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REFLECTIONS ON
THE ROLE OF AIR TRANSPORT IN
THE HARMONIOUS EVOLUTION OF
UNDERDEVELOPED COUNTRIES

Jacques Jodeau

Translated from the French by
Jack Gallob, Trans-Slavic Associates

The RAND Corporation
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TRANSLATOR'S PREFACE


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I. INTRODUCTION

Production techniques play a particularly important role in a development plan. In the majority of countries, setting up these means of production can be accomplished only to the extent that a previous major effort has been made in the area of transportation.

The efficacy of the production techniques which have been set up is measured, moreover, by the efficiency of the existing means of transportation, where the latter are providing the necessary flow of materials and provisions, transportation for people, or the removal of finished goods to commercial centers.

Even though investments in transportation may comprise only a small fraction of the total expense, they are indispensable to the realization of any development operation.

Thus a general plan for economic development necessarily includes a plan for development of transportation; it may involve quite diverse aspects.

River and maritime transport may be considered where certain geographic and climate conditions apply.

Pipelines and cables may be used when, after consideration of local factors, the problems of pure exploitation can be dissociated from general problems of economic and social development or when the former should be treated in a very different or particular fashion.

The three remaining means of transportation are road, rail, and air. These have a global role in the economy, depending on varying factors which include inequalities arising from economic, geographic, or demographic conditions, as well as more or less important financial considerations; this is particularly true in a developing economy.
This global character should be seen first in the light of the services rendered; each of these means of transportation contributes directly to the economic development of a region as well as to the raising of the social level and development of political and administrative life.

On the human level, each of these methods of transportation has a somewhat more definite significance than a pipeline or cable, for example, since the only purpose of the latter two is to transport materials. Generally, transportation investments have a much broader goal.

The global nature of the significance attached to the three means of transportation extends to the geographic level as well. But for certain exceptions, transportation by road, rail, and air - even if it originally had a specific geographic function - generally affects much broader zones than those foreseen. This geographic extension of the transportation role serves as a continuous infrastructure (rail-air-road) of the means of transportation, as well as a point infrastructure.

Air transport having been rapidly established within the context of other means of transportation, it is possible to discuss a number of questions relating to the role which air transport may play in a developing economy.

Numerous examples of the role of air transport will be selected from Africa. There the airplane has, in fact, a particularly important role; however, this role is duplicated in all regions of the world where, due to reasons of geography, history, or climate, surface transportation has not reached the degree of development which is characteristic of a number of countries in the temperate zones. South America, Greater Northern Canada, Southeast Asia, or Australasia could also furnish numerous examples illustrating the role of air transportation in a developing economy.
II. TRANSPORTATION NEEDS AND PROBLEMS IN DEVELOPING COUNTRIES

It would be convenient in this respect to define an underdeveloped region. In our opinion, it is a region possessing a potential for production (mineral, agricultural, etc.) that has not been realized due to the lack of one or more necessary elements such as capital, labor, means of transportation, power, consumers' markets, or ease of access and mobility of finished goods.

The development of this region - and it should be emphasized that even in developed countries there are some insufficiently developed regions - will consist, as far as an external contribution is concerned, of filling existing gaps in order to start the economy. This external supply should always be predicated on the existence of a production potential, since the level of development will eventually be a function of the importance of production.

Many problems which arise in underdeveloped countries can be partially, if not completely, solved by the use of transports. A. Huxley wrote that "transporting material from one point to another is the essence of human activity." Actually, human activity only attains maximum efficiency when man can transport himself rapidly from one point to another. Quite graphically, it can be stated that economic development results from the active presence of man at a certain point, which develops a potential production for an easily accessible consumers' market. The simultaneous existence of these three elements is extremely rare, and can only be realized by the transportation of substantial quantities or numbers of cargo over fairly great distances; the means of transportation is itself dependent upon energy and capital resources.

To effect the simultaneous presence of a production potential, a consumers' market, and man poses certain problems which we will investigate in the following.
Without attempting to draw a full scheme of an underdeveloped region, it is possible to give a few characteristics which are relevant to the transportation aspects.

The distances to be traversed are generally great. These distances should be measured in travel time rather than in kilometers. The time required to cross a virgin forest, swamp, river rapids, or a mountain range may considerably increase the duration of a passage and has often rendered useless the efforts expended on the creation of a continuous transport infrastructure; the cost involved would be disproportionate to the expected gain. In this respect one should keep in mind the cost in capital and human life in constructing the Congo-Ocean railway from Brazzaville to Pointe Noire.

