).

The first kind of mass transportation was a horse-drawn car, conceived by the French mathematician Pascal in 1662. His horse-drawn car did not become successful until 1830. The next step in the development was to run the horse-car on steel rails which made it more economical. The cable car was the first city transit medium to use inanimate energy and was introduced in San Francisco in 1873. The electric railway was conceived in 1837 but was not successfully operated for another 46 years. The gasoline motor-bus first appeared in 1905, but it received general acceptance only when a low-deck bus was designed in 1922. As an answer to the gasoline bus, power companies developed the electric trolleycoach in 1928. The larger metropolitan centers turned to rapid transit systems as early as 1868, when the first elevated train was built in New York. It was operated by cables. Its noise and street obstructions led to the much preferred subway, which appeared in 1892.

Today, the trend in urban transit is towards public ownership or local private ownership with strong public controls. In 1947, the States of Illinois and Massachusetts created transit authorities to acquire and operate transit lines. This development grew out of the fact that urban transit was no longer serving individual cities, but also entire urban regions.

A similar approach is used by the San Francisco Bay Area Rapid Transit Commission, which proposes to build a regional rapid-transit system serving the more important urban centers. The Bay Area transit study is very comprehensive in character and is based on valuable regional economic and social information (14).

The private automobile. -- The success of the private automobile is based on its versatility and on its combined advantages to the owner. The private car cannot be compared with urban transit on the basis of economic efficiency, since their relative uses are different and coincide only as far as commuting to work is concerned. The private car is the dynamic part of the house. It is storage space, truck, recreation, a place for discussion, conferences, waiting and intimacy. It provides social standing. It means freedom to move up to six persons or a thousand pounds at any time and to any place.

The private car has given the urbanite a mobility which has revolutionized the urban pattern. The city exploded in all directions. The environments of the city, which before had only been developed along

railroad lines and urban transit lines, were all within easy access by car (Fig. 10). The result has been urban sprawl outrunning both government control and public facilities. City-planning efforts can bring the various forces of urban growth into balance and safeguard the interest of the public both as individuals and as a group.

The construction of modern freeways, in conjunction with the Interstate Highway System, is greatly affecting existing cities and new urban growth. Existing cities are being cut up by new, wide rights of way and huge access facilities. New urban growth takes place in a fingershaped pattern along the freeway routes (Fig. 11). Urban areas are beginning to feel the impact of this new trend and are trying to plan for orderly growth in these rural areas. In Atlanta, the Metropolitan Planning Commission and the Georgia Power Company have organized such a regional movement including the area which will be accessible to the center of Atlanta in one hour's driving time (15).

Findings. -- This brief historic review shows the following. Government controls have been initiated after the creation of problems and conceived for special purposes with little regard to side effects.

Common carrier passenger operations, except during extensive growth periods, are not profit making, except when coupled with freight operations or some other rewarding activities.

Private enterprise is looking for quick returns and is seldom concerned with the country's long-range interests. Government policy can provide incentives which would bring private and government interest together.

The transportation field is constantly in a state of change. A successful transportation system must have extreme flexibility of organization and equipment.

CHAPTER IV

PLANNING CONSIDERATIONS

Traffic Ways

Comprehensive transportation efforts. -- Technological progress and economic necessity are forcing the coordination and cooperation of the various branches of the transportation industry. Bitter competition and freight-rate wars among the different services are giving way to new efforts at increasing cooperation in transportation. Truck trailers can be seen riding on specially built railroad flatcars. Specially built ships carry trailer boxes over the seas. Expected VTO passenger and freight transportation will require coordinated planning of comprehensive trafficways to provide for air, land, rail and water transportation, if uneconomical competition between services is to be prevented.

The design of new trafficways is of great importance to the economic future of the nation. The new interstate highway can provide opportunities for new growth by its design and its location. Its route can be so located with reference to navigable rivers, powerlines and pipelines as to provide suitable industrial tracts. The new federal airways system similarly should be closely related to existing urban patterns. Present approach paths to airports have influenced surface

developments. The use of VTOs will further increase the importance of airways as they become an urban development factor equal to railroads, highways and waterways.

