TENTATIVE COMPARISON BETWEEN FRENCH AND AMERICAN
NEW TRANSPORTATION SYSTEMS DEVELOPMENT POLICIES

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Introduction

Since the mid-sixties in the United States and France a great number of "new transportation systems" have been developed with such names as PRT, TACV, Dial-A-Ride, and Dual Mode. The original concepts were mostly proposed by private entrepreneurs or academics trying either to find a market for some advanced technological and highly computerized concepts or to propose a solution to the increasing woes of the city. Some of them have been developed with the help of various public agencies: federal government in the USA, Central government, local authorities, and operating agencies in France, and the participation of transit and automobile manufacturers, and aerospace firms.

This paper is directed towards establishing a comparison between the French and American experiences in the development of such systems. Consequently, it is first concerned with the differences existing in technological choices, management methods, and institutional and financial frameworks, which form the layout for the development process of such an industrial product. However, it would be difficult to understand these differences without a preliminary analysis of the urban transportation context in the two countries. (Indeed, the most modern transportation system, is only a partial answer to a more complex problem associated with the development of cities. Transportation is only one aspect of the urban problem and only one among several other technologies which must be considered in any solution to the problem.)

The design of new transportation systems has to be carefully related to the transportation needs as far as they can be precisely assessed. Hence, the basic differences between the systems developed in both countries are born of the differences existing in their urban patterns which generate transportation needs. Because of these differences and certain political,
economic, commercial, and sociological considerations, the actual system could be far different from the original theory.

At first, the coordination of urban planning processes and development of new technologies was a casual one. Comprehensive planning and transportation studies issued in the sixties dealt with the new transportation technologies only as a curiosity. At this time they were used mainly to enhance the image of conventional rapid transit systems. When it became apparent that they could perhaps satisfy travel needs other than those actually handled by the conventional rapid transit systems, their development was more carefully planned and they were considered as a real alternative to the more conventional transportation systems, i.e. subways, commuter railways, and buses. As such they allowed urban planners to think more freely about various forms of urban development instead of being locked in the continuous dialectic: suburbs--central business district.

The backing of the central governments and the large amounts of money needed for the development of these sophisticated industrial products have necessitated careful planning before introducing them to the urban context. (However, this has often been based more on intuition than on an in-depth analysis of the urban transportation problems.)

At the present time, several of these new systems have undergone comprehensive testing and a few have operated more or less successfully. From these experiences it is possible to draw some preliminary conclusions, to analyze shortcomings as well as successes and to set some general rules which should be observed when dealing with development of new technologies which are to be utilized in an urban environment.

Therefore, this paper will contain three sections; the first will compare the general aspects of transportation problems in American and French cities,
and will underline and explain some of the basic differences existing between new American and French transportation systems concepts. The second section will attempt to present, after a short history of the new transportation systems, the basic concepts which underly the development policies as well as the various agencies in charge of their administration in the two countries. The third will show the application of these principles in some development projects currently underway in France and the United States.

In a field which changes very quickly, this paper obviously cannot draw definite conclusions about a problem as complex as urban transportation. It reflects only the intermediate stage of a constantly evolving process and should be regarded simply as a guideline for subsequent projects rather than a definitive statement about new transportation systems.

This paper is based on the personal experiences of the author, regarding the development of French transportation systems and, as far as the American examples are concerned, on a series of interviews with various manufacturers, transit operators, transportation consultants, and administrative bodies. Therefore, it will not include selected bibliography though the ideas developed here have been largely influenced by numerous readings.
I. Transportation Problems in American and French Cities Related to the Development of New Transportation Systems

Any general comparison between two countries on a complex matter such as transportation problems must be done carefully. American and French cities cannot be reduced to a set of specifics regarding their transportation characteristics. An American city on the west coast and one on the east coast could well be more different than an American city and a French city. Also, when attempting to define national policy for development of new transportation systems one must consider general goals and mean characteristics which will permit the development of systems able to deal with the broadest range of urban transportation problems. (This approach, although not entirely satisfactory at a conceptual level, is required by the scarcity of resources which can be devoted to the development of transportation systems.) Therefore, when taking into account the high costs involved in the development of these systems, administrative agencies and manufacturers tend to develop only those transportation systems which have the biggest potential market; instead of attempting to solve transportation problems of any one city they will try to solve as many basic universal problems as they can in order to design the least number of different transportation systems. The comparison between American and French cities must therefore be regarded, keeping in mind that economic and financial standpoint, which leads to a synthetic approach rather than an analytic approach.

The second point which must be kept in mind is the static nature of the comparison. When possible, dynamic aspects and trends will be underlined, but the basic components of the comparison will refer to the actual situation rather than the projected one. The recent issue of the energy crisis has pinpointed the shortcomings of long range forecasting methods and it would be hazardous to set up a comparison between several planned pictures!
The first basic characteristic stems from the differences between urban patterns in France and the United States. In the former, urban development is still largely composed of high rise apartments (which is about one half the housing units built each year) instead of individual units. As a result housing density tends to be higher in France than in the United States. "Urban Sprawl" in the United States has been, of course, the result of the availability of automobiles, freeways, expressways, etc. On the contrary, freeways in France are only a recent acquisition. The first complete expressway surrounding Paris was built in 1973 and Toulouse (population 500,000) in the southern part of France had no expressway until 1968.

In this context housing units tend to cluster either on the cheapest land available near the center or around the important commuter railway lines. In the first case, mainly in the central part of the country, cities tend to grow in concentric rings around the center; in the second case, as in the Paris area, the two phenomena mix together and urban development consists mainly of a combination of government housing (high rise apartments) on the cheapest land and private housing (mainly individual units) in the vacant areas close to the railway lines. As far as the transportation problems are concerned, this urban development pattern tends to generate more trips per surface unit than in American cities, at least in so far as public transportation systems, coeteis partibus, are concerned. Meanwhile the accent has recently been on building a great number of individual houses, which could result in a lower population density, especially in the provincial cities where automobile ownership is higher than in the Paris area. But this trend could be counterbalanced by the rarefaction of energy and a subsequent decrease in highways investments. These considerations lead one to think that there is more potential support for high or medium capacity transportation systems in France than in the United States.
Another important characteristic of French cities is the importance of the city center not only as an employment center, but also as a commercial and population center. Even though these two last functions have tended to decrease slightly in recent years, the urban centers are still multifaceted centers and represent an important proportion of the overall job opportunities, housing units, and commercial spaces. Paris itself, for example, accounts for about 50% of the overall employment opportunities and more than 20% of the regional population. The figures are quite similar for a provincial city like Toulouse. Conversely, the central part of the American cities seem to be less diversified. They are mainly devoted to office space with less emphasis on housing and commercial functions. Moreover, many of the employment opportunities are no longer found in the urban core but are scattered in the suburbs where the greatest part of the population is located. The implications of this fact on the transportation pattern are significant. Whereas in the French cities the most important part of an individual's trips are still directed towards the urban center or originate from it, the typical American trip pattern is much more diffuse and widely scattered among the entire urban area.

In many of the French cities, except for the Paris area, individual trips from suburb to suburb, can still be accommodated with radial facilities, at least with respect to the public transportation system. Meanwhile, in the last few years, many industrial activities and households have tended to move out of the center in order to get more space at cheaper prices. As a result, population as well as industrial employment in the urban center is decreasing slightly; poorer people tend to leave the urban core of the city and are often replaced by a fewer number of "well-to-do" who can afford to live in the historical part of the city. Therefore, the fastest growing travel pattern is one of trips outside the urban
center from suburb to suburb. And, as the size of the city increases, it will become more and more difficult to accommodate this kind of trip pattern with radial facilities, either railway lines or expressways.

In American cities, space which is devoted to highways, expressways, freeways and so on is more important than in French cities. The road network in France is still underdeveloped at least with respect to the freeway and arterial expressway network. Besides, the French urban road network is made up mainly of narrow streets (40 feet wide and sometimes less!) in the urban centers and the suburbs. Wider roads are found only in some of the new developments on the outskirts of the city. Meanwhile some broad arterial roads (more than 70 feet wide) can be found in those cities, particularly those which were created in the middle of the 19th century under the Administration of Baron Haussmann. Unfortunately these roads are often located outside the urban centers, on the periphery and do not match the radial traffic pattern generated by the center city. As a result, it is very difficult with such a road network to implement aerial structures in the central part of the cities. Furthermore, the architectural quality of many urban centers in France prevents a widespread use of aerial or grade right of ways. As it is highly probable that any new transportation system will have to go into the central part of the city by means of underground sections, the emphasis will be set upon highly travelled corridors, thus reinforcing the need for high or medium capacity systems.