Often there is no juxtaposition of densely populated centers and centers capable of development.

Whereas favorable agricultural regions often coincide with zones of high demographic density, this is not always true of zones with mineral or industrial potential. Whatever the level of employment, amount of labor force from adjacent regions and number of technicians from abroad, their presence often poses difficult transportation problems which must be solved.

An underdeveloped region is sometimes one where the existing means have not always been utilized for the general economic and social development of the region.

Mineral railways, for example, are often constructed for the purpose of exploiting a geographically well-defined deposit; usually insufficient attention is given to the development of the entire region. Moreover, the regions traversed may be so poverty-stricken that a means of transportation can no longer fill a global role, but must only retain its function of transporting freight.
Numerous difficulties of access often complicate the development plan of a region which, for example, is far from the sea.

A substantial investment in a mineral zone which is 500 or 1000 kilometers from a port can be made only after taking the entire situation into account, since difficulties of access often tend to affect adversely the efficiency of these investments.

The lack of capital is often particularly evident; such capital that exists is always cautious, undertaking investments in new regions by conventional and secure methods in order to limit risks. In a virgin region the penetration of capital is often a function of the conditions which determine the penetration of transportation. The need of creating a transportation infrastructure, if it is costly and must be constructed at the expense of industrial, mineral, or agricultural investors, will abort any operation if the initial cost is too high. If, on the contrary, the initial burden represented by the creation of a transportation infrastructure is small or relatively so, even though the costs of exploiting the transportation are high, the operation could be undertaken.

Intervention of public power plays, in the final analysis, an essential role.

The liaison between centers of production and of consumption corresponds to increasingly diversified needs. It is evident that in the development process of a given region, the transportation needs differ in the "to" and "from" directions, often presenting very important differences in urgency and nature, and in some cases requiring different means of transportation. Urgency of transport, and the possibility of transporting small masses may figure in one case, whereas in another case it is essential to have massive
and regular transport. Naturally, some of the needs may be equally satisfied by several means of transportation. Engineers may be transported 500 or 1000 kilometers by a mineral railway just as bulky products can be carried by airplane. Although, except for particular cases, the transportation means may be bivalent or multivalent during the development of the economy, it is likely that once the development is achieved, each means of transportation will acquire a more limited sphere of activity, according to the global tonnage conditions. It is only when such a situation can be attained that a development operation is fully justified on an economic plane.

Numerous other aspects of transportation in underdeveloped countries could be examined. The few remarks above, however, make it possible to establish the role of transports; here, air transportation may assume a particularly important position. We will attempt to clarify this in the following.
III. THE CONTRIBUTION OF AIR TRANSPORTATION IN UNDERDEVELOPED REGIONS

First it would be useful to review certain characteristics of this means of transportation in order to define its areas of use and limits of application.

The airplane can shorten transit time considerably and can reduce inequalities in transit time due to geographical and climatic conditions, etc. The speeds attained since the advent of the DC-3, at least in local applications, have been sufficient to bring about revolutionary changes.

The effect has been to reduce to hours what used to take weeks of traveling time (the number of hours being proportional to the straight line distance); the number of weeks was a function of geographical and climatic conditions, among others.

It does not appear, under these conditions, that further increase in speeds will result in anything but a slight improvement in comfort and available commodities, at least with respect to local transport. On the other hand, emphasis will be placed on decreasing costs as much as possible.

The airplane does not require a costly infrastructure during the development of a region; one need not be concerned with the cost of a large modern airport, since the latter plays no part in the evolution of an underdeveloped region. What is needed here is an airplane which requires only a short distance in which to take off, crude facilities, and simple maintenance. Of course, there are examples of long-distance airplanes being "adapted" for the exploitation of air transport in some underdeveloped countries, but the infrastructure which is used often remains relatively rough, as in the Sahara, Brazil, Black Africa, etc.
The airplane is not fixed to a particular infrastructure; this gives it complete mobility. This mobility can be cyclic; in the course of one day an airplane may make several round trips to different points. In the course of a month or a year, the same plane may be used for quite different purposes - for transporting freight or passengers or both. Such mobility makes it possible to engage in rapid exploitation involving several unknowns, without great financial risks. A total or partial change in plans will involve only the write-off of limited investments; most of the expenditures - flying equipment in particular - can be used in other places. The case of In Salah in the Sahara could be cited, where the evolution of traffic has been largely influenced by the vagaries of oil prospecting.