Federal airways and VTO operation. --The Federal Airways, like the highways, are free public facilities. They provide flight control along the fixed-route system and at controlled airports. At present the airways system is used in the following approximate break-down: 50 per cent by the commercial airlines, 30 per cent by general aviation aircraft and 20 per cent by military aircraft (16). The majority of general aviation aircraft are not equipped to benefit from the radio airways and fly only under VFR (visual flight rules). Air collisions in the past few years have created demands for more efficient radio controls on the airways. The President appointed Mr. Edward P. Curtis to prepare a study on Federal Airways Requirements for the period 1956 to 1975 (17). The study is based on the needs of the coming jet airliners. Jet aircraft, which will fly at higher speeds, will require a higher degree of radio flight control than is now used. Volume IV of the report, which contains forecasts on aviation and was printed in mid-1957, does not mention VTOs. It contains a small section on helicopters and STOL (short take off and landing) aircraft. Based on the performance of helicopters in New York, Chicago and Los Angeles and some studies of the Cornell Aeronautical Laboratory, the report comes to the conclusion that the required fares would not support any air-bus operations between cities,

nor be in the range of the average city commuter, but that they would support airport shuttle operations, serving up to 50 per cent of the passengers now arriving by limousine.

This report shows that the Federal Airways System is not prepared and not able to handle any large amount of private aircraft under IFR (instrument flight rules) conditions. Mr. Curtis' report does not consider the possibility of such requirements. It appears therefore that the Federal Airways, as they are conceived today, could not take care of a mass VTO market.

The ultimate development of VTOs will provide two types of traffic: the private VTO to serve individual needs with as much freedom as possible and the multi-passenger and cargo VTO to serve along special routes.

Multi-passenger and cargo VTOs, similar to present-day aircraft, will fly along existing airways or air channels. Their ability to fly slowly and to come to abrupt stops will greatly increase maximum possible frequencies over these airways, since the danger of collision will be greatly reduced. Traffic-safety considerations will become more important in the determination of new airways for VTOs. The distribution of points of access to air routes cannot please all people concerned.

A mass market of private VTOs cannot be served by the present Federal Airways System. Besides the problem of checking each VTO individually under IFR conditions, the private VTO would also have

unscheduled and diversified route patterns. New flight controls will have to be so designed as to permit a maximum of access freedom to private VTOs.

New ideas in travel systems must be explored and tested. Following is a proposal for a VTO airways system which was adapted from a subterranean highway system proposed for Paris, France.

The suggested VTO airway system is designed to provide complete control on flights between any two points. VTO air travel would be restricted to four vertically separated travel directions. Vertically, air layers would be reserved for flights to the North, East, South and West. The system is also conceivable with six or more travel directions. Set travel speeds would prevent any collisions within a layer. In-between layers would be used for 90° directions changes, requiring complete stop or slowdown, depending on IFR or VFR conditions. This travel system could be integrated with existing air routes operating at higher altitudes.

Transition from air to surface transportation. --Access from the air to the surface will be part of the new airways system, but it will also have to be a part of the future urban surface traffic ways.

Current urban growth is mostly taking place in widely decentralized patterns, as found in the Los Angeles-Long Beach region. But city planners are working on concentrated central city proposals such as the Ft. Worth project with a highly developed core area within

a freeway loop and integrated parking facilities. Such central business districts may eventually attain a degree of coordination with integral vertical and horizontal transportation systems that they will function like one well-designed building.

Such central business districts and all other areas of concentrated urban activities like industrial districts and shopping centers will require organized, controlled landing points for transition from air to surface transportation. These access points will be located on the basis of the operational characteristics of VTOs such as noise, vibration, air downwash, parking needs and the ease of convertibility from air to road traffic. Access points will probably be located along highways, outside of densely developed areas.

A Bill, H. R. 3620 (19), proposed in Congress by Representative George H. Fallon in 1957, attempted to set aside land along the interstate highway system in urban areas for eventual use as heliports. Such landing strips would be ideally suited for the type of VTO operation contemplated.

VTO access to low-density residential areas will cause other problems but may not require total control of access, since fewer VTOs will be involved. Yet some system for granting VTO access will have to be developed. New traffic signals will be needed to announce directions, restrictions and available facilities.

Land-Use Considerations

The influence of VTO access on land-use policies. --Land-use planning is the process of estimating the future land needs of the population for its residential, commercial, recreational, agricultural and industrial activities and of assigning them to well suited areas. Prime considerations in the land-use analysis are topography, means of access, utilities, water, minerals and natural beauty. Most planning programs take place in and around urban areas with many fixed factors influencing future land-uses, such as railroads, roads and existing growth trends of the city. In these developed areas, the VTOs will share influence with these other factors.

However, the VTOs will be of great importance in determining land uses in rural and undeveloped areas. A new town, instead of originating at a bridgehead or railroad terminal site, may be founded at the intersection of two invisible airway routes, with no relation to topography. Climatic conditions, such as year-round visibility and lack of strong winds, may become very important factors in urban growth.

Land-use considerations will develop a new sensitivity towards noise and altitude. Hills, instead of being inaccessible, will become most accessible and even desirable for commercial properties. On the other hand, low land and deep valleys might prove desirable for residential use because of their protection from the noise of the airways.