Another consequence of the characteristic French road network consists in the appearance of road congestion though smaller percentage of the population uses automobiles than in the United States. As a matter of fact, many people who could use their private automobile on the journey to work have to use public transport because of congestion. This leads one to think in terms of capacity
before comfort. In other words, operating companies are much more worried about the volume of passengers that they have to handle than about their comfort on board trains, at least on the radial routes. On the contrary, in American cities the vast amount of space devoted to road infrastructures to allow free movement between any given points provides an opportunity to easily erect aerial structures wherever necessary. The emphasis is then mainly on the problems of aesthetic appearance, integration of the existing buildings, visual obstruction and so on, rather than on capacity problems.

Many American cities are set up with a grid pattern instead of the circumferential one common to French towns. This particular layout allows a greater flexibility in the choice of routes for a fixed guideway public transportation system. The radial layout, on the contrary, tends to be much more constraining as evidenced in the case of Paris. As all of the railway lines converge towards the city center, following the alignment of densely populated corridors which provide them with riders, the "suburb to suburb" trips have to cross Paris even though some suburbs are only a few miles apart. Thus, many people travelling along this route switch from public transportation to private cars as soon as they can, and those who can't afford to own an automobile or who are unable to use it have to spend several hours on public transportation, with one or more interchanges at terminal stations inside Paris. They also tend to increase the capacity problem of the central sections of the most highly travelled public transportation system, thus increasing the need for higher capacity transportation systems.

Automobile ownership presents a different picture in the two countries. In the United States, 80% of the households own one or more cars and 30% two or more cars; less than 60% of French households own one automobile or more, and for the Paris area, this figure drops to a little more than 50%. Under these
conditions, public transportation can be considered in many American cities as only a social problem, its function being to carry only those people unable to drive or who do not own several cars. This can also partially explain the state of disrepair and obsolescence of most of the transit equipment; public transit is still considered a costly necessity. In French cities, public transportation is not only a social necessity but an economic one as well; it is an indispensible tool to move people to and from work and to allow the people who do not own an automobile to travel for personal convenience, i.e. recreation, shopping or other kinds of trips.

Once again, this can partially explain the differences in the acceptance of the role of new public transportation systems in the two countries. In the United States, to be successful, a new transportation system must attract enough users to offset its operation cost. Besides, many users will consist of former automobile riders lured out of their cars by the potential qualities of the new system. Thus the emphasis will be on two particular aspects of the transportation systems: quality of service, i.e., comfort, convenience, dependability, and so on; and a high level of automatization in order to reduce as far as possible the operating costs. In France, although these two characteristics are considered important, especially on circumferential routes where competition with automobiles is most intense, automatization is planned to increase the capacity of the line as well as to reduce operating costs. From a complementary standpoint, reliability and security are considered of primary importance when it comes to the number of people who must be handled all day long, year after year.

The urban development pattern is noticeably different in the two countries. A great deal of urban growth in the United States is left to the initiative of the private developers who make their own plans and think more in terms of profit than in terms of comprehensive urban planning. French administration has striven
in the last decades to develop master plans for every important town in the country. These "Schemas Directeurs d'Amenagement et d'Urbanissme" (SDAU) set the general framework inside which more detailed plans, called "Plan d'Occupation des Sols" (POS) are set up for each one of the "commun" of the agglomeration and legally enforced. Therefore, the administration hopes to control the development of these agglomerations. One particular characteristic of these plans, at least some of them including Paris, is the proposal for several important new towns (with an average population of up to 500,000 inhabitants at the turn of the century) which are far different in concept from the American new towns. Their developers intend to create real towns, with job opportunities, educational facilities, commercial spaces, and housing. As such, a strong public transportation system is needed if these new towns are to be self-supporting. If the proposed population and employment targets are to be reached, these systems will probably be fixed guideway systems. From another standpoint, these new towns have long been considered as an ideal experimentation and demonstration field for new transportation systems. Even if conventional transportation systems will eventually be able to meet the transportation demand inside new towns, there still will be a strong incentive to rely upon new technologies for doing the job.

New town developers are aware that these technologies will enhance the modern and dynamic image of their new towns and are willing to apply for central government demonstration projects, as in the case of Cagy Partoise, with the aerotinani, or with a dual mode bus system. American new towns do not seem to have reached the population and employment thresholds which would allow them to plan a whole fixed guideway system for their distribution needs. Doubtless, they represent a potential market for some of the new transportation systems developed in this country but they are not as yet an important
consideration in the designing of new systems. On the contrary, where the French developer of the dual mode system will initially design the system for the new town and then will try to extend it to other French towns and abroad. This same attitude has been adopted by the developers of the transportation system for the new town of Villeneuve d'Ascqtestille, who have designed a system specifically for the new town without paying any attention, at least at the outset, to the transportation needs of the city of Lille. This fact shows how those in charge of developing new transportation systems feel that their first utilization should be in the new towns.

On another hand, airports represent in the United States a broad market for new transportation systems and, in a certain sense, they play the role of new towns in the French context. As 90% of the intercity traffic in United States is handled by air carriers, many cities have airports large enough to support a distribution system. In France, at the present time, there is only one or perhaps two which need a distribution system. In turn this will strongly influence the goals of the development programs; the traffic pattern in an airport is very often quite different from the traffic pattern in a city. The users are also quite particular. Airport layout and transportation routes can be carefully planned, making it easier to integrate the guideway into the buildings. Origin-destination patterns are also, in many cases, much more balanced than those in cities. The reduction of the number of circulation roads tends to make the transport of goods, postal service, garbage, food, and so forth easier. This is often difficult in cities because of necessary transfers and subsequent lack of flexibility and problems dealing with the integration of stations. As a result, transportation systems in use inside airports are structurally different from those needed in the cities.

The airport market can also be extended to some closely-related markets
such as large university campuses, shopping centers, etc. which still do not exist in France.

Since airports are often located far from the city, some kind of public transportation system will also be needed to carry airline passengers and employees as well as visitors between the city and airport thus avoiding a total dependence upon the automobile. These systems are generally regarded as fast transit links between airports and urban centers, the distribution of people being handled by an urban transportation system.

In France, intercity trips are achieved mainly by private automobiles or by train. Therefore, the emphasis will be on distribution systems able to deliver passengers to their final destination in the city. This will be done either through the public transportation system or by means of a special distribution system inside the central part of the city.

Racial problems in the United States have led to the "ghetto" phenomenon in the central part of the city. People living in these districts have less income and fewer automobiles than the average; they badly need a public transportation system to reach their jobs, which are more often scattered in the suburbs than located in the central part of the city. As a result new transportation systems have to be carefully planned in respect to this distribution problem. They must be conceived as means of getting people outside the urban centers as well as getting them inside the central business district. In France, where racial problems, are less acute, poorer people tend to live on the fringe of the city where housing is cheaper, or in the industrial areas where they are nearer their work. As a consequence, there will be a stronger incentive to look for radial routes that can bring these people to the employment center.

For some years now American cities have tried to revitalize their urban centers by bringing back to the core areas housing units, offices and commercial
spaces, recreational opportunities etc. If successful there could be a strong incentive to plan radial networks with high capacity fixed guideway systems as in Washington, Baltimore, or Atlanta. This need for revitalizing urban centers plus the strong influence of the traditional rapid transit approach could narrow the range of differences between French and American cities at least with respect to their transportation systems. However, the discussion is left open as to what kind of transportation systems other cities need. In the case of Los Angeles, for example, studies demonstrate that a transportation system of the PRT type could do a far better job than the 6.6 billion dollars proposed rapid transit system. And the study of transportation alternatives for Denver have shown that the best system of all was probably a Group Rapid Transit System.

From this brief overview emerge some of the basic differences which will be observed later in the new transportation system development policies of the two countries. Although developers in each country are willing to build systems that are safe, reliable, comfortable, convenient, and automated, the trade-offs between all these characteristics, will lead them to make and to emphasize different values. The first difference appears to be related to the notion of capacity for French designers, capacity means handling large numbers of passengers, which are generated along urban corridors; the American standpoint seems to consider capacity as a means to achieve greater comfort. Vehicles will be larger for example in order to accommodate a high proportion of seated passengers (BART) whereas French vehicles will be large in order to handle the flow of riders (RER), with a high proportion of standees.