Airplanes can be put to use very rapidly, as is shown by the development of traffic in certain airports. A crude landing strip is sufficient for the Breguet 941 (double deck) which has a payload of 12 - 15 tons.

Current military orders for cargo planes frequently call for vehicles which can function in all types of terrain with a minimum of delay and which have wide areas of application; these planes do not require the long runway necessary for planes with four jet engines.

The airplane is a less important unit of transportation. A railway becomes profitable only at a high level of usage; the profit is affected by the original investments required. With an aeronautic infrastructure, which is relatively much less costly, the profit threshold is reached much sooner. Thus the exploitation expenses are proportionately higher for air transport than for rail transport, for example.

The airplane can be used in a very progressive fashion. This is due to the small ratio of ground expenses to exploitation costs. A railroad
must receive very heavy use in order that the substantial infrastructure expenses do not overburden each unit transported. In air transport this is a small encumbrance.

The wide variety of available planes makes possible rapid adaptation to achieve results.

Naturally, whatever the advantages of air transport, certain of its limitations should be pointed out.

The cost of air transport remains high, in spite of the progress which has been made. Of course, in the case of heavy-duty planes the price per kilometric ton is reduced; however, this is often achieved at the expense of flexibility, since the tonnage loads must be considerably more important.

A C-133 (American military cargo plane) has a 45-ton payload; this certainly tends to lower considerably the actual cost per kilometric ton (and the trend can continue), but nevertheless it is undoubtedly a long way from offering the same advantages as the small C-47, which can be used for many small errands.

At a certain volume of traffic, surface transport regains its advantage and the traffic justifies the construction of a continuous infrastructure.

There has been much investigation and experience in this field. In studies made before exploitation of copper ore in Akjoujt, Mauretania, air transport had been considered for the copper ingots, if not for the copper ore. This idea was abandoned later, particularly when a rail connection with a highly efficient railroad (Fort Courad (iron ore) - Port Etienne) was considered.

Prospecting and development of the Sahara resources have been undertaken almost exclusively by air. As soon as definite traffic patterns were established,
the road network developed widely, owing to new and more economical techniques of road construction. Moreover, pipelines were built although air transport of crude oil by airplanes, gliders, or dirigibles had been considered.

It is obvious that a decision to construct a road or a railroad must take into account not only the foreseeable traffic but also the conditions and difficulties encountered in establishing this infrastructure.

In a mountainous zone, the traffic volume needed to make a railroad profitable will be much greater than on level ground.

Air transport, in distinction to road or rail transport, makes possible the development of various points within a region. It is not evident that this is always in line with the intent of the general economic plans. The building of a railroad (as in the United States during the westward movement) makes possible the development of land on either side, if the traversed zone has agricultural possibilities. The same holds true for a road. Air transport, on the contrary, permits skipping over quite vast regions; this makes no difference if the skipped zone is poor, but the poverty of a region does not always justify excluding it from the economic and social development of a country.

Development in various points may perhaps make it possible to obtain more rapid results; however, these results are not necessarily as thorough as those obtained with a road or a railroad.

Air transport is not self-supporting in its current state. It must be supported by an expansive road network, which has to be well developed around the points served. It may be assumed - in the long range - that the initial choice of air transport will lead to the progressive construction of surface transport, given favorable economic and geographic conditions, particularly
of a road network which will supplement and parallel the air transport.

The characteristics of the airplane, as important as they may be, cannot lead to its being considered the sole means of transport in a given region. Actually, air transport must be integrated with the general economic context, but it is likely that this means of transport, if given priority, will permit the acceleration of the development of several construction centers along the predicted route (e.g., the case in which a railroad was constructed in Labrador by using air transport for the men and necessary equipment), and will help fill the requirements for exploiting other means of transport, i.e., in the initial stages of creating a production volume which will justify the use of other means of transport.
IV. SOME CONSEQUENCES OF THE INTRODUCTION OF AIR TRANSPORT IN UNDERDEVELOPED REGIONS

Air transport has led, moreover, to fundamental modifications in many aspects of social and economic life in numerous countries. However, no new technique makes its appearance unaccompanied, and it is always difficult to evaluate its consequences on a general as well as on an individual economic plane.