The need for total land-use planning. -- The VTOs will increase the mobility of the urban population to the extent that development activities can reach any part of the country. In most of these newly accessible areas there are no planning programs, much less any land-use plans. Yet, if we are to avoid country-wide chaos, coordinated land-use planning is necessary and should cover the entire surface of the nation.

The responsibility for such planning cannot rest in local hands only. Local land-use planning should be tied in with regional plans. These in turn should be based on national resources planning.

Changes in land-use planning. -- The changes in land-use planning criteria will interrupt continuity in urban development. The resulting problem will be how to conserve existing urban life and its investments and how to provide for their transition into the new VTO age. During the period of change, the courts will have a hard time in zoning cases, involving both existing development and new land-use considerations based on the use of VTOs. The change in land-uses, however, does not alter the objectives of maintaining property values, preventing blight and coordinating new growth for the long-range interest of the people.

Methods of implementing land-use policies. -- Zoning ordinances are used by most communities to implement the objectives of land-use planning. The office of a building inspector enforces zoning with

building and land-use permits and occupancy certificates. This allows control of both new construction and existing land uses.

Performance standards have been established in various sections of the country to control nuisances such as smog, water pollution and noise. The use of performance standards to control land use for the public benefit has not yet been fully explored. Performance standards are desirably based on exact measurable criteria. They have the advantage of providing flexibility in land-use control. Transition from one land use to another can be accomplished without increasing nuisances and without detriment to the public welfare and safety.

In the case of future VTO land access with its noise-control problem, performance standards are preferable to out-right prohibition of access. Good, reasonable standards will encourage the aircraft industry to accomplish necessary noise reductions. Outright prevention of access would discourage such efforts. The New York Port Authority, by establishing maximum allowable noise levels for the use of its airports has actually forced the aircraft industry to increase its efforts in noise reduction of jet aircraft.

Performance standards, with exact numeric limits, cannot be determined by laymen or political bodies. The desirable limits are usually set by scientific research and administered by trained personnel.

The nationwide or regional character of these standards may prove useful in establishing minimum performance-type land-use controls at

federal or state levels. Such direct comprehensive regional and national land-use planning would require means of enforcing its policies.

The Air Commerce Act of 1926 and the Civil Aeronautics Act of 1938 formally declared that "The United States of America is hereby declared to possess and exercise complete and exclusive national sovereignty in the airspace above the United States" (49. U.S.C. 176). In enacting this legislation, Congress relied on a combination of the commerce power, the war power and the postal power. The Federal Government therefore has jurisdiction over air access to land which means that by granting or denying access it can control any land use depending on such air access. This shows that the responsibility of controlling air access to land cannot be based on air transportation considerations only. VTO air access affects urban life and it should be controlled by a federal agency for urban affairs.

Economic Considerations

Mass production of VTOs. -- The market for multi-passenger VTOs will depend on how soon they can replace fixed-wing aircraft on short-range flights, and on their success in replacing surface passenger transportation. Eventually the VTO bus will have to face competition of private VTOs in all of their short-haul and medium-distance operations. Like commercial jet aircraft, the VTO bus with its higher speed, higher carrying capacity, better utilization factor and longer life

expectancy, will not provide the ideal basis for mass production.

The market for private VTOs and commercial-delivery VTOs looks entirely different. The services offered will appeal to the general public and form the necessary basis for mass production. Whatever the complexity of the vehicle, automation should make it possible to bring down the cost to a level acceptable to the general public.

This new transportation device will provide people with a new three-dimensional mobility. At the same time, if VTOs are roadable and if access to private properties and to community facilities is made available, VTOs will reduce the need for automobiles. The VTO market therefore will not create an entirely new field of industrial endeavor, but it will replace a large segment of existing automotive production facilities.

The auto industry today seems to hide its lack of progress in transportation behind yearly fashion-like changes in looks. Unless the auto industry gets back into developing progressive means of private transportation, a separate new VTO industry may grow up and take over the private mass-transportation market.

If anti-trust government policy fails to see the functional similarity of automobiles and VTOs, the auto industry may be prevented from taking part in the new and growing VTO development. Such an abrupt break in the continuity of the industrial transportation effort would hurt both the national economy and social stability. Such damage

can be avoided by basing government policies on comprehensive, long-range planning.

Consumption or conservation. -- Longevity and high utilization factors are characteristics of modern aircraft which differentiate them considerably from surface vehicles. The D-C-3s, which the Douglas Aircraft Corporation produced in 1936, are still in use today after more than 20 years of intensive service. The reason may be found in the higher quality of maintenance and servicing which is required for aviation safety, in the presence of aerodynamic and functional design which eliminates waste, and in the high procurement costs which require long-term financing.

