# SYSTEMS OF URBAN TRANSPORTATION IN THE FEDERAL REPUBLIC OF GERMANY

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## 1. General Development of Transportation in the Federal Republic of Germany

A basic difference between West Germany and South Africa is the growth of the population. Until 1970 we worked on the assumption that population would increase by 10% up to the year 1985. But since then we have been faced with a decrease, which is now estimated at a 3,3% loss between 1980 and 1990, from 60,6 million to 58,6 million.

The number of motor vehicles in West Germany will grow, though the population is decreasing. In 1977 we had 23,5 million motor vehicles inclusive of 20,2 million private cars. The number of private cars will grow in West Germany from 22,0 million in 1980 to 25,9 million in 1990. This is an increase of 17% in the same time as the population is decreasing by 3,3%.

In contrast to this the Driessen Report calculates for South Africa that the population will increase from 27,9 million in 1980 to 36,1 million in 1990, which is an increase of 29,4%. By the year 2000 the figure will be 46,8 million.

For South Africa the Driessen Report estimates for 1980 3,4 million motor vehicles inclusive of 2,6 million private cars and for 1990 5,75 million motor vehicles inclusive of 4,2 million private cars. This means an increase of 61% for private cars and 69% for motor vehicles in total. While the number of motor vehicles will stagnate in West Germany or even decrease between 1990 and 2000, the increase of the total number of motor vehicles will go on in South Africa at least until the year 2000. The expectation according to the Driessen Report for 2000 is 10,0 million motor vehicles inclusive of 6.9 million private cars, which is equivalent to an increase of 162% from 1980 to the year 2000 in the ownership of private vehicles. This comparison shows that in South Africa the population as well as motorization experience a dramatic trend upwards whereas the population is going down in West Germany and motorization is not far from saturation point.

A more valid comparison of the rate of motorization is the number of private cars per thousand of population. This index figure for West Germany in 1980 is 353 and in 1990 399. For the Republic of South Africa the figures for 1980 are 94, for 1990 115 and for the year 2000 141.

Considering Whites only, the index figure for private cars are similar to those of West Germany and even higher. The index figure for private cars of Whites in South Africa was already 374 in 1970. This figure will be reached in West Germany between 1985 and 1990 and is about equal to the saturation limit.

We might deduce from this comparison that the traffic conditions in the biggest cities of South Africa are not too different from those in West Germany. The factor of *mobility* which means the number of trips per person per day is also an important criterion for measuring traffic. In Germany we have a general mobility which includes the number of movements by foot or by bicycle.

It would be interesting to look at the development of this figure in West Germany in the past and as it might develop in the future. In this development three phases might be singled out: the **pedestrian phase** which covers the period from 1900 to 1950. Within the half century general mobility was rising from 1,5 to 1,6 whereas motoring mobility went up from 0,3 to 0,4. The next phase is characterized by an exclusive growth of the motoring mobility. At the end of this period in 1975 the motoring mobility was 1,65, the total mobility being 2,65. This means that the pedestrian and bicycle mobility had gone down from 1,2 to 1,0 whereas the motoring mobility had gone up from 0,3 to 1,65. This period is called the **growth phase**. The next period from 1975 to 2000 might be called the consolidation phase which ends with a maximum of the general mobility of 3,2 inclusive of the motoring mibility of 2,2. It might be mentioned that the motoring mobility in the USA is already 2,4 or more. On the other hand, cities like Warsaw or Budapest have a motoring mobility of 2,2. But this mobility is mostly for public transport and caused by the extremely high proportion of working women who have to use buses or streetcars twice or even four times a day.

The motoring mobility is always higher in the city than in rural areas: for example in West Germany in 1975 it was 1,45 in rural areas and 1,75 in cities. The difference will be lower in 2000. For that year we expect 2,05 in rural areas and 2,3 in cities.

In the cities the portion of public transport is comparatively high, about 30%. In rural areas it has gone down to 10%. On the other hand in the bigger cities such as Berlin, Hamburg and Munich public transport forms 40% and more, especially in the Central Business District. Investigations have proved that even an offer of more attractive public transportation will not alter these figures much. Today the traffic policy of West Germany does not aim at stopping motorization, as car ownership is an economic factor of great importance. But nevertheless the improvement of public transport will be promoted by grants because there is not enough space in the cities for commutors and the aim is to avoid deterioration of city structure. Individual trips are desireable for business contracts and to a certain extent also for shopping, visiting etc. The traffic policy is directed towards a reduction of the individual traffic in the morning peak hour, especially for commutors. And this policy has been partly successful. In the Central Business District of Hamburg about 80% of commutors take the U-Bahn, S-Bahn or buses. Still 5% walk or use bicycles. Only 15% come by car, and these are mostly persons who need their cars for professional purposes during the day. But the most decisive factor is that only a limited parking space is available, the City of Hamburg is not willing to enlarge this space.