Business, administrative, and political structure, dissemination of education and hygiene are areas in which the introduction of a new means of transport has a noticeable influence.

It is not our purpose here to draw complete and definitive conclusions about the influence of air transport on various aspects of collective and individual life. However, we will reinforce our observations with some examples and brief commentaries.

It should be noted, besides, that these consequences are often easier to study in countries which are undergoing a process of evolution and whose economic and human structure is often more simple than that of developed countries; there is considerable variation among underdeveloped countries as well, though, depending on the region.

THE INFLUENCE OF AIR TRANSPORT ON THE GENERAL ECONOMY

It is incontestable that air transport, because it can be introduced rapidly, often helps to "remodel" the economy much more rapidly and efficiently than could surface transports; the latter are time-consuming to set up and often require heavy investments, particularly in countries where each of the economic and social sectors of activity is an important consumer of capital.
The consequences which can be noted in underdeveloped regions may be illustrated by examples taken from any part of the world. As the introduction of rapid train service has geographically and quantitatively increased the consumption of sea fish, so the use of the airplane has considerably extended the Côte d'Azur flower market.

Similar examples of the creation or extension of consumer markets, leading to a parallel development of production markets, can frequently be found in underdeveloped regions. A characteristic example would be the air transport of meat between the regions of Tchad and the consumer markets in equatorial regions or in Australia. The conditions under which this development took place merit considerable attention, since the field of application can be extended in certain cases to products which a priori do not appear to be transportable by air. The possibility of such transport by air can, by encouraging an increase in consumption, modify the character of it. It is certainly the airplane which has been responsible for the considerable increase in European population in Africa and for the evolution of its structure, particularly by increasing the ratio of women to men, which was previously much lower.

As another example, the airplane has brought about important changes in the eating habits of African populations. Moreover, by making possible the creation of new centers of activity in the Sahara, the airplane has contributed indirectly to the progressive construction of new consumption centers.

Air transport has also had a definite influence on the development of mineral resources. On one hand, it permits prospecting of certain regions rapidly and the simultaneous prospecting of groups of large areas. This has been true of the still-incomplete inventory of the Sahara mineral resources;
it has been said that this inventory would have required several decades if done by surface transport. It is a faster means of starting the exploitation of certain resources; this can result, e.g., from a simultaneous construction of production and delivery facilities at the location of the mineral deposit. A well-known example is the railroad connection between mineral-rich Labrador and the Saint Lawrence River. The airplane contributed to construction along the entire route, reducing construction time by two-thirds, and exploitation of the mine began as soon as the railroad was completed. It allows great human mobility, which in some cases makes possible frequent and brief stopovers by technicians who could not remain permanently in uncomfortable regions. For example, a personnel rotation system which only the airplane can make possible is used in the exploitation of oil in the Sahara.

Among the economic resources of a country, tourism figures more and more prominently, and investments made to develop tourism must naturally take into account the possibilities offered by air transport. Just as in recent years the Zambezi Falls, Sahara cases and tropical African safaris have been important tourist attractions, it can be expected that in the future each developing country will find tourism to be an important source of revenue, which justifies investments in the aeronautical field.

This extension of tourism toward the tropical and equatorial regions would be a logical consequence of the expansion of distances traveled by European and American tourists, who, after having limited themselves to their own countries, and then to the Mediterranean regions, are now attracted to the exotic intertropical regions.

Although, naturally, it is not possible to state that air transport is the essential element in the general economic development of a region,
nevertheless this does not reduce its importance; the stage of economic development attained in the Sahara, Siberia, and Northern Canada - to name a few examples - and the rate and simultaneity of this development can only be explained by the role of air transport. It should be noted, moreover, that this role applies not only to countries commonly termed underdeveloped, but in all cases where there must be an interchange between two regions at different stages of development. The airplane then plays the role of a homogenizer on an economic and geographic level; for example, the rate of economic development in the United States, which is most rapid on the west coast, is reflected in the greater rate of traffic increase in Los Angeles.

We should add to the economic consequences of air transport the repercussions in the political and administrative fields. For example, the very rapid and widespread emancipation of Africa undoubtedly would not have been conceivable, either nationally or internationally, without air transport.