The VTO will probably follow that trend. A new VTO mass market may therefore not be based on quick physical deterioration, nor on rapid design obsolescence. The new market may require high quality production for a long and useful life, with maintenance accounting for an increasing portion of total transportation expenditures. That trend may be part of a possible large economical change towards rental service markets in which customers no longer buy equipment but rather buy service from a company.

The national economy would gain some stability from such a rental service system in the transportation field, since replacement and new acquisition of vehicles could be predicted with a much higher degree of accuracy than with our present-day millions of individual buyers.

Economic effects of increased transportation efficiency. --Mr. Erich Zimmermann, in his book, World Resources and Industries, (20) states that the triumph of robots and the conquest of space are solving the two problems which alone stood in the way of American prosperity, labor scarcity and excess of space. Assuming that automation will solve the labor scarcity problem, we can predict that VTO transportation will neutralize the space handicap of the North American Continent. It will then be possible to create what Zimmermann calls optimum density of population, which is found when the level of technology and the available land make man's effort most productive. The natural result of such optimum productivity in a country which believes in hard work will be an increase in gross national product and the formation of new wealth.

Economic expansion. --Besides the general economic expansion discussed above, there are two additional areas where the VTO will bring about great development.

The barren lands and the deserts of the West, through the great speed and the ease of air access of the VTOs, will be opened up to urban development. A trend to reclaim deserts is already established, but the VTO, together with the use of nuclear and solar energy and new methods of de-salting sea water, will provide man with the tools to realize his wildest dreams.

Another less spectacular but equally important economic influence will be felt by the rural areas of the East and South, which have been

losing population to the cities for the past decades. VTOs will reverse that trend. This does not mean that the migrated farmers will return to their farms, but it means that urban development will take place in what are now rural areas and that the central cities will lose their present advantageous position as far as transportation is concerned, e.g. today a small rural town 150 miles away from a large urban center is relatively farther away than another city 600 miles distant with direct air service connection. The VTO will re-establish reasonable relative accessibility to all areas and provide rural areas with their proper share of the total urban development activities.

Social Problems

New urban growth pattern. --The gradual introduction of VTOs around cities will provide people with a greater choice of residence. Instead of being restricted to narrow strips of land along highways and to the vicinity of large urban centers, the new method of access and the increased speed of travel will permit residential development as far as 100 miles away from the place of employment. What kind of development can be expected? Will people try to have individual country estates, or will they prefer to live in apartment houses in the midst of large acreages of natural land, or will they again create subdivisions as we know them now?

VTOs will not change people over night and it is expected that we will again have subdivisions with continuously developed land,

community facilities, public services and utilities. However, subdivisions will no longer need to be part of the urban sprawl. They can become self-sufficient, independent communities and they can be located in favorable spots, on lakes, rivers and hills. In Atlanta, Georgia, there is already a group of developers planning a new, self-sufficient town with residential, commercial and industrial areas (21). Low land cost permits the creation of sizeable lakes and the retention of a wide bufferstrip around the development, thus safeguarding its natural setting. With the advent of VTOs, such developments will have even higher chances of success. They might take place in small country towns or as entirely new ventures.

All small towns within a one-hour's flying distance of large metropolitan centers will feel the urban proximity and share in its growth. The population of these old towns, many of which stopped growing many years ago, is relatively conservative and its younger groups have left for the larger cities. The remaining group controls the political set-up, the land and all the social organizations. They will welcome new growth for the money it brings in, but they will dislike it for the turmoil that goes with it. New people moving into these towns will try to organize better schools, build new churches, etc. There will be disturbances between new and old.

Dispite of these disadvantages, these old towns offer one great advantage: they provide an existing working nucleus of a society and

with normal democratic processes such revived towns can achieve many things within a short time.

New town development provides an entirely different picture. It has no other roots than the will of the developer. Until recently most new towns were formed in connection with a single industrial or economic development. Numerous new mill towns, college towns and resort towns reflect the lack of a normal social life because of their specialized and unbalanced economic and social structure.

A new town development offers the opportunity to create an environment designed to suit modern economic and recreational needs. Yet this advantage can be more than offset if the new town development does not create a natural social environment offering the wide diversity of modern urban life with balanced age distribution, variety of job opportunities and recreational and educational facilities.

The Federal Housing Policy, which has been rather conservative, should assume a more progressive attitude in creating incentives for long-range, large-scale and comprehensive new town developments. Its loan policies are centered too much on the individual home which is being added to the large community, thus creating modern "urban sprawl." A widening of the scope of Federal Housing Agencies may lead to the desired formation of a department of urban affairs.