French planners are, at the present time, only concerned with lines, mainly radial although sometimes circumferential, whereas American planners are much more concerned with networks. This shows the strong influence of the operating problems upon the conception of new facilities in France. As it
is far easier to operate independent lines than networks, transportation engineers in this country are more inclined to think in terms of networks as compared with several independent lines. In the United States it seems that the willingness to offer to the potential riders a strong incentive to leave their cars leads the planner to propose networks with partial or complete interrelation between lines. This inclination is a consequence of the widely scattered pattern of urban development in this country.

As it appear quite impossible to erect aerial structures in the urban centers of French cities, French developers will tend to emphasize the reduction of vehicle size and improvement of tunnelling methods. On the other hand, American planners will pay more attention to the architectural quality and aesthetics of the guideway which could be an aerial one in most city centers. They will try also to look at the possibility of integration of the guideway and the stations into existing buildings in order to offer a better distribution of their passengers.

The important market represented in the United States by the major airports has contributed to the need for horizontal elevators or group rapid transit, an intermediate step towards personal rapid transit, which does not exist in France. On the other hand, one of the main demonstration fields is represented by French new towns which have some particular characteristics not found in older cities. Problems of distribution of people inside urban centers have also aroused the interest of developers in this country for pedestrian aid systems.

Another slight difference lies in the conception of automatization in transportation systems. French engineers tend to consider automatization as a means of regularly upgrading train operations, and improving system capacity and subsequently have developed a more progressive approach to
this problem than American developers who are trying to implement the more sophisticated and comprehensive automated systems to get rid of human labor in systems operation as well as to use the important skills that they have developed in computer science in recent years.

The greater "compactness" of French cities, thereby requiring shorter guideways and closer station spacings for carrying the same number of people has made the need for high speed in these systems less. At the same time, this represents a further incentive to completely automatic American networks which require, ceteris paribus, more labor force per revenue passenger than in France.
II. Comparative New Transportation Systems Development Policies in France and the United States

The main options about new transportation systems induced by urban characteristics have been presented earlier in this paper; this part will attempt to present the options resulting from historical economic, and political factors or from the social goals set by the various agencies in charge of these development programs. Therefore, this chapter will be divided into three main paragraphs. The first will present a brief historical review of the introduction of new transportation systems in the two countries; the second will attempt to explain the functions assumed by the administrative bodies in the development process; the last one will summarize the various goals assigned to the development programs by their sponsors.

1. Historical Overview

As mentioned earlier, the development of new transportation concepts in the two countries dates from the beginning of the sixties. At this time, it was mainly due to a few individuals either private entrepreneurs or academics (in the United States). Already, the differences between the concepts considered in the two countries were obvious. In the United States many of these concepts were related to what will be called later Personal Rapid Transit (PRT). Concerned about the increasing congestion in the heart of the American cities, their originators wanted to develop a substitute for the private automobile, based upon, small vehicles, able to carry their passengers from origin to destination without intermediate stops at speeds up to 60 mph. Two manufacturers, Teletraus and Alden Starrcar, went so far as to make proposals in American cities. Both systems intended to use a mix of highly sophisticated software while relying upon classical hardware for vehicles mechanical parts and guideways. From another standpoint some manufacturers aiming at the airport market were
proposing horizontal elevators or people movers the purposes of which were not so much to offer a direct route to their riders but to get rid of the increasing part of operating costs of conventional systems: the drivers. Thus, Westinghouse proposed the skybus and Stephens Adamson, a leading firm in walkways manufacturing, the Conveyor.

In France, at the outset the emphasis was placed on technological advances in components hardware rather than on automatization. Three concepts were explored: the Aerotrain proposed by an engineer, Jean Bertine, was built around the utilization of air cushions with positive air pressure which he had previously invented, and airplane construction techniques; the Urba system proposed by Mr. Barthalon was based upon the utilization of another kind of air cushion (with negative air pressure) and the linear induction motor; and the safege system was an overhead suspended system using the rubber typed subway bogies to reduce the noise and improve the quality of ride and the travel speed (by eliminating the need to slow down along the curves). None of them at this time intended to make use of automated operations and the vehicles were driven by an onboard attendant.

So, this first phase, characterized in France and the USA by an outburst of "new" transportation systems indicates that there are some basic discrepancies in their concepts. The second phase can be described as the progressive involvement of federal and central governments in the development process and a tentative organization of the new transportation systems field. In the USA after the Urban Mass Transportation Act of 1964, the Housing and Home Finance Agency, which later on became the Department of Housing and Urban Development, gave some Mass Transportation Demonstration Grants, as in the case of the Transit Expressway in Pittsburgh, with the idea of demonstrating the capabilities of modern off-the-shelf technology in improving conventional mass transit
systems. At the same time, this department initiated a long-term study known as "Tomorrow's Transportation", the purpose of which was to assess the future needs in the field of public transportation, to review the candidate systems, and to propose a comprehensive development policy of these systems. Eighteen contractors, such as Universities, non-profit corporations, transit manufacturers, and private consultants, participated in the study, each of them developing a particular aspect of the proposed development program. The final report analyzed the actual transportation situation in urban areas, assessed future trends in automobile and public transportation use, developed a strategy for immediate and long-term improvements in urban transportation systems and eventually recommended a complete research and development program.

The recommended program involved not only new systems for meeting urban needs but also improvements in existing service and facilities, new and improved system components, and new and improved methods of planning and operating urban transportation systems. The new systems reviewed for future development included such items as Dial-a-Bus or demand activated bus, Personal Rapid Transit, Dual mode automated system (private vehicle or bus), Fast Intraurban transit links, and systems for major activity centers (moving belts, capsule transit, Network Cab Transit). Their recommended program entailed a total program funding of $980 million phased over a period of 5 to 15 years. Three basic criteria were considered in structuring this research and development program; first, the projects to be undertaken should contribute towards an amelioration of the more salient urban problems identified in the first part of the study; a second criterion involved the concept of a mix between low risk, near-term projects and higher risk long term proposals with an emphasis on the need and desire to pursue projects with early or near term payoffs in
order to ease worsening urban problems as soon as possible; the third criterion followed was to maintain an appropriate expenditure level among the types of activity programs undertaken whether research, development, test and evaluation, or urban demonstration.

In France, the first studies dealing with the idea of new transportation systems started with the completion of the Master Plan for the Paris area in 1965. At this time, the main idea was to implement a Rapid Transit Network, called Reseau Express Regional (RER). In order to do so, various technologies, including the most advanced ones were carefully reviewed. However, the study concluded that more of the proposed advanced systems concepts had undergone enough testing to challenge the conventional railways system. As a result the RER was set up with modern off-the-shelf technology used in railway equipment. But this study also recommended the utilization of the new transportation systems for collection and distribution purposes in new towns and suburbs. Three years later, in 1968, two different studies were initiated at the request of the Prefect of the Paris Region in order to analyze the capabilities of the new technologies to fulfill the transportation needs of the new towns and other local communities. The first of them, dealing with the new towns which were just starting at this time, concluded that at least two of the four planned new towns could rely upon new transportation systems for their distribution needs instead of bus systems. It was recommended that Ely, in the south-eastern part of Paris use a dual mode bus system in order to cope with the travel pattern induced by the combination of a strong regional activity center with low density housing communities. St. Quentien on Yvelines, formerly called Ville Nouvelle de Trappes, formed from several independent low density housing communities linked by a bus system in order to accommodate multiple origin-destination trip pattern inside the communities.
The second study looked at the possibilities of using new transportation systems to complete the Rapid Transit network (RER) to create new links between local communities located in the suburbs of Paris. Several peripheral routes were proposed; no specific technology was recommended at the time but general specifications were made for candidate systems; maximum capacities were in the range of 10,000 to 15,000 passengers/hour/direction and the level of service requested called for commercial speeds of nearly 30 mph. These specifications could be fulfilled by light rail systems, or group Rapid Transit systems, or advanced Personal Rapid Transit Systems.

These studies were all initiated at the regional level either to deal with regional transportation needs or to analyze local transportation needs inside the Paris region in further detail. The national counterpart for these studies started with the issuing in 1969 of a list of specifications for the candidate systems in the provincial towns. The final report of the study group provided some guidelines for systems developers and manufacturers related to capacities, commercial speeds, comfort, minimal radius of curvature, and maximal investment and operating costs; these specifications, more precise than in the case of the regional studies, called for rather similar systems. Capacities were in the range of 10,000 to 15,000 passengers per hour per direction; advised commercial speeds were in the range of 20 to 30 miles per hour.

