

# National Traffic Planning in Developed Countries - Taking the Federal Republic of Germany as an Example

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The co-operation among scientists, administrative experts, and politicians in the field of traffic and transport has become increasingly closer during the past decades. The reason for this is, on the one hand, that the science of transport and communications has consolidated and the white patches in its "territory" have become smaller. It is in a better position today to offer practice-related solutions. On the other hand, administration and politics have to deal with much more complex situations than was formerly the case. It does no longer suffice to consider only the individual mode of transport, but the transport system must be looked at in its entirety. In addition to that, the interrelations between the transport sector and other sectors - let me mention as examples only the sectors economy, regional planning, and environment protection - must be given more attention.

This development has in some way formed all those involved in this process. Today administrative experts as well as politicians are much more open-minded vis-à-vis scientific problems than they used to be in the past. In some ways reproaches have even been expressed to the effect that transport-policy decisions were far too much tied to the results of scientific investigations - in the case in hand cost-benefit analyses. On the other hand, science offers nowadays more assistance for the solution of administrative and political questions than formerly.

I will restrict myself in this paper to the co-operation between science and administration in traffic infrastructure planning, more precisely in the planning of long distance traffic routes, which are the direct responsibility of the German Federal Government.

In the Federal Republic of Germany the planning of long distance traffic routes is characterized in the past ten years by progressive integration. It developed from object planning to programme planning for individual modes of transport and from there to comprehensive planning of all traffic routes which the Federal Government is responsible for, the so-called Federal traffic infrastructure planning.

The investive part of the transport budget of the Federal Republic of Germany was, up to the fifties, not much more than the sum of the amounts required for the individual projects together with the considerations justifying these projects. With road construction becoming more and more important, programme planning in the present sense was introduced. The so-called first development plan for the Federal trunk roads was completed in 1959 and covered a period of twelve years.

The necessity of a co-ordination of the traffic route planning of all modes of transport had already been pointed out during the 1950s. As we all know the development of traffic, first in the communal sphere, reached a stage which required planning as well as measures that were not restricted to one mode of transport alone but would cover all modes of transport. The experiences of

the communities led, in connection with the intention of a better harmonization of regional planning and planning in special fields, to the first attempts at master traffic plans at regional level and the level of the Federal Laender. A report of experts on the improvement of transport conditions in cities of 1964 contained the explicit recommendation to draw up master traffic plans for towns, regions, and the Federal Laender.

Today many towns in the Federal Republic of Germany have set up traffic infrastructure plans which comprise all modes of transport. Their methodology meets the high standard which can be expected in developed countries today. At the level of the Federal Laender the master traffic plan of the Land Northrhine-Westphalia, which appeared in 1970, has set up important standards.

A traffic infrastructure plan comprising all traffic routes in the responsibility of the Federal Government was not begun before the end of the sixties, however. Its result was the Federal traffic infrastructure plan first stage submitted to Parliament in 1973.

The four main characteristics of integrated programme planning are the application of uniform forecasts and investment objectives as well as uniform assessment and financing of all projects. These requirements have not yet all been fulfilled in the Federal traffic infrastructure plan first stage.

The events in 1973 in the field of energy policy and lasting changes in world economy have strongly affected the growth, the extent, and the structure of overall economic production in the Federal Republic of Germany and in many other parts of the world. A decrease in the population must also be reckoned with in the long run.

Both developments produce consequences for the economy, the finances, and the demand for transport.

For these reasons the Federal traffic infrastructure plan first stage had to be updated during the period 1974-76. This updating did not only take into account the changed demographic and economic development, it even went in its methodology beyond the first stage of the Federal traffic infrastructure plan.

The planning of the traffic routes which the Federal Government is responsible for extends over a period of twenty years. It is subdivided into two periods of five years each and one period of ten years. The four-year planning period of the German financial plan progresses within the two 5-year periods from year to year. It is thus a combined system, consisting of two fixed 5-year programmes and supplemented by a progressing 4-year programme, which is updated annually.

The long-term plan comprises those projects which might be carried out within a period of twenty years. The long time is necessary for the preparation of the project itself, but also communal and regional land use planning require such a long planning period. The inclusion of a

project in this plan means that the Government basically intends to realize it; the project may be abandoned, however, if circumstances so require.