Air transport has, in effect, played an essential role in drawing the various African regions into international life, both on a global and local plane. A maritime-structured set of international relations allowing a limited amount of contacts with a few countries has been replaced by aerial-structured relations (which can be termed "open") with the entire world. Recent years have witnessed the multiplication of possibilities for liaison between African countries, for a certain African solidarity, and for a regularization of the rate of development, as well as for liaisons between African countries and "developed" countries in temperate zones, and for a multiplication of channels for technical cooperation between European and African countries.
Air transport thus plays an essential role in the rapid establishment of new institutions, but it also figures equally in the movement of men along new routes and in the diffusion of political and economic ideas. In some cases its role is analogous to that of the radio. The airplane thus accelerates the formation of African nations, allows the establishment of firm administrative structures and the affirmation of a national character vis-à-vis the rest of the world.

Whereas air transport plays an important part in the formation of a new economic structure, it already has modified and continues to modify to a considerable extent the habits and methods of industrial and commercial enterprises, as well as those of individuals.

**THE INFLUENCE OF AIR TRANSPORT ON BUSINESS**

The great mobility of administrative, technical and control personnel leads to a fundamental reconsideration of some management methods, either by achieving economies in personnel or by reducing the degree of autonomy enjoyed by certain distant establishments. Economic and technical contacts being faster and easier, a greater administrative homogeneity results. Journeys which require a month by sea now take a maximum of a few hours or days by air and there are no delays, which were previously unavoidable when traveling by sea, due to the small number of departures.

The use of air transport, moreover, increases the rate of activity of commercial companies and makes possible the application of methods developed in European countries. The penetration of phenomena such as fashions, the need for rapid activity at crop marketing time or after particular events, the possibility of global intervention in various countries in order to give to
African markets an amplitude justifying the interest of European or American countries, cannot be conceived without air transport. A depth study of a few markets such as the automobile or agricultural equipment market would undoubtedly be quite fruitful. This generally applies for distant markets, where equipment can be sold only if maintenance, spare parts and repairs can be provided within a short time. Establishment of spare-part depots near the consumer would undoubtedly burden the selling price considerably; a better solution seems to have been found in certain cases by the setting up of regional stock depots, from which spare parts are flown out by request to the locality where the need exists.

These examples could be multiplied; they show how air transport can modify the overall view when a particular African market is being studied.

THE INFLUENCE OF AIR TRANSPORT ON THE INDIVIDUAL

On the individual level also, air transport plays an essential role which is more profound than spectacular. The creation of new commercial routes, which was mentioned previously, leads to an increase in the living standard and to modifications in the way of life. The income level increases noticeably when a product - such as that of meat in Tchad - can be commercialized; the nutritional level in calories increases and brings about an improvement in the hygiene and state of health of the population. Movement becomes easier and more frequent, and not just for the upper economic level of the population; Europeans can make briefer and more frequent visits and can bring their families; the European and African cultures find more numerous meeting grounds; the Africans can pursue more profound and diversified studies which aid in the rapid construction of an African elite suitable to each new
nation but still having a common structure. All these elements - and there are others - tend to contribute to the profound and very rapid modification of living conditions in regions which until now were underprivileged.
V. CONCLUSIONS

It is no longer possible, within a brief framework, to summarize completely and exactly the contribution made by air transport to a development policy. This contribution pertains to the economic plane and to general policies, as well as to commercial and industrial companies and to the individual. Thus air transport - when its particular characteristics are taken into account, especially its flexibility and speed - is an extremely valuable means of obtaining rapid and numerous results.

Of course, in spite of the advantages it offers, air transport is limited by its exploitation costs and by the fact that when an economy has reached its "cruising speed" air transport alone cannot satisfy its needs. Air transport must then be installed within a complex of transportation means which tend to specialize by reason of their own nature. We can thus witness in developing countries an inverse phenomenon to that seen in developed countries where surface transport inhibits air transport development.

Considering everything, in our opinion it is difficult or impossible to assign to air transport a fixed and theoretical place in the plan of economic development; this place depends upon the following: on the one hand, upon aircraft possibilities, and on the other, upon the possibilities of other means of transportation, which are changing more rapidly. And finally, besides economic, demographic, and human geographic factors, it depends (and this is essential) upon particular options made on the economic as well as on the social plane.

The development observed since the end of the last war and the prospects of air transport evolution during the coming years - particularly with respect
to lower costs, reduced infrastructures for short-distance transport, better adaptation of transport equipment to diversified needs and increased transportation regularity - allow the assumption that the role of air transport can only increase.