So, at the end of this second phase, characterized by the involvement of administrative bodies in the new transportation system development process, the differences which appeared in the first phase became more obvious. The emphasis placed in France upon capacity, and commercial speed rather than personal service and automation as in the United States, led to the concept of systems similar to the conventional ones. The tentative approach was more
technology oriented than system oriented; the emphasis was placed upon improvement of such components and subsystems as were known (utilization of the linear motor for example) or suspension (capabilities of various air cushion systems) rather than a radical change of the transportation system.

The third phase of this historical overview could be referred to as an organization phase. In both countries the increasing urban transportation problems had aroused an interest to create administrative bodies able to cope with these specific problems. However, the situation in France and the U.S. was quite different at the end of the sixties. France already had a Department of Transportation ("Ministere des Transports") with a specific administrator in charge of Ground Transportation problems (the "Direction des Transports Terrestres"). As a result, there was no basic change in the structure of the Administration. However, some specific groups were created either inside this department, or jointly with other departments. Two of them have played an important part in the subsequent working out of development programs: the IRT (Institut de Recherche des Transports or Transportation Research Institute) and the CDTNTU (Joint Committee for the New Transportation Systems Development). The former was set up as an agency related to the Ministere des Transports. It was devoted to the improvement of transportation planning tools as well as to the management of some development programs. The latter was a joint committee, created in 1970 and composed of representatives from the Ministere des Transports, the Ministere de Developpement Industriel et Scientifique (Department of Industrial and Scientific Development) the Ministere de l'Amenagement du Territoire, de l'Equipement du Logement et du Tourisme
(Department of Regional Development, Public Works, Housing and Tourism) the Ministère de l'Intérieur (Department of the Interior), the IRT, the Paris Region, the RATP (Paris Rapid Transit Operation Agency) and the UTPUR (Association of the local public transit operation companies). The main function of this committee is to make decisions about the appropriation of public funds in the development of new transportation systems. It was also intended to coordinate the development policies of the various national, and regional agencies involved in this activity. On the other hand, the Ministère des Transports and the District of the Paris region set up an annual program of Research and Development equally funded by the two administrations. The annual budget was about $1 million and was devoted to initiate studies and experimentations at the Paris Region level. The District of the Paris Region was responsible for the definition of the annual program, and the allocation of the funds. These programs were to be managed by the IAURP which was in charge of the Master Plan for the Paris area in 1965 and later on used to be a technical consultant for the Head of the regional administration.

In the U.S., on the contrary, there was no such department in charge of Urban Transportation Problems. The first step was to consolidate all the transportation activities in 1968 in the Department of Transportation which included urban transportation activities which were formerly part of the Department of Housing and Urban Development. The second step was the creation of the Urban Mass Transportation Administration (UMTA) the assignment of which was basically to reinvigorate public transportation in cities in order to provide service that will attract new riders. For this purpose, it was assigned the function of allocating capital grants to the
cities for their public transportation investment needs (fixed facilities and vehicles), to help the local communities in their appliance for capital grants through the technical studies programs and to set up a national research development and demonstration policy able to provide local communities willing to apply for capital grants with various alternative public transportation systems.

At the end of this third phase, the federal and central governments in both countries were provided with the necessary in-house capabilities to set up and to manage development programs for the new transportation systems. In the last four years several of these programs have been initiated. Some of them will be described in detail in the last part of this paper. A list of the most important ones follows:

In France, the development programs were based upon the recommendations of the commission created for the preparation of the sixth Development Plan which spans the years 1970-1975. This commission used the previous works and studies mentioned earlier, such as the review of urban transportation needs in middle-sized cities and the regional transportation studies in the Paris area, to a large extent. As a result, four main orientations for research and development programs were identified. The first one was relevant to the transportation systems for short distances (up to about 1 mile). This category encompasses such systems as moving walkways, small capsules, pedestrian accelerators, etc. The second one was described as the type of system adapted to the low population density area transportation needs. In this category the dial-a-ride systems or so-called demand bus can be listed. The third one was identified as urban transportation systems for medium-sized cities and included light-rail or similar systems; all kinds of systems
able to satisfy the transportation needs of cities up to 1 million population level. The last one was related to the fast transit systems (100 to 150 mph) for medium distance trips (up to 30 miles). Development programs relevant to three of these four categories of systems were initiated at the beginning of the sixth plan.

In the first category, the VEC, a system of small capsules (2 places) driven by a linear induction motor embedded in the guideway was demonstrated during a four month period at the end of 1971, in La De Se. Two other systems called TRANS 18 and TRAX 1 are still at the research level; their developers are working on full-scale models of the boarding and deboarding subsystems.

In the third category, several systems are under development. One, known as the VAL (for Villeneuve d'Ascq les Lille) is currently referred to as a mininmetro. It is composed of small rubber-tired vehicles, automatically controlled, able to accommodate up to 15,000 passengers/hour/direction. The vehicles run in trains at intervals similar to those of the Paris Metro. This system is under active testing near Lille, in the new town of Villeneuve d'Ascq. Recently the development program has been modified in order to accommodate a possible extension of the system, originally assigned to link the new town to the central part of Lille, to the whole metropolitan area composed of the three towns of Lille, Roubaix and Tourinconig. Another system known as ARAMIS, uses a completely different concept. Small individual vehicles (4 to 6 seated passengers) are running in platoons, with one foot leadway between each vehicle. Each vehicle in the platoon has a particular destination and can be diverted to its programmed off-line station by means of an on-board switch activated by a local control system.
The different platoons run at one or two minute intervals in order to achieve maximum capacities of up to 15,000 passengers/hour/direction. The system has undergone a one-year testing program on a test-track located near Orly airport outside of Paris. A complementary development program should start soon with a more complete test track and more vehicles.

In this same category, a system known as POMA 2000 has been tested for about one year in Grenoble. This system is usually driven by a cable travelling at a speed of about 20 mph., between two stations; inside the station area it is propelled by a series of rubber-tired wheels, embedded in the guideway, which slow the vehicle down to a speed of about 1 mph allowing the loading and unloading of passengers and then accelerate the vehicles up to 20 mph again until they are taken over by the cable propulsive system. A system usually referred to as the Dual Mode bus is currently planned for a new town in the southeastern part of the Paris area. Up to now only preliminary studies have been implemented. The development program started at the beginning of this year and should be completed in three years. At this time a vehicle prototype should undergo intensive testing on a test track located inside the New Town area.

The fourth category of systems is represented by the so-called suburban aerotrain, a vehicle propelled by linear induction motors and provided with an air cushion suspension. This system has been tested for several years now on a test track near Gouletz le Chatel; an urban deployment is planned in the western part of the Paris area. A 15-mile double-track guideway will link the New Town of Argy Pontoise to the business district of la Defense. The travel time will be about 8 minutes instead of 60 minutes at the present time. The construction of the guideway, which should
have begun last year, has been delayed because of the problems associated with the development of the linear induction motor. Despite these difficulties the French government has decided to carry on this experimentation and to complete the development program with a new engine design.

The studies and experimentation initiated by the District of the Paris area, related to electric vehicles, electric bus and new bus design should be added to this overview. A fleet of electric vehicles built by the French National automobile manufacturer RENAULT and provided with electric equipment by Electriate de France, the National Electric Energy Utility Company, was dispatched among administrators for purposes of testing. These vehicles have undergone comprehensive testing during a one year period in the Paris area. In addition, three electric buses have been in regular passenger service in various new towns of the Paris area on an experimental basis.

Compared to these achievements, the VOITA Research Development and Demonstration projects currently under way cover a broader range of experimentation. As for the technology oriented projects, they fall into three different categories: Bus Transit, Rail Transit, and New Systems, each of these categories encompassing either research and development projects or demonstration projects. At the present time these various projects under consideration can be described as follows:

Bus Transit: the principal emphasis is RDLD bus transit has been to develop new transit bus prototypes; as a matter of fact, the design of currently available transit buses had not changed fundamentally since 1959. The so-called TRANSBUS project intends to consolidate available technology in a modern 90 foot, 50 passengers transit bus and define major advances for buses of the future. This project was undertaken in 1972 and has led to
the building of three prototypes by AM General, Rohm Industries Incorporated and General Motors Corporation. A complementary project is devoted to the improvement of the diesel propulsion system used on most city buses and an attempt to explore alternatives to diesel propulsion.