The large volume of traffic associated with growing mobility follows on the separation of the functions of living and working. The rather low mobility at Hong Kong, for instance, of 1,1 is partly due to the fact that numerous small workshops are in the living quarters. There are nevertheless big traffic problems.

## 2. Transportation systems for short-distance traffic.

The most important means of transport for short-distance traffic is without any doubt the private vehicls, especially in rural areas. But coming nearer to the core of the cities, it gets more and more difficult to handle great quantities of traffic, especially in

the peak hours when commutors are driving into the CBD. One possibility of solving this problem has been tried in Singapore, a city of about 2 million inhabitants. In 1975 Singapore created a Restricted Zone which includes the CBD. Only by buying a license for a month or a day may one enter this zone during the peak hours from 7.30 to 10.15 in the morning. Cars which have 4 or more passengers are allowed free. Now Stockholm considers following this example. The different means of public transport for short distances are described below.

### 2.1 *Suburban Railways (S-Bahnen)*

This system is mostly used to connect the suburbs of a big city with the centre. In the Rhine-Ruhr the S-Bahn forms the major part of the basic network of railway traffic between the different cities of this polycentric conurbation.

The type mostly used is called ET 420 which consists of three-unit trains (194 seats, standing room for 254 persons). The system is based on conventional wheel-rail technology. The maximum speed is 120 km/h. Some of the lines use the tracks of long-distance rail traffic. This is an intermediate solution only and requires off-line stations to allow long-distance trains to pass. Trains of up to three units can be coupled together.

The ET 420 is used in Munich, the Rhine-Ruhr Region, the Rhine-Main Region including Frankfurt and elsewhere. In Berlin one will find very old-fashioned cars run by the East German Railways Administration. They are mostly nearly empty as the population of West Berlin avoids the use of this Eastern-managed S-Bahn system, though it is very cheap.

### 2.2 *Metropolitan Railway (U-Bahn)*

The driver-controlled double-motor units with short couplings (98 seats, standing room for 192) use the conventional wheel-rail system as well. The power supplied is a direct current of 750 V from a contact rail. The maximum speed is 80 km/h (in Philadelphia the Lindenwold goes up to 120 km/h).

This type or similar ones is used in many cities including Berlin, Hamburg, Munich and Nürnberg as well as in New York, London, Paris, Tokyo, Moscow and dozens of other cities in many countries, mostly as subways. In Tokyo the different systems have been combined during the last years. They handle about 22 million passengers per day. This is an extremely high figure. Taking into account the 12 million inhabitants of Tokyo and about 3 million in the environs, the public motoring mobility is about 1,5 trips by public transport per inhabitant per day.

### 2.3 *Urban Railway System (Stadtbahn)*

This system is an improvement on the old streetcars or tramways. In many cases rather old-fashioned types are used with modern cars. The standard type is a six-axle driver-controlled car (51 seats, standing room for 64) which operates on the conventional wheel-rail system on special roadbeds or in tunnels. But on many lines these modern cars are still operating in streets with a normal traffic flow. In such cases the average speed is very low; without any hindrance on a typocal line in Essen (Porscheplatz - *Frohnhausen*) it might be 20 km/h. Loss of speed is due to delays at signals (21%) and 16% for other reasons such as congestion. The result is that the attractiveness of this line diminishes. The number of passengers is lower than it could be and more drivers and cars are required to make the same number of journeys. Altogether this line will bring less return and be more costly than the same one without level crossings and its own roadbed. Therefore, complete separation from private traffic must be envisaged for the future. Several decades will be required to fulfill this goal. But even small improvements bring more passengers and reduce the costs as the example of Wiesbaden and other cities has shown.