The inclusion of a project in one of the two 5-year plans, on the other hand, can already be regarded as a commitment by the Government, even if the realization of these programmes still turns upon the supply of sufficient funds. Such programmes over several years can - from the point of view of the buildings industry or of regional policy - be balanced more easily than annual plans. If the network as a whole is kept in mind, it is possible to create sensible intermediate conditions, so that investments will be of use even if the possibilities of financing deteriorate. Whereas economic reasons are determinant for the inclusion of a project in one of the two 5-year programmes or in the subsequent 10-year plan, it would hardly be sensible to establish an order of the projects contained in a 5-year plan according to their economy, as within such a relatively short period of time the progress of the preliminary work for actual construction work decides in the first place on the sequence in which construction is to begin. These aspects form, therefore, also the basis, when a project is to be included in the German financial plan or in the annual budget.

On account of the urgent problems in connection with the financing and the realization of the development of the traffic infrastructure, it seemed of first importance to establish the two 5-year programmes 1976-80 and 1981-85, when the Federal traffic infrastructure plan first stage was updated. The result was given the name "Koordiniertes Investitionsprogramm für die Bundesverkehrswege bis zum Jahre 1985" \*1. Statements of the Government concerning projects beyond the year 1985 exist at present only in the sphere of road construction.

The establishment of the co-ordinated investment programme had to solve the task of structuring an investment volume of a total of 110,000 million DM in such a way, that means to select the projects proposed for realization, that they render the greatest possible overall economic benefit. Moreover, the objectives of regional planning and regional policy had to be taken into account. Furthermore, the investments in the railway network of the Deutsche Bundesbahn were intended to reduce the latter's deficit.

The total volume of investment of 110,000 million DM expected to be available had been estimated on the basis of assumptions concerning the development of the gross national product and the Federal budget. This is basically what we might call a "conservative" estimate. The analysis of the costs and benefits of the individual projects showed, however, that this financial volume will suffice for achieving in the transport policy objectives. A catalogue of objectives was set up as a pre-condition of an assessment of the projects proposed for construction. For various reasons the projects were evaluated with the aid of cost-benefit analyses. This means that the significance or the order of the objectives is expressed in the assessment parameters chosen. The establishment of a hierarchy of objectives was, therefore, not absolutely necessary for the achievement of the planning result.

The employment of a system of objectives offers the advantage, however, that certain benefit components can be assessed more easily, that aspects of regional policy or of economy of transfers can be more easily taken into consideration, and that it is easier to give weight to political influences or to control them. I suppose however, that the possibility of expressing one's political will, as it offers itself in the establishment of a system of objectives, is from a political angle just as unsatisfactory as the possibility of influencing the assessment parameters of a cost-benefit analysis.

We decided, despite the afore-mentioned limitations,

to have the bases of a system of objectives and an objective oriented assessment procedure worked out scientifically<sup>2</sup>. The result of the research offers above all possibilities to derive a system of objectives for the transport sector from a system of objectives comprising all sectors of society. The employment of electronic data processing does not only facilitate the establishment of the system of objectives and assessment itself, the result, has moreover, numerous possibilities in its application to demonstrate the influences of alternative political or regional weighting on the order of the projects.

The second step in the planning was the analysis of the existing traffic system in regard to the achievement of the planning objectives. Such explanations occupy much room in many traffic infrastructure plans. Sometimes one cannot help feeling that these extensive analyses serve more the expert's better understanding of the problem than the administration's. When planning is conceived as a continuous process, the scope of such "condition analyses" can be smaller. Just as important as the analysis of the initial state is, in my opinion, the analysis of the change of conditions effected by a project or programme that has been realized, in other words - an ex-post economic analysis. This "ex-post economic analysis" in traffic route construction today mainly consists in stating the length of traffic route built and the amounts spent. We must endeavour to come to such a point, however, and conduct more and more ex-post cost-benefit investigations. Only in this way will we be able to escape the danger of attributing effects to projects, which they do not have, or of overlooking effects that are significant.

The determination of possible measures and the development of strategies for the improvement of the traffic network - which I wish to mention here as the third step in the planning - is often considered to be exclusively the concern of the administration. This has certainly to do with the fact that very often subordinate bodies submit projects to a central planning body or prepare them for the latter. But the backing by research is important also in this planning step, at least as long as the methods of dynamic investment planning have not yet been developed to such a degree as to allow to take the frequently occurring complementary and substitutive effects among the various traffic projects into account at justifiable expenditure. Thus it is necessary to find simplified methods for the practicable definition of projects and the determination of complementary and substitutive effects. The Federal Republic of Germany possesses a dense traffic route network. The purpose of most projects is to improve this network locally. Apart from that there are projects, however, which must be seen in the wider context of a system still to be established. The autobahn network in the Federal Republic had been planned as a system and it really is a system today. The new construction and improvement of railway lines for speeds up to 250 km/h seems to signalize a similar development in the railway sector. Approximately a year ago the Government of the Federal Republic of Germany gave the Deutsche Bundesbahn the green light for the construction of a new line of about 110 km length between Mannheim and Stuttgart. The line is being built with funds from the Federal Government. We must be aware of the fact that the new construction or the improvement of a railway line can bring full advantage only if it is accompanied by a certain improvement in the whole network. Advantages for the users and thus also an increase in the demand due to an enhancement of the attractiveness will occur only after a certain threshold of advantage has been passed. Moreover, the employment of rolling stock suitable for higher speeds will only pay, if the overall demand has reached a certain level. Also in

road construction the summation of measures occasions effects which the individual project does not have, e.g. changes in the modal split in passenger and goods transport.