Rail Transit: these activities involve research, development testing and demonstration of new vehicle systems as well as development of supporting technology and test facilities. Three different kinds of systems are investigated. The first one is referred to as Urban Rapid Rail vehicles and systems. It involves the testing of two new state of the A cars (SOAC), incorporating the best of existing new technology and the conception of an Advanced Concept train (ACT) which intends to incorporate major advancements beyond state of the technology; at the same time advanced propulsion systems are under development and test as a part of the Rail Rapid RDZD Program especially an alternative current propulsion and control system and an energy storage propulsion system. The second one is related to commuter rail vehicles and systems; the purpose of the projects in this category is to develop, test, and evaluate in service several types of dual power gas-turbine, electric commuter cars to permit single train service between electrified and nonelectrified areas on commuter railroads. This program has led to the construction of three four-car turbine electric trains by the Garret Corporation, the General Electric Company, and the General Motors Corporation. The third one includes the lightest rail vehicle systems. In this field UMTA has issued specifications for a standard lightest rail vehicle which has allowed a reduction in unit costs by about $200,000. At last UMTA and the Federal Railroad Administration have cooperated in the construction of test track laboratories and facilities at the High Speed
Ground Test Center near Pueblo, Colorado.

New Systems: this category encompasses all the most innovative modes of urban mass transportation. In addition, the program provides for a continuous upgrading of the transportation planning methods. Various systems are developed under this category of programs.

The Personal Rapid Transit Technology Development program involves such important studies as command and control problems, guideway and station engineering, safety reliability, further analysis and correction, high capacity PRT Research, hardware development components.

The idea of the Personal Rapid Transit System deployment is to provide cities, which otherwise would be reluctant to request funding for PRT systems under the capital grant activity, with systems which have been fully tested in an urban environment. The first step was made during the U.S. International Transportation Exposition, TRANSPO 72, at Dulles International Airport. Four systems, A.C.T. from Ford Motor Company, Monocab Inc., a subsidiary of Otis Company and Dashveyor from the Dashveyor Corporation, a subsidiary of Benix Corp., were selected, then fully tested after the close of the Exposition. The next step will be to select one or more of these systems for further engineering development in order to qualify them for UMTA capital grant assistance.

Another field of interest for UMTA were the so-called Dial-a-ride systems. To demonstrate the technical feasibility and marketability of this concept UMTA has been conducting a demonstration of both a manual and a computerized system in Haddonfield, N.J.

As for the Dual mode Transit Systems, which tends to combine the best features of the PRT systems with the flexibility of the bus, only paper
studies have been achieved at this time. A development program, which involves three different plans (design studies, hardware studies, urban deployment) has recently been set up by UMTA and should start during 1974.

One of the best known experiments during the last few years has been the Morgantown Personal Rapid Transit Systems. A detailed study of this experiment will be presented at the end of this paper. The objectives of this program are to assess the institutional problems associated with the building of a PRT system in an urban environment. At this time, a 3 station, 5 vehicles system has been built in Morgantown to link the campuses of the West Virginia University. The construction of an additional 40 vehicles and the demonstration of the 3 station system in revenue service should start during 1974.

UMTA has also been concerned with development of Urban Tracked air cushion vehicles. Two 60 passenger prototype vehicles propelled by a linear electric motor have been built by Rohr Industries, Inc. and Vought Aeronautics Company. The Rohr vehicle has undergone a first testing program in Pueblo, Colo. and should soon be ready for comprehensive testing and evaluation. UMTA is also currently assessing, in the field of High Speed Ground Transportation systems, the capabilities of Magnetic levitation in order to compare it with the air cushion suspension.

This cursory overview shows once again, the basic differences between the development programs in the two countries. The UMTA approach appears to be much more comprehensive than the French approach. For example, the French have not conducted any experiments in the field of dial-a-ride systems; as for High Speed Ground Transportation systems, French developers have only relied on one kind of system, the air cushion suspension and linear induction motor,
instead of testing and assessing various kinds of propulsion and suspension components as has been done in the U.S. This review shows also the emphasis placed by American administration upon early demonstration models (Transpo 72, Morgantown), whereas French developers have adopted more conventional development programs with test tracks not located in an urban environment, or accessible to the general public.

2. The role of the various administrations in the New Transportation Systems Development process

The activity currently referred to as the Research, development and demonstration process, involves the sequence of studies, hardware construction and testing necessary to bring a transportation system from the concept stage to the industrial product stage. Usually, the different steps of the sequence can be defined as follows.

The Concept Stage involves some paper studies defining the new system proposed; usually, this definition is neither very precise nor very detailed. The proposal can either encompass the use of advanced technology components or deal with a whole innovative system.

The Feasibility studies try to determine both technically and economically whether the proposed concept is workable or not. At this stage, the developers are concerned with the general functioning of the system; for this purpose they can build work-ups at a reduced scale for checking the validity of the basic principles. The outcome of these studies will be a list of critical points and a general development program.

Research projects are concerned mainly with the prototype stage. They study the various technological components and begin the testing of these components. At the same time general studies and simulation studies of the whole system are undertaken in order to coordinate the operation of the
various components. Preliminary studies of investment and operating costs are made. This is usually referred to as the developmental stage in the U.S. when talking about the administration role which does not go beyond prototype development. In France, this term is applied to the next step.

Development projects are concerned with testing and evaluation of a complete system prototype (software as well as hardware). At the same time studies are undertaken to determine the industrial procedures for system construction. Operating policies are closely examined through case studies in a real urban setting. Social and economic feasibility are assessed in order to warrant actual testing of the system.

The idea of Demonstration projects is associated with the introduction of an experimental system in a representative urban environment. This permits measurement of passenger and community acceptance of the system, economic viability, endurance testing and operational performance of new methods of equipment in daily public service. The end of this phase should be marked by the official acceptance of the system and, in the U.S., its eligibility for a capital grants application. The next two steps would be the construction of the system, and then its operation in a city.

The differentiation between these phases is not only a formal one; it is defined by the level of involvement of the various administrative bodies participating in a development program. These various public agencies can act at different levels, either national, regional, or local. Their roles will be examined as follows:

2.1 The National or Federal Levels. In France, the central government is primarily concerned with development of new technologies and new transportation systems. Several Ministries play an important part in this process.
The first one is the Ministere de Transports (Department of Transportation) within which the Direction des Transports Terrestres (DTT) defines general transportation policies (both urban and intraurban), controls the various operating agencies and allocates public funds between the different development programs, and the Institut de Recherche des Transports, (IRT) which serves as a technical support for the DTT. The second one is the Ministere de l'Aménagement de territoire, de l'équipement de logement recently consolidated with the former through three of its agencies, the Direction de l'Aménagement financier et de l'Urbanisme (DADU), de Service des Affaires Economiques et Internationales (SAEI), and the Delegation a l'aménagement du Territoire et a l'Action Regionale (DATAR). The first two agencies are mainly involved in feasibility studies (economic and social feasibility; impact studies and so forth); the third one, formerly directly responsible to the Prime Minister has some funds available for development of new systems concerned with regional planning. This flexible definition allows it to allocate funds to new transportation projects; for example the Aerotrain and ARAMIS systems have been financed mainly by the DATAR. The Ministere de Developpement Industrial et Scientifique takes part in the development process through the Delegation generale a la Recherche Scientifique et technique (DGRST). This administration is entitled to provide developers with funds at the Research and Development levels mainly for components and sub-systems (propulsion, suspension and so forth); another agency, which is a joint agency between the Ministere de l'Equipement and the Ministere de l'Interieur must be mentioned. It does not provide money as the other administrations do but it takes part in the development and demonstration process on behalf of the local communities which depend
upon it. It must be mentioned, in addition, that all these agencies depend
upon the Ministere des Finances for their allocations.

Some particular points must be emphasized at this state. First there
is no general precise rule defining the amounts of money that each adminis-
tration ought to spend on specific development projects. Each administration
has its own budget and decides for itself. The financing of the various
development programs has to go through a preliminary bargaining process
between the various administrations. Second, there is a provision in the
contracts between private developers and administration for a refund of
the money allocated to the contractor if the system is commercially
successful. Third, if the role of the various administrations other than
the Ministere des Transports is a financial and technical one, the Ministere
des Transports has a control function upon the various systems used in the
transportation area. The system must be accepted by the Ministere des
Transports, for public utilization.