### 2.4 *Buses*

In the big cities buses run mostly on feeder lines to the stations of the S- or U-Bahn. Central bus stations have been built in combination with U-Bahn stations and the system is very effective. In smaller cities, as for instance the city of Wiesbaden, all passengers are transported by bus. In such cases it is very important to have bus lanes in the CBD. But this makes sense only when many bus routes are put together in one street; a high frequency of buses will induce private drivers to respect these lanes. In West Germany there are no special bus streets, as those introduced in Johannesburg. But in some cities the pedestrian zones are open to either bus traffic or streetcars. This method is effective and doesn't cause accidents. To give priority to the buses at signals so-called bus locks have been arranged. They prevent delays for buses negotiating a left-hand turn (which is equal to a right turn in South Africa). The aim is a fully controlled bus system where the position of all buses is permanently known at the control centre.

The so-called O-Bahn consists of several steps of handling the buses: within the normal traffic flow, on special lanes, or bus-trains running between fixed guiding rails. This system is just now being tested in Rastatt. The O-Bahn can be operated as a Dual-Mode-System.

### 2.5 *H-Vehicle System (H-Bahn)*

Large cabins (8 seats, standing room for 8 more persons) are suspended from a chassis running on an elevated trackway. Synchronous linear induction motors automatically ensure a constant speed of 35 km/h and a fixed headway between cabins. There is no time schedule as the frequency is high. A test line has been installed at Düsseldorf, a bigger one is nearly completed in Erlangen.

The H-Bahn wil serve in middle size cities (100 — 500 000 inhabitants) or as a feeder line in the same way as buses. But it has the advantage of a higher speed and smoother running as there is not as much acceleration and deceleration as on a bus trip in the normal traffic flow.

### 2.6 *CAT (Cabin Taxi, Cabinentaxi)*

Small or middle size cabins (for 3 to 50 persons) run on a wheel chassis above or below the same trackway at a maximum operation speed of 36 km/h. They are driven by two induction motors whose traction rails are imbedded in the trackway. The stations are situated off the main line with a separate line beside the through-line to allow cabins to stop. This system operates automatically. An experimental round-about course has been installed near the German city of Hagen, in the Rhine-Ruhr district.

A feasibility study has been prepared for the City of Hamburg. It is intended to build a feeder line system between several outer suburbs and the airport for the International Transportation Exhibition 1979.

A small CAT-system has already been built for transportation within a hospital area.

### 2.7 *Dial-a-Bus (Rufbus)*

In Friedrichshafen the first Dial-a-Bus has been started as a test in December in 1978. It is a system which does not follow fixed routes and has no time schedule. There are 14 call points and 30 stops. The test shall run for 6 months and will measure the reaction of the population and the effectiveness of the computerized demand control. It is expected that this system will be convenient for outlying areas in large cities and for rural districts.

## 3. Financing of construction and operation

Strictly speaking, public transport should be self-supporting like

private cars. But at present, private traffic is paying high taxes on mineral oil and petrol apart from special taxes on all motor vehicles. The total tax load per vehicle every year averages at about 500 dollars (U.S.). Three quarters of the tax income goes to the Federation and one quarter to the 11 States. The money is spent partly on construction of roads and partly on the improvement of public transport, for instance the building of new U-Bahn lines. Under normal European conditions it seems to be impossible to finance a U-Bahn on a private basis and to expect returns to pay for interest and depreciation. One non-European exception to this rule could be Hong-Kong where a new U-Bahn system is now under construction. Such a high traffic load is expected that it might pay for the whole project.

The private car is in many ways much more convenient than public transportation and even seems to be more economical for the individual. Whenever a person compares lists of car travel with public transport he does not usually consider the purchase costs of the car. So he ignores from the outset interest and depreciation — the car being considered an indispensible part of daily life. Nobody wants to miss out on the general mobility offered by a car.

When this is the general feeling of the public we have to ask whether a policy favouring public transport has any sense. It is true that public transport is required to serve the three "A"'s, meaning **A**rme, **A**lte und **A**usländer or poor people, old people and foreign workers. Is public transport only a question of public welfare?

It is impossible to preserve the amenity of the interior of many cities if they depend only on private traffic, which requires an enormous amount of space for parking purposes. Ten years ago we in Germany expected that many CBD's would suffocate under the preasure of too much traffic, that shopping would be transferred completely to hypermarkets and that the old centres would deteriorate. This development has been stopped mainly by the creation of more than 440 pedestrian zones. And the number of these are still growing. Nearly everywhere the pedestrian zones are being continually enlarged. Shoppers still frequent the old centres and the merchants are content. Many cities have got back the charm that they had before the First World War, and this is particularly true of Munich.