These system effects of some investments make it necessary in the planning to evaluate not only individual projects but also investments strategies. We have carried out such a strategic study in the Federal Republic of Germany, in which a delimitation between rail traffic and domestic air traffic was made <sup>3</sup>. I think it is necessary to increasingly conduct such strategic studies in the future.

The planning of the Federal traffic routes is based on a forecast of the demand for transport of the German Institute for Economic Research <sup>4</sup>. In this forecast the expected traffic distribution in passenger and in goods transport among 79 planning regions within the Federal Republic of Germany and 15 regions abroad have been established for the year 1990. The demand has been subdivided into modes of transport as well as into purposes of travel in passenger transport and into twelve groups of goods in goods transport. This forecast of the demand for transport is founded on an estimate of the development of the population and the economy, which above all takes into account the changes in world economy that have occurred since 1973.

The traffic forecast is based on the assumption that existing development trends will continue - it is thus a status-quo forecast. It was assumed, among other things, that the State will not essentially interfere with the competition among the various modes of transport, that the rate relations among the individual modes of transport will approximately remain as they are, that private transport in city centres is subjected to limited restrictions, and what, owing to environment protection as well as rising oil prices, private transport has to reckon with rising costs. The forecast comes to the result that by 1990 the transport performance in passenger transport will rise by approximately 30% and in goods transport by approximately 40%. This would mean that above all in passenger transport the annual growth rates would be below those during the past 15 years.

Furthermore, the investigation comes to the conclusion that the shares of the individual modes of transport in the total demand will not vary so strongly any more as was the case in the past and that above all the railways will be able to stabilize their share in the market. This is especially true for passenger transport in urban agglomerations, where the supply of rail transport is being improved. For rural areas, on the other hand, a relatively stronger increase in private transport as well as a shift from rail transport to motorcoaches was assumed.

The transport demand of the railways and of shipping could be directly assigned to the railway and waterway networks, since these networks are comparatively wide-meshed, so that the calculated volumes of traffic reflect the amount of traffic on railway lines and waterways in passenger trips and goods-tons per year with sufficient accuracy. The construction of new lines and the improvement of existing ones for higher speeds enable us to expect considerable shortening of travel times in long distance travel by rail. This will lead to increased demand of the railways, which has not yet been included in the forecast. The increase was taken account of by adding a certain percentage of traffic. There is considerable uncertainty as regards the estimation of such gains which are due to attractiveness, as no experience has hitherto been made in this field in the Federal Republic of Germany, and it is doubtful whether experiences made in other countries can be transferred to the Federal Republic.

To assess the road construction measures with their

effects on for the most part small areas, the rough regional division into 79 regions did not suffice. You know the problem that for the evaluation of planned traffic routes very often forecasts are required which refer to very small regional units, whereas on the other hand such forecasts tend to be increasingly unsharp. For road traffic a forecast very largely disaggregated as to space was set up, which starts out from approximately 1,100 regional units for the Federal territory <sup>5, 6</sup>.

It is based as to the number and the regional distribution of the population and gainfully employed persons on the above mentioned forecast of the German Institute for Economic Research <sup>4</sup>. The results of the above rough forecast and those of the regionally more differentiated forecast for road traffic have been adapted to each other. It was not possible, however, to achieve full adaptation, owing to different definitions and delimitations. There are two scientific schools in this field in the Federal Republic of Germany, whose teachings can only be very slowly reconciled. These difficulties of understanding in the scientific sphere have quite concrete effects on the practice of planning.

The central task within the framework of the planning was the evaluation of the proposed measures. The special problem was not only the evaluation by a uniform and comparable standard of the very different measures taken with the individual modes of transport, railways, road, and waterways, but also to deal with the great number of projects in such a short time with only few personnel. In addition to that, the evaluation procedure should be reconstructible. It should take the legal and organizational conditions of the individual modes of transport into account and should apart from results concerning the relative priority of the projects also furnish such with respect to their "absolute" economic efficiency. These demands could largely be met by an evaluation with the aid of simplified cost-benefit analyses. They have the additional advantage that the reference to monetary quantities exerts strong pressure on planners to seek for low-cost solutions.