In the United States the bulk of the development process is devoted
to UMTA; its main function is primarily to provide guidance to local communities
in tailoring capital grants to suit local needs. For this purpose it is
entitled to award contracts to private developers for the development and
demonstration of both conventional and unconventional systems. Therefore
the role of the Federal government is mainly to produce an incentive for
private industry to enter the transportation field and build the systems
needed by local communities. It attempts to help the local communities
assess their transportation needs and private industry to develop the proper
systems to match these needs. In this task, UMTA receives assistance from
several agencies. The Transportation Systems Center (TSC) manages and
monitors a certain number of development programs such as the Higher Capacity PRT project or the Dual model project, on behalf of UMTA; this agency is a kind of in-house agency and its budget is granted by UMTA. Several non-profit corporations such as the Applied Physics Laboratory (APL) of the Johns Hopkins University, the Mitre Corporation, the Aerospace Laboratory, the Stanford Research Institute (SRI), and so on, are awarded contracts for specific projects, to help UMTA in establishing development policies or to assess the technical capabilities of new systems. They are able to provide UMTA with the technical support it needs for its development programs. Some other agencies independent of DOT such as the Department of Housing and Urban Development (HUD) and the Federal Railroad Administration play a part in the development process. The first monitors some Dial-a-Ride experimentations, the second operates the Pueblo Test track jointly with UMTA.

With respect to the points mentioned above, in France, there are some specific rules for the funding of development projects. Usually UMTA finances the total amount of the project; however, UMTA has the capability to review the financial evaluation made by the private contractor and the funding is allocated on the basis of this evaluation. This technical capability does not exist in France where funds are usually granted on the basis of the evaluation of the contractor. On the other hand, there is no provision in these contracts for a possible refund from the contractor in case of commercial success. As in the case of the French Ministere des Transports, a new system has to be approved by UMTA for eligibility for capital grants, but it also has to be accepted by the individual states specialized commissions (Public Utilities Commission in California for example).
If the regulatory powers in the two countries appear to be rather similar, there seems to be a basic difference in the conception of the government's role in the development process. In the U.S., UMTA has a more active part in the process than any of the agencies in France. UMTA tries to instigate and initiate the development of new transportation systems by formulating precise goals and the attached development programs. UMTA draws up these development plans and issues requests for proposals on which various manufacturers can bid; of course there is a constant flow of information between manufacturers and UMTA in order to avoid discrepancies between request from UMTA and the technical capabilities of the manufacturers, but the leading role no longer stays in the manufacturer's hands but in UMTA's.

In France, the situation is basically different. The central government provides the manufacturers with development grants, defines a general development policy but does not go into further detail. The development plans are drawn up by the manufacturers and endorsed after discussion by the central government. There is a tendency at the central level to leave the technical work to the industry and to keep only the central and financial responsibilities. This tendency can be partly explained by the reduced scale of the French transportation industry. Basically each manufacturer has specialized in the development of one particular system; as a result it would be impossible to find several manufacturers to bid on a particular development project. Also, in France, there is no new organism in charge of the whole transportation development plan; new capabilities have not been created except in the case of DGRST which was set up about ten years ago, and plays only a partial role in the development process and, as a result, the transportation program has been handled in a conventional way which means a preeminent role for financial
and control functions.

2.2 The Regional or State Levels. Regions in France and the individual states in the U.S. constitute an intermediate level of government between the central or federal government and local communities. But there is at least one important difference between the two countries. In France the region is more or less a technical subdivision set up for industrial programming and planning purposes, the powers of which depend upon the central government, whereas the states in the U.S. are the basic sovereign entity of the American Constitution.

In France, the regional level is a recent creation; formerly, the only intermediate level between central government and communities was the "department" headed by an administrative official appointed by the central government. As a result, the only regional body which was active in the recent years was the District of the Paris Region headed by a "Prefet de Region" appointed by the central government and assisted by a board comprised of elected representatives and appointed ones. In 1971, the District of the Paris region set up with the help of the Ministere des Transports a development budget intended to finance studies and experimentation about new transportation systems which could be used to fulfill the goals assigned to the Regional Development. This financial help is not devoted to the whole technological development process but only to the specific parts of this development which would directly interest the Paris Region. The District by means of its technical capabilities keeps in contact with the private developers, providing them with information about the transportation needs and policies of the region. It initiates and funds studies in order to get from developers technical solutions to the transportation problems it has
specified. The role of the District is also to provide the local communities within the region regional transportation projects in order to get their advice and final approval.

In the U.S., the various states do not seem to have an equal interest in the development of new transportation technologies. They participate in the funding of the construction of transportation facilities by matching federal grants, as in the case of the Baltimore Rapid Transit System, but they do not participate in the research, development and demonstration processes, at least since UMTA has taken over the main responsibility in this field. Some states have been involved, in the development process, as in Pennsylvania which participated, through the Pennsylvania State Department of Commerce, in the funding of the transit expressway experiment in Pittsburgh.

2.3 The Local Levels. Institutionally, the local levels in the two countries are quite different. In France, the communes (of which there are about 38,000, in the country of various sizes and population) are the basic local communities. They elect their own "council municipal", which in turn elects the mayor; the council municipal runs the municipal affairs, public works, fire department, secondary education, police, and so on. With respect to transportation problems, it oversees and controls the operation of the transit systems, but private or public common carriers and receives grants from the various Ministeres for construction of transportation facilities. Local roads are funded with partial grants from the "Ministere de l'Intérieur" which controls the operations of the communes, main roads depend upon the Ministere de l'Équipement, whereas transit facilities are partially funded by the Ministere des Transports. Meanwhile, the communes are not often provided with the requested technical capabilities to deal with construction
problems. In this case, they delegate their responsibilities to the local
departments of the corresponding Ministere which acts on their behalf;
the communes keeping the right of control over the project. So, the communes
are mainly confronted with daily operating problems rather than research and
demonstration problems. As a result, they do not participate in the develop-
ment process, except in some new towns, which provide some commodities to
the developers in order to build their test tracks. Meanwhile, many of them
actively follow the progress of the development programs and set up transpor-
tation plans considering various alternatives including new transportation
systems. For example, the city of Nancy established a transportation
plan using a new American transportation system manufactured by TTI Otis.
The city of Grenoble has also been fairly active in the development process
of the French system POMA 2000 by giving the land needed for the test track,
and by drawing a transportation plan using this transportation technology
as a part of the public transportation system.

In the United States, the various local bodies hold only the powers
that the state legislatures have given to them. So, they are not institutionally
independent as the French communes are. The most interesting creation in the
transportation field appears to be the special districts. These districts
created by state legislatures are given a particular task; for example the
Bay Area Rapid Transit district was set up by the California legislature to
provide three counties of San Francisco, Alameda and Contra Costa with a
rapid transit system. The creation and the resulting taxation was approved
by the people of these three counties. As a result, BART was able to build
the whole project, and handle research, development and demonstration
process. However, since the creation of UMTA, the local authorities have
given up their responsibilities in this field; the Regional Transportation District of Denver which will build and operate the public transportation system for the Denver Region has only a minor role in the development of the eventual PRT system. It participates as a technical advisor in the process led by UMTA and has given the land needed for the implementation of a test track at Broomfield near Denver.

At the local level, in spite of the institutional differences between the two countries, there does not seem to be much difference between the basic attitudes towards research and development of new transportation systems. With a few exceptions, the local authorities have mainly a passive role in the process in both countries. The most active local authorities try to keep informed of the development programs and sometimes participate in them. But basically they are concerned with operating problems.

3. **Summary of the Basic Orientation of the Development Programs in Both Countries**

As underlined in the previous chapter, the main responsibilities for research, development and demonstration of new transportation systems belong to the central and federal government. However, there is a basic difference between the two countries in the way they handle these development programs. In the United States a special agency (UMTA) has been created to initiate and manage these development programs whereas in France, these programs have been initiated under the responsibility of various agencies of the Ministeres involved in transportation or industrial problems. As a result, the pattern of research and development activity is less clear in France than in the U.S. The responsibilities are much more scattered among various bodies and each development program must be set up and funded separately before its implementation. Also, this situation often leads to the fragmentation of the development
programs, in order not to exceed the financial possibilities or each participating agency, and influences in turn the scheduling of the program.

As mentioned before, one of the differences between the two countries stemmed from the quality of their transportation networks. Many of the U.S. transportation networks were in bad shape some years ago. The decrease of ridership had led to a reduction of service and drastic cuts in operating expenses, and maintenance levels. In France, although the same difficulties have appeared in recent years, the importance of the public transportation system is such as requires its careful maintenance. The Ministere des Transports has also soon been involved in granting subsidies for offsetting the operating deficits. As a result, in the U.S. there was a technological gap to fill and after so many years of neglect a huge effort was made to reverse the negative trend. In France, at the same time, the prevailing idea was more to improve the existing facilities rather than develop something very different. So, American developers have been induced first to look for very sophisticated transportation systems able to lure potential riders from their cars and second to look for immediately viable systems. Their programs reflect these two goals. The first one, a long range goal, has led to the setting up of such development projects as Dual mode systems, or High capacity PRT systems. The second one, a short term objective, has led to the construction of such transportation systems as the Morgantown PRT system and the Haddonfield experiment (Dial-a-Ride). This strategy has given way to a combination of programs using either an off the shelf technology and trying to put together the best transportation system possible with this kind of technology or trying to develop highly sophisticated systems, which of course requires a longer lead-time.
France has been more involved in the improvement of conventional systems, with various types of metro, rubber tired vehicles, automatization, etc, which partly explains the technological approach adopted in some development programs, rather than a general transportation problem solving approach. At the same time, the appearance of new kinds of transportation systems has directed the conventional transit systems manufacturers to look for important improvements of their products. As a result of the aerotrain (high speed tracked air cushion vehicle) development program the Railways National Company (SNCF) has started a development program for a high speed turbotrain. Thus a new high speed link between Paris and Lyon will be built with this railway technique instead of an aerotrain. Even the development programs based on a system analysis approach like ARAMIS rely upon fairly conventional technologies which have not required long development delays.