Certain areas of the inner city have been made free of traffic on the surface of at least private traffic. These pedestrian zones can be kept alive only if they can be reached either by car or by public transport. Away from these pedestrian zones, the large cities can no longer handle the whole of private traffic which is concentrated at peak hours. The main problems are caused by commutors, workers and students.

The following may be regarded as an agreeable compromise:

(a) It is desirable that every family should have one car or, if necessary even more.

(b) But these cars should not be used to enter the CBD on the basis of one car - one person.

(c) The acessibility of the interior of cities therefore has to be assured by the provision of public transport. This transport must be attractive, providing a saving of time in comparison with private transport.

(d) On the other hand, street space must be kept free for other purposes by keeping out the greater part of commuters, professional and shopping traffic and visits to friends, the cinema and similar leasure-time activities.

(e) Under these conditions the hearts of cities will continue to beat in future as in the past, for the enjoyment of the whole city and even of people living in the region beyond the city.

(f) Under these circumstances where public transportation is motivated not only by time-saving for the users, but by amenity for the whole city, it is justified that the taxpayer bear the bigger part of the construction costs.

This situation now prevails in West Germany. Normally the Federation grants about 50% of the total costs, the State provides 35 or 40% and the rest of 10 or 15% is paid by the community involved. This financial sharing is justified for instance for the tunnels of a U-Bahn system or for the building of a central bus station.

The transport companies have to pay for the mechanical and electrical equipment and for carriages or buses. But sometimes there are grants for these purchases as well. No German city would be able to build a U-Bahn without this help. But a certain danger lies in these high grants. Sometimes projects, which are submitted by the communities to the authorities of the State or the Federation, are not fully justified or the ratio of effectiveness to costs might be rather unfavourable. The city may have prestige reasons for building a project. And if there is enough political pressure they might carry the project through the approval procedure.

Now what about the *operation costs?* During the last 15 years there were growing deficits nearly everywhere in short-distance public transportation. The burden of these is bourne by the cities which are owners of public transport companies or the German Federal Railways which nowadays have a total deficit of about 6 billion dollars (U.S.) per annum. Still higher losses are expected.

On average, the returns of local transport companies cover not more than 60 to 65% of the costs. These companies always try to alter the tariff in accordance with rises in wages which form 70% of the total expenditure of these companies. But then passenger figures drop, as it looks cheaper to the owner of a car to use it to work. The owner of the private car does not take into account interest and depreciation or taxes and insurance and other expenses for his car. So the driver considers no more than the price of petrol. He has no interest in using the car only occasionally, because he wants to buy a new one in 5 or 6 years time. People become emotionally involved in car ownership with a total disregard of the economics. Besides, the enormous variety of consumer goods which is offered and must be paid for, reduces one's willingness to pay more than is necessary for any essential of life which is not enjoyed, namely the journey to the office.

Today a skilled labourer in West Germany earns about 6 dollars per hour. He should pay 50c to one dollar for each trip, which is the normal price for a ticket. And this proce just covers the cost. But there are so many reductions from his earnings that real earnings are 35 to 40% lower. This is exactly the percentage of the loss or the subsidies paid by local governments, or compensated for with earnings from electricity, gas or water.

These losses are in the region of several billion dollars per annum. In particular, German Federal Railways are very deeply in the red. Each taxpayer has to bear the sum of about 200 dollars for the railways per annum and many local railways are losing money due to the trains very often being empty.

But local politicians will fight for these lines and always try to prove that they are of vital importance to the region. They can do this because local authorities have no financial responsibility. It is easy to want goods which don't cost you any money! The solution might lie in distributing the costs in such a manner that local authorities also contribute to the dificits of the railways in their own administrative areas.

In regard to the effectiveness/costs ratio of the integrated mass transportation systems most statistics show that buses are

cheapest. But under ideal circumstances the operation costs of CAT are no more than a quarter cent (U.S.) per person per km. Only experience over a longer period than the system has been in operation will show the true relationships.

Finally, it appears that, under German and European circumstances, a combination of about 80% private traffic and 20% of public transportation seems to be satisfactory. From a town planning point of view it is justifiable to pay for the erection of public transport construction. Subsidizing the operation costs of public transport seems to be unavoidable in the immediate future. We must get accustomed to the fact that in an industrial society, consumer goods are always getting relatively cheaper and services have to go up together with the wages. If we are willing to pay the price in the barber's shop, we should do so in the bus as well.