Social behavior. --Like the automobile, the VTOs will have a considerable influence on social behavior. Will the increased mobility and

its time savings be invested in more work or will we use it for leisure and family life? Another choice open to the business man will be whether he should use his increased mobility to go farther away or to work more intensely in the immediate surroundings, e.g. an Atlanta business man will be able to fly by jet airliner in three hours to Venezuela, or he may use his VTO and visit several places in Georgia during the same time. All of these possibilities will be tried out, but the most successful will determine the final trend.

Present migration trends seem to lead to a greater standardization of all people and to the elimination of many social differences between nations and regions. On the other hand, VTO and jet transportation will provide easier means to keep closer contact with particular social groups and may start a reversal of the standardization process.

The increased urban mobility, resulting from the automobile, has expanded the sphere of social activities outside the "neighborhood" which has changed its social function. VTOs will further help the "dispersed social group" to keep alive and to conserve social differences and characteristics.

At the local level, social behavior will be vitally affected by the kind of privacy afforded to people. Should the airways system permit landing on official landing pads only, then that problem would be solved, since access would occur over the conventional road system. However, it is believed, that, in the new urban developments, people will be able

to land on their own property. In this case, protection is needed from noise and vision. The noise nuisance, as previously discussed, will be considerable and could at first control the determination of the height of private property air space. But the reduction of noise is a technical problem and may be solved to the point where privacy from vision will become the determining factor.

Apart from any airway consideration, local privacy demands will force the Federal Government to set an air space property limit, based on a minimum distance from the highest obstruction on any property.

Transition problems. -- The new urban growth resulting from the VTOs should be prevented from continuing the past trend of being restricted to the economically most productive age groups and of leaving the older settlements to the economically weak younger and older generations. Urban redevelopment and conservation policies should plan for the eventual use of VTOs in already built-up areas.

Government

Changing needs in urban government. -- The dynamic urban growth which resulted from the enormous technological progress in transportation has outgrown the boundaries of existing city governments and has created new problems which the city cannot solve. Recent efforts in creating a metropolitan government in the Miami (22) and Toronto metropolitan areas have been well publicized. However, they represent

only two specific approaches to the solution of urban problems. Other solutions include municipal utility districts, school districts, single-purpose authorities and intergovernmental service contracts.

VTOs, which will further increase the rate and spread of growth, show the need for geographic continuity of urban services and controls. Whether these services and controls are to be provided by metropolitan governments, special districts, authorities, intergovernmental contracts or by the formation of urban counties is less important than realization of the need for geographic continuity at the earliest date. The new interstate highway system is already bringing urban problems to rural areas which are totally unprepared for this new situation. It seems almost inevitable that the counties with their political power and their complete coverage of the countryside must take on urban responsibilities. However, special service districts and contracts between local governments as well as area consolidation will still be needed in many places to create a continuity of efficient governmental units.

National transportation policy. --The United States Government has always taken an intensive interest in transportation in its effort to tie together the developed regions of the East and West which were separated by vast stretches of barren land. George Washington was the first in this effort. He initiated construction of a canal from the Potomac River to the Ohio River. Federal land grants to railroads helped to open

up the western territories. Waterways have been developed by the Tennessee Valley Authority and the Corps of Engineers and today the United States Government is engaged in a giant road-building program.

It is therefore not surprising to find the Federal Government as the prime promoter of air transportation. Its Air Force contracts for research and procurement, its operating subsidy to airlines in form of mail contracts, its subsidy to the construction of airports and the free operation of the Federal Airways System mean that the air industry is a government-supported industry. Today that industry could not survive on its commercial market alone. The continued need for national defense and for transportation service gives air transportation a public-service character with a built-in guarantee against bankruptcy.

It is important to know how the total amount of the federal transportation budget is distributed among the various branches of transportation (23). The current administration method uses agencies which were specially created to promote particular forms of transportation, such as the Civil Aeronautics Administration. The result is that within the government different transportation forms are found in tough competition. If competition outside of the government and within each transportation field is added, the result seems to be chaotic and we wonder how our legislators are able to safeguard the public interests. The various pressure groups and lobbies are often thought to be part of the democratic process of balancing out clashing opinions. Yet it is

doubtful that their compromise solutions will guarantee the country's long-range interests.

In their book National Transportation Policy Charles L. Dearing and Wilfred Owen of the Brookings Institution (24) propose the establishment of a federal transportation department which would be responsible for coordinating the complex field, eliminating wasteful practices, encouraging efficient cooperation and planning for coordinated growth of all transportation means.