The concentration of all development responsibilities in the hands of UMTA, enables the U.S. to assign precise goals to the development programs and to build all the technical tools requested for the measurement of their achievement. The scattering of these same responsibilities among various agencies in France has prevented, to a large degree, precise statements about possible goals. In addition, the involvement of many levels of government in the development process insures that local interests are not forgotten. As a result the two approaches can be summarized as follows:

In the U.S., the federal government takes care of the whole development process in order to achieve improvements that will benefit riders, transit equipment manufacturers, transit operators and the urban community. As a result of this policy, UMTA sets up development programs which aim at a revitalization of the transit industry, which will provide local communities with fully tested systems ready for capital grant application.
The French way of proceeding is more integrated. There was at first no need to stimulate a decaying technological community and therefore no need to initiate development programs at this level. As a result development programs result more often from direct proposals from the transportation industry. Secondly, the participation of several agencies at various political levels assures a "smoother" process and a constant attention to the interests of the various communities.

In assuming the responsibility for the carrying out of development programs, the federal agency takes all the chances on these new systems; on the other hand it better controls the contractor's work. In France the risks are shared, theoretically, on an equal basis between the agency and the developers. However, the greater responsibility assumed by the industry prevents the exercise of an in-depth control of the developer's work. This is reflected in part in the financial procedures adopted in the two countries. UMTA evaluates the cost of the projects and sets the price of the development program and there is no refund from the developer in case of success. In France this evaluation is made by the developer who proposes a package deal to the agency, which in turn, tries to recover at least a part of the public funds involved in the development process in case of success. However, these differences appear much more theoretical than practical. The provisions for refund in the French legislation deal with only one part of the development process and they are often rather indefinite.

The U.S. Administration shows a greater willingness to test various technologies or components for the same class of transportation than the French. For example in the high speed ground transportation field, several
suspension systems (magnetic, air cushion) and command and control systems have been tested. This has led the administration to set up a test center in Pueblo in order to get a basis of comparison between all the different techniques. Such a facility does not presently exist in France. This reflects the orientation followed by the French which deals with innovation more on an individual basis. Although there is a general framework which acts as a guide for the development policy, in order to avoid eventual duplications in the choice of the systems to develop for example, the case of the URBA, which apart from the technological innovations proposed like air cushion suspension and linear induction motor propulsion systems did not really improve the quality of the present transportation systems, each development project is handled separately.
III. Case Studies--two examples of development programs: ARAMIS in France and the MORGANTOWN Project in the United States

In the former chapters, guidelines used in both countries for the development of transportation systems have been outlined. They have been derived from historical and institutional backgrounds as well as those issued from development policies which have been set up in France and in the U.S. In these chapters development projects have often been referred to as illustrations of specific development policies. This last chapter will be an attempt to describe all of these policies as they relate to two specific projects, one in the U.S., the other in France. The Morgantown project has been selected for the U.S. as a convenient means to illustrate all the different influences which can be exerted on a particular project. It is also a convenient example illustrating the critical points of a development project.

The ARAMIS project in France has been selected for its interesting approach based on systems analysis rather than on a pure technological basis. However, it would be of little use to make comparisons between the two projects as they did not have the same goals. The Morgantown project was intended as a demonstration of what could be achieved with the most advanced off-the-shelf technology, the French one was conceived as a full research, development and demonstration project, although the temptation to make it a demonstration project was often strong.

1. the Morgantown Project. This project was initiated in 1967 at the University of West Virginia which is located in Morgantown. The University is split into two campuses which are several miles apart. The traffic congestion is such in this little town (resident population 30,000) along the Monongahela River that it sometimes takes a full hour to drive from one campus to the other. As a result, classes are very
difficult to schedule and many students (22,000 at the present time) have to shuttle back and forth between the two campuses during the day. S. G. Elias, an industrial engineering teacher at the University, obtained a Transportation Department grant to study the feasibility of an automated system linking the two campuses. The study concluding that a PRT system would be suitable for Morgantown, was concerned with the technical and economic feasibility of the system and also with public acceptance and operating problems. It processed almost 100 transportation concepts and 8 developers were asked for preliminary studies at the end of which one was selected to oversee the project. The company selected was a small one which had formerly proposed the starr car concept. The University then asked the federal government for a grant to build the proposed 13.5 million system. The federal government did not approve the choice of the prime contractor by the University because it felt the company was too small. The University then asked the government to hire the Jet Propulsion Laboratory at Pasadena, California which had a solid experience in aerospace projects, to monitor the work. But the government, eager to find a showcase and a demonstration site for the PRT system, proposed to take over the project and to fund it on a 100% basis with UMTA Research Development and Demonstration grants. UMTA then took management responsibility for the three station, 2.5 mile, 95 vehicle system. If successful, the system would then be extended on a normal UMTA grant (80% federal, 20% local funds) to a 70 to 100 vehicle system. The federal government issued a request for bids from several private companies and stipulated that the competing companies should be of a similar size. This eliminated the Alden Self-Transit Corp. from making a bid.
An agreement was made with the Boeing company for construction of the vehicles, Alden became a subcontractor for the first five prototype vehicles, and Bendix Corp. won the control and command system bid. The specification for the proposal had been made by JPL which had not taken part in the design phase. Their estimate for the cost of the new proposed system was $40 million. At that time, the system was quite different from the original concept. The vehicles, for example— which had been planned for 3 or 4 seated passengers, were turned into twelve passenger vehicles with room for standees. The role of JPL was never very clear; and it left the project after setting up an agreement with UMTA. The administration then issued a request for the role of prime contractor on which Boeing and Bendix bid. Boeing was selected as prime contractor in August 1974. At that time the administration decided that the system should be working by the end of October or in time for the Presidential election of 1972. This led to a choice of systems which increased the cost of the project in dramatic proportions. The guideway was built, for example, without an exact knowledge of the size and weight of the vehicles. So it turned out to be bigger and more costly than necessary. Some construction problems also emerged; the facilities did not exist in Morgantown to build a pre-stressed concrete guideway, so the concrete had to be poured on the construction site. The difficulty of finding permanent specialized workers in that part of the country raised a certain number of management problems. Then, the communication and control system had to be completely reviewed, as the first one which had been designed was not fail-safe. In order to keep up with the deadline of the Presidential election, the components were not fully tested before their integration inside the vehicles. As a result many of them
had to be replaced or redesigned. In order to lay down the guideway on
land owned by the University, stations had to be designed in a more complex
way. For example, the intermediate station of Beechurst which overpasses
the main street, required the building of costly bridges. In order to
demonstrate a system which could be used in any city of the U.S., specifi-
cations were oversized like the requirement for heating the guideway in
order to allow a functioning of the system to \(-30^\circ\) F. Boeing had to build
a special test track in its plant in Seattle in order to thoroughly
test the vehicles before shipping them to Morgantown.

At the present time UMTA has accepted the phase IA system (5 vehicles
3 station system) from Boeing after the tests dealing with safety, reliabil-
ity and operating costs were completed. The other functional tests
will be achieved in the fall. An order has been made for an additional
40 vehicles which will complete the phase I system.

The University, which has a contract with UMTA guaranteeing that the complete
system will work at a fixed operating cost, is anxious to get the system
finished. But the federal government has not decided at the present
time whether it will go along with the Phase II part of the project,
including the completion of the whole system. The University contends
that it cannot operate only one half of the system and that in any case
it should operate an additional bus system in order to carry all its students.
It also contends that it would rather see the system torn down, as mentioned
in its contract with the federal government, than operate an incomplete
system. The University can therefore refuse to accept the system if it
receives no assurance about its operating capabilities. The operation and
maintenance of the final system should be assumed by the technical staff of the University assisted in the first operating years by a small team from Boeing. Boeing at the present time drafts the specification for the operating characteristics and helps the federal government in writing the specifications for the systems eligible for capital grants. The local authorities willing to apply for federal grants will then be provided with these specifications before selecting a transportation system.