Such a department might help eliminate problems which result from a lack of coordination in the transportation field. On the other hand, the new distribution of responsibilities might disrupt other coordinated government activities by such agencies as the Corps of Engineers, Tennessee Valley Authority or the Department of the Interior which engage in construction, irrigation, navigation, flood control and power production. The creation of a new transportation department would vitally affect all government departments. No change of responsibilities should be proposed, unless it is based on a comprehensive analysis of the entire Federal Governmental structure. The result of such an analysis might show that the reshuffling of responsibilities is no cure to the lack of coordination.

A worthwhile national transportation policy should be formulated, based on comprehensive and continuous national planning. In the National Resources Planning Board the United States had an effective planning

organization which could have grown into a most valuable asset of our government. It could have provided our legislators with unbiased, scientifically developed recommendations based on the long-range interest of the nation. Unfortunately, these national planning activities were discontinued during World War II. However, the need for national planning is still here and increases as government grows and becomes more complex.

Air transportation policy. --The lack of national planning is reflected in the Civil Air Policy of 1954 (25) which nowhere discusses its relationship with other means of transportation. However, it puts forth policies on subsidies, airports, airways, safety, relations with local, state, federal and foreign governments, defense and aircraft manufacturing industry. These policies will change with the introduction of VTOs. Advance planning will provide a view of the expected development and make possible sounder present-day decisions.

Subsidies to the air transportation industry were originally conceived as a temporary help to a new growing industry, to be discontinued when the new industry reached maturity. The fallacy of this thinking is clear, since the subsidy provides artificial economic living conditions out-side of the normal economy. The problems of multi-passenger air transportation are the same as those of its historic predecessor, urban transit. The Civil Aeronautics Administration, contrary to common belief, is not a public agency to supervise air-transportation. It was

created to promote its growth. The result is that we are today following step by step the mistakes that happened in urban transit a hundred years ago.

Government help should be used in furthering research in transportation service on a comprehensive basis. It is incomprehensible that we should subsidize three helicopter companies, operating similar airport shuttle services, while refusing to subsidize the following proposed operations of much greater research value: (1) A helicopter service in the San Francisco Bay Area, where helicopters are at their best to overcome physical obstacles and (2) the use of helicopters in the feeder airline operations of Mohawk Airlines in the New York region (26).

Federal aid to airport construction was definitely needed to provide necessary accommodations for the growing passenger needs. The necessity of long-range planning in this field can be seen by the number of discontinued air strips and airport buildings that are found at each major airport. Air transportation will soon go through another period of growth because of VTOs, which will affect all the fixed investments in airports. Airport investments should be financed over reasonably short periods or they will create future financial burdens.

The determination of new routes or of the number of competing air lines on a route is the responsibility of the Civil Aeronautics Board. The process used is without logic and does not include the study of long-range effects. It is based on hearing interested parties; on one side

the airlines trying to get the route and the chambers of commerce of the cities served and on the other side the railroads and the bus companies. The determination of air routes should be based on a national transportation plan designed to best develop the nation's resources.

Public-safety considerations will change greatly with the use of VTOs and their direct access into populated areas. Fixed-wing aircraft operations, with few exceptions, have never been restricted because of safety considerations for the people on the surface. With helicopters, this situation is different. Their ability to fly complicated flight patterns, together with their slow speed, noise-nuisance and safety considerations for the densely populated areas have led to government restrictions. In the case of the New York Airways, helicopters have to follow the coast line when they fly from Idlewild to La Guardia Airport, a route which is considerably longer than the direct one.

Vertical air-access to land will pose many governmental problems. Federal sovereignty over airspace has not yet been questioned in fixed wing transportation because most flights cross state lines. Local VTO flights, however, will seem less of a federal problem to local governments. Will the Federal Bureau of Investigation be able to enforce all law violations involving air transportation? Some form of direct federal-local relationship is going to be necessary to provide workable solutions to urban problems.

Defense considerations must include the potential of a VTO mass

market as a commercial production balance to military production.

The VTO manufacturing industry will be able to absorb most of the industrial capacity of the auto industry including the new peace-time potential of the guided missile industry.

Government policy favoring the growth of new industries should try to encourage well balanced industries, i.e. organizations which have a good share of a commercial market and a corresponding military production. Such industries will be able to stand up in all kinds of emergencies. The same thinking should apply to research work. Government research contracts have created private research laboratories for exclusively military purposes. Here again an economic balance should be established. Private laboratories should balance defense contracts with commercial contracts and universities should balance military contracts with academic research.

Ultimate thinking in defense matters must lead to the use of continued national comprehensive planning as a means of keeping the nation in its best possible and economically feasible state of military readiness.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

New trends in aircraft technology point towards the development of vertical take-off and landing flight-regime. Two types of aircraft are contemplated: first, the multi-passenger VTO with its reduced requirements for landing space and facilities and ability to feed into central city locations and small towns; secondly, the private VTO, which will eventually replace the function of the present private car.

Obviously, such a change will affect urban life to a great extent and it is necessary to engage in long-range urban planning in order to insure proper and beneficial growth of the new means of transportation.

Planning considerations include the study of transportation history and are based on the projection of past experiences into the future.

Trafficways will need to be coordinated for total national transportation efficiency. New concepts of airways will have to be explored to take care of mass VTO traffic.

Land-use considerations will be greatly influenced by the new form of air access and by the increased travel range of people. This may call for total land-use planning of the nation. The sovereignty of the Federal Government over the United States airspace creates direct Federal influence on local life where it depends on VTOs.

Economic considerations must include the possibility of a mass market for private VTOs and the threat to the automobile industry if a new VTO industry grows separately. The VTOs will expand the economy in general but especially they will be instrumental in reclaiming the barren lands of the West and in urbanizing the eastern rural areas. The high performance and safety requirements of VTOs may lead to new rental service markets.

Social considerations on the effects of VTOs will show a trend towards a more dispersed population. The change may cause problems of unbalanced social structure. The VTO's effect in increasing standardization of remaining regional social characteristics may be outweighed by its making possible a "dispersed" group life which also is able to preserve individual characteristics.

Governmental considerations show the need to cover the entire nation with urban forms of government, if unchecked urban growth by VTOs in rural areas is to be avoided. National transportation lacks coordination of its various branches. Defense considerations should lead to an ideal production balance between civilian mass-VTO market and defense market for guided missiles and other aircraft.

Recommendations. --(1) Establishment of a National Planning Board to provide coordination and long-range planning criteria to all government branches. Concerning VTOs, that board should study effects of government anti-trust controls on functional continuity in the transportation

industry. It should then advise on military VTO procurement policies to insure the establishment of well balanced civilian and military industrial potential. Its activities should include the formulation of a National Transportation Policy and the coordination necessary to achieve a VTO airways system, based on both air transportation and urban development considerations.

(2) Creation of a Department of Urban Affairs to include and expand present activities of the Federal Housing Agency to cover all urban problems. This department should develop means of assistance to rural areas, to cope with urban problems arising from new VTO access. A further aim would be to re-evaluate existing government policy on housing and urban renewal and to include new town developments in its programs.

(3) Reorganization of agencies dealing with transportation, or if necessary, creation of a new transportation department in order to provide coordination between existing transportation fields and to guide growth of new branches such as VTO transportation for total national transportation efficiency.

LITERATURE CITED

1. Zimmermann, Erich W., World Resources and Industries. New York: Harper and Brothers, 1950, p. 138.
2. Hiller, Stanley, Jr., "The Approaching Era of VTO," Newsletter, American Helicopter Society, Vol. 2, No. 12, December 1956, p. 5.
3. Armstrong, John E., "VTOL, Tomorrow's Aircraft Today," United States Army Aviation Digest, Vol. 3, No. 7, July 1957, p. 5.
4. Beasley, Peter, "The Aerocycle," Newsletter American Helicopter Society, Vol. 12, No. 12, December 1956, p. 1.
5. Port of New York Authority, Aviation Department, Transportation by Helicopter 1955 - 1975. New York, May 1953.
6. Civil Aeronautics Board, Helicopter Air Service Inc. Certificate Renewal Case, Docket No. 6600 et al. Washington D. C., 1955.
7. Civil Aeronautics Administration, U. S. Dept. of Commerce, 1960 - 1965 - 1970 Civil Aviation and Federal Airways Forecasts. Washington: U. S. Department of Commerce, December 1956, pp. 1, 12.
8. Weyl, A. R., "Anti Gravity," Aeronautics, Vol. XII, No. 10, October 1957, p. 24.
9. The Air Coordinating Committee, The Convertiplane. Washington: U. S. Government Printing Office, October 1954.
10. Owen, Wilfred, The Metropolitan Transportation Problem. Washington: The Brookings Institution, 1956.
11. Lehner, W., Die Eroberungen der Alpen. Innsbruck: Hochalpiner Verlag, 1924.
12. Association of American Railroads, Federal Aids to Domestic Transportation. Washington, April 1954.
13. Mossman, Frank H., "Transportation History" by Guy C. Hekker, Principles of Urban Transportation. Cleveland, Ohio: The Press of Western Reserve University, July 1951, pp. 1 - 38.