The Morgantown project, even if it is a complete success, will have at least underlined the basic difficulties hidden in a research, development, and demonstration project.

The lack of in-house technical capabilities at the beginning to oversee the development work, such as the absence of a general manager able to review the work of the contractors after having set up a precise development plan is the first reason for the delays and setbacks of the project. The difficulties encountered in producing a completely fail safe command and control system, with a technology not fully mastered by the contractors was another reason for the delays and cost overrun. And, to illustrate the dangers of a demonstration project, the final system will not be a very satisfying one because of its complexity. Even Boeing acknowledges that the system will not be an industrial product when completed and will need further research and development in order to be sold to a local authority.

2. The ARAMIS Project. The ARAMIS system claimed the development of a new concept able to offer a level of service competitive with a private automobile. To achieve this goal, several criteria were established:

-- the notion of a direct service where all the passengers are seated
-- a high commercial speed (30 mph)
-- a high frequency (headways of about one minute)
-- a great number of stations to achieve a door-to-door service
-- a small-sized system to allow more flexibility and an easier insertion in the urban pattern.
-- a medium capacity system (up to 13,000 passengers per hour per direction)
-- the ability to provide an eventual demand service.

The original concept of the ARAMIS system was developed in 1969 by a small research firm named Automatisme et Technique. This concept was originally called PVP, Programmed vehicles Platoons. At the beginning of 1970 an agreement was set up between the Societe des Engins MATRA and Automatisme et Technique entrusting MATRA with the responsibility of developing the ARAMIS system among other transportation systems. At the end of 1970 the feasibility studies of the system were reviewed. Their positive conclusions provided MATRA with the incentive to develop a program for the system. The development program presented to the administration was accepted and funded on a sharing cost basis. The original cost of the 2 1/2 year program was $1.6 million with a government participation of $10.8 million. This financial aid was split among several administrations: The DATAR, the Ministère de la Recherche (a joint agency between the Ministère des Transports and the Ministère de l'Equipement), the Paris region, the Paris Airport, and RAT, Public Transportation operating agency in the Paris area, and Air France.

Originally the main goal was to achieve an industrial product which could be sold to cities at the end of the development program. At this stage two
goals were assigned to the development program. The first one was to define and realize an experimental prototype which should justify the basic principle and options associated with ARAMIS. The second one, concerning systems studies, was to show that the ARAMIS concept could answer a large variety of transportation problems, and to generate from these specific problems technological options and operating strategies. At the time the decision was made to limit these studies to lines only instead of complete networks.

In June 1971 the location for the test track was selected; this test track, on a piece of land owned by the Paris Airport, was 3/4 of a mile long, with one off-line station. It would allow a thorough testing program of all the basic functions assumed by the 3 prototype vehicles: power pick up, propulsion, guidance, safety and noise effects, plus the system functions like, platoon operations, automated control, switching, station stops, safety devices, and various operating modes. Some reliability and maintenance.

After the prototype testing was started, the cost of the development program was increased by $0.8 million thus raising the overall cost to $12.4 million (on this overall cost the share of the various administrations was $1.2 million).

In June 1973, the development program was over and the three prototypes were presented at the Transpo 73 Exhibition, on the test track. At that time some of the goals assigned to the development program had not been completely fulfilled; the original program foresaw 5 vehicles; the revised program dealt with three. The original engine could not be used because delays occurred in its development program, and an alternative solution had to be found.
A global test of the system's safety could not be performed nor could the
dependability and maintenance testing programs. And finally, the actual
test track could not accommodate more vehicles; this prevented the testing
of the functioning of platoons composed of several vehicles (some case
studies have emphasized the needs for up to 50 or 100 vehicle platoons).

At the end of this program, the vehicle system was not ready for
operation. A new program had to be planned in order to make it ready
for construction and operation in French cities. The RATP and MATRA,
set up such a program at the beginning of 1974, requesting for three
years, a $6 million development program which should allow the system to be
demonstrated in an urban setting. For this purpose a first link will
be built between CRETEIL and CHOISY le Roi in the southern part of the
Paris area in the next few years; after a period of intensive debugging
and testing, the system will be open to the public in order to test public
acceptance. If this demonstration is successful, the line will be extended
to VIROFLAY in the southwest part of Paris and eventually to MARNE LA
VALLEE (East of Paris) and EVRY (Southeast of Paris). Thus, the Paris
area would be provided with a peripheral link in the suburbs which at
this time is badly needed.

Unlike Morgantown, ARAMIS system has not been given important problems
to solve, which would have skyrocketed the cost of the whole project. How-
ever, it must be noted that the project has not been easy to manage. The
goals of the first development project have not been fulfilled and it
has taken two and a half years to understand that the system could not
possibly work in an urban environment without an important complementary
program for least three times, financially speaking, the size of the previous
one. One of the problems of this program seems to be due to the scattering of responsibilities among various agencies. Few technical in-house capabilities were available on the government side to overlook the development of the program and the work of the contractor. The RATP which has these capabilities had adopted a very cautious approach and has been in waiting position for a long time. It actually took over the project a few months ago. Fortunately, due to the high degree of government control, political pressures could have been avoided during the program. So unlike Morgantown the program schedule was observed, thus avoiding some mistakes.
Conclusion

Many of the differences existing between development policies for new transportation systems have been outlined in the previous chapter. Some of them are only technical and secondary ones. But the most important seem to appear in the very nature of transportation problems which both countries are coping with. The widely scattered housing patterns of the American suburban sprawl have led to the concept of PRT systems, which have the difficult task of trying to attract their potential ridership by offering better service than the private automobile. This orientation has been sustained by the huge amount of technical capabilities acquired by American engineers in computer science. It has sometimes led them, in turn, to choose far too sophisticated solutions to their transportation problems. The comparison between the BART and the Lindenwald line near Philadelphia, for example, is one illustration of this.

France on the other hand is confronted with problems of congestion on its roadway network, which seems to be worse, at least for a French observer, than the congestion problems in American cities. Thus the problem the French transportation engineers have to resolve is mainly a capacity problem. So, they have looked for more conventional technologies to provide personalized service in order to cope with the growing peripheral traffic pattern. These basic differences in French and American behavior regarding transportation problems have also been supplemented by more technical ones. The example of the U.S. in creating a special administration, UMTA, for dealing with problems has not been followed in France. On the contrary, these development programs are handled by a dozen different administrations. The only control which can be exercised by the French
administration is a theoretical one instead of the technical one exercised by UMTA. As a result, French administrators did not initiate the development programs going on at the present time. They have only supported a part of the overall cost of development programs proposed by the industry. The American administration has been far more active in this field and has tried to stimulate the American transit industry by initiating development programs on such systems as PRT or dual mode bus. On the other hand, French administrations seem to be much more concerned about operating problems, and this point is thoroughly scrutinized in all the development programs. In the same way regional and local authorities are willing to participate in the development process, even at its onset. This allows the people in charge of the development projects to be always informed of local transportation problems and to plan their systems to match as closely as possible the needs of the cities. The gap between the federal administration and local bodies as to who will be responsible for operating the new systems once they are implemented, appears to be one of the shortcomings of the American Program. There seem to be two different approaches from each which leads to some conflict regarding the evaluation of needs. The importance of the financial participation of the federal government in transportation system construction projects (up to 80% of the construction projects are federally funded) has led several American cities to plan completely new transportation systems the overall cost of which largely exceeds the financial possibilities of the administration.

Lastly, American projects, in a country which has suffered the lack of an efficient public transportation system, for a long time, have been oriented towards demonstration projects using primarily off the shelf advanced technology whereas the first French projects have tried to use a
more modern technology to suit conventional concepts.

Thus, after these initial years of intensive development, the first new transportation systems should soon be ready. After the numerous studies undertaken in the late sixties proposing new advanced concepts, it seems that these first systems are not to be too different from the most advanced conventional ones. After all, the operating capabilities of modern commuter railways are not very far from those of a system like ARAMIS, and the metro system in Paris would be difficult to compete with if it was less crowded. It will be necessary to wait for the second generation transportation systems to see a real difference from the conventional ones. Meanwhile, let us hope the forthcoming implementation of the first generation of new transportation systems will not disappoint the hopes that have been placed in them and that they will contribute to a reversal of the trend to dislike public transportation systems which plagues both American and French cities.