14. San Francisco Bay Area Rapid Transit Commission, San Francisco Bay Area Rapid Transit Study. San Francisco, 1955.
15. North Georgia Conference for Planning and Development, Patterns of Change. Atlanta Metropolitan Planning Commission, September 1957.
16. Civil Aeronautics Administration, op. cit., pp. 57 - 70.
17. Curtis, Edward P., National Requirements for Aviation Facilities. 1956 - 75. Washington: U. S. Government Printing Office. June 1957.
18. Gruen, Victor, "Typical Down Town Transformed," Architectural Forum, May 1956.
19. Fallon, George H., "A Bill," H. R. 3620. Washington: 85th Congress, 1st session, January 1957.
20. Zimmermann, op. cit., p. 140.
21. Byrd, Willard C. & Hammer & Co., New Town, Metropolitan Atlanta, Atlanta, 1956.
22. Public Administration Service, The Government of Metropolitan Miami. Chicago: Public Administration Service, December 1954.
23. Ricklefs, James S., Why No More Helicopter Subsidy. San Francisco, 1955.
24. Dearing Charles L., Owen Wilfred, National Transportation Policy. Washington: The Brookings Institution, 1940.
25. The President's Air Coordinating Committee, Civil Air Policy. Washington: U. S. Government Printing Office, May 1954.
26. Peach, Robert E., Statement on Recertification of Mohawk Airlines. S-2647 U. S. Senate, Washington. April 27, 1954.

OTHER REFERENCES

Aldrich, Grahame H , Helicopter Horizons. Air Transport Association of America, Washington, D. C., 1955

Discusses the potential market for helicopter transportation and reviews equipment and facilities needed for the contemplated operations.

Association of American Railroads, Subcommittee on Airtransport. Railroad Participation in Air Transport. Washington, 1946

Reviews various phases of air transport: domestic and international, technical progress, etc. Claims that airlines receive favorable treatment from the government. Advocates that rails be permitted to engage in air transportation.

Autenrieth, Dr. , "Zukunftsaussichten für einen deutschen Luftnahverkehr", Nahverkehrs Praxis. Vol. 4, No. 4, Dortmund, Germany, 1956

Discusses the potential market for a helicopter transportation system in the densely populated industrial areas of Germany.

Clerk, A. C. , Highway and Heliport Program Planning. Bureau of Public Roads. New York, 1957

Compares the new Interstate Highway System with the future airways system and shows the areas of cooperation.

Cooper, John C. , "State Sovereignty vs. Federal Sovereignty of Navigable Airspace," Journal of Air Law and Commerce, Vol. 15, No. 1, Winter 1948, pp. 27 - 38

Discusses the problems arising between states and federal government concerning jurisdiction of airspace over the United States.

Coward, Ken, "Ryan to Build VTOL for Army." Ryan Reporter, Vol. 17, No. 3, p. 18

Describes performance and potential uses of new VTO aircraft, based on the deflected slip-stream principle.

Cunningham, W. J. , "The Transportation Problem." Harvard Business Review, Vol. 25, p. 74. Autumn 1946.

Suggests that the country needs to revise its policies to create a coordinated transportation system. Points out that air transportation is favored by the government. Discusses proposal to make CAB, the agency which controls aviation, a division of the ICC.

Farrell, James A., Jr., "Letter to the Editorial Advisory Board." Air Affairs, September 1946, Vol. 1, pp. 109 - 112.

Calls on CAB to permit American shipping to engage in aviation. Compares United States position with foreign operations which permit such a tie. Minimizes CAB fears that a tie between shipping and aviation is dangerous.

Isard, Caroline & Walter, "Economic Implication of Aircraft." Quarterly Journal of Economics. February 1945, Vol. LIX, pp. 145 - 169.

Attempts to predict changes due to increased aviation activities. Predicts residential population centers will move farther away from business centers, concentration of fewer, more important financial and commercial centers, development of new areas, trades and resources.

Mazzitelli, F. R., The Tilt-Wing VTOL Aircraft as a Commercial Air-Transport. Vertol Air Craft Company, Morton, Pennsylvania, 1957.

Describes the performance of tilt-wing aircraft and suggests that this type of aircraft is suited to fulfill the urban need for short-haul travel.

Middleton, R. H., Transport Coordination in the United States. Railway Business Association, Chicago, 1946, p. 72.

Discusses the characteristics of the various transportation media. Shows that inherent differences in service offered and cites need for a coordinated transportation system to serve the public interest and still permit individual profitable operation.

National Planning Association. National Policy for Aviation. Washington, 1946.

Speaks of airpower as combination of aircraft manufacturing military airforces and air commerce. Stresses need for government coordination of commercial and military aviation.

Ogburn, William Fielding. Social Effects of Aviation. Boston, Houghton Mifflin Co., 1946. p. 755

Discusses effect of inventions on people and predicts effects of aviation on the many aspects of our civilization.