In view of the great number of road construction measures, the benefits were in the first instance determined by means of a point evaluation process and compared with the costs of the measure represented in terms of money <sup>7</sup>. The point-cost relationships were then converted into benefit-cost relationships. The key for these conversions could be determined from a random sample of projects.

In all projects a difference was made between the benefits of the construction agency concerned and traffic and non-traffic benefits. Traffic benefits were here those savings in operating costs and travel time which are directly connected with the traffic performance, as well as reduced accident costs and environmental nuisances due to noise and exhaust gases. Any effects of the projects on the regional economic structure, regional planning, and economics of water supply and distribution were considered as non-traffic benefits. Jobs that were created or transferred on account of the measures, were counted as benefits only if they were situated in economically weak areas. The objectives of regional planning were taken into account in that way that the benefits brought about by the projects were regionally weighted the higher, the lower was the degree of the development in the field of traffic of the region concerned and its connection with other regions <sup>8</sup>.

Such regional weightings are of great significance on the political level, as the territorial bodies naturally endeavour to get as much as possible for their respective area. In the evaluation of road construction measures alternative weightings were therefore applied to those benefit components which contain the contributions of

the projects to the improvement of the regional structure and the regional economic structure. The Federal Laender participating in the discussion had thus the opportunity to give their vote for one of the weighting alternatives and in this way to take part in the decision on the extent of the preferential treatment accorded to areas whose development is below average. I think that here a promising possibility has been found to bring pluralistic interests in a planning process to bear. The method to evaluate road construction measures was developed in close co-operation with scientists and specialists of the administration; it would not have been feasible without electronic data processing.

The result of the evaluation was a priority list of most projects of the railways, the waterways, and in road construction. The financial means to be expected were in no way sufficient for the realization of all projects. Besides considerable amounts had to be designated for the completion of projects under construction or which have already been fixed by contract. It had moreover to be taken into account that for existing traffic routes replacement of investments are becoming increasingly necessary. The estimate of the replacement of investments starts out from the previous investment activity which is reflected in the structure of fixed assets according to years; the individual components of the fixed assets, such as earthworks, structures, superstructure, and equipment, were depreciated by the straightline method in accordance with their respective service life<sup>9</sup>. The available financial volume which remains after the deduction of these amounts was compared with the accumulated investment volume of the priority list. The result of this comparison was that only such projects will be realized whose benefit-cost relationship exceeds a certain volume.

As a result of the investigations it was demonstrated that the construction of Federal trunk roads should remain the focal point of investment activity also during the ten years to come, even if its share in the total investment volume will decrease somewhat in favour of railway transport. The share of the Federal waterways in the investments volume will remain approximately the same.

A traffic system is subject to constant change, if it is to adapt itself to changing social requirements. Planning is, therefore, a continuous task. In updating the planning, we will have to take into account not only changed initial conditions and objectives but also improved methods. I had already in the description of the planning process to some extent indicated the necessity of such improvements.

Let me also say some words on the motto of this conference, before I speak about further necessary improvements. You too will, no doubt, have thought about whether there is greater uncertainty in the field of transport today than in earlier decades and what this uncertainty might be. There are doubtless developments nowadays which render planning more difficult than it used to be: the technical development offers us a wider range of possibilities in traffic and transport; the demand for transport performance of the population and the economy have at the same time become more differentiated; the increasing significance of regional policy and environmental protection have on the whole further intensified the insertion of the transport sector in the development of society, and not least the citizen follows the development of the traffic system much more critically than formerly.

I suppose, however, that the intention was to express something else with this motto, namely a certain break in a hitherto fairly steady line of development. The past 25 years were characterized in the Federal Republic of Ger-

many by a steady increase of road traffic. These growth rates will, there can be no doubt, be smaller in the future. We must part with those plans for the development of the road network which were set up in the past and which are to some extent exaggerated. Also the optimistic view that we would be able to fundamentally improve the traffic and environmental situation in our cities by an intensified development of public short-distance passenger transport has disappeared in view of the high deficits of the short-distance transport enterprises.

As far as the energy situation is concerned, our forecasts of the demand start out from rising mineral oil prices. We cannot say in how far the latter will not only affect the level but also the structure of the demand for traffic, for we know very little about that.

Road traffic has on the whole proved relatively stable in the economic ups and downs and we can assume that it will remain rather stable if structural changes in the economy occur. Moreover, in road construction even parts of major projects can in most cases be sensibly utilized. The risk in connection with road construction investments is, therefore, comparatively low.

It is different, however, with the railways and with trackbound vehicles of the new technologies. The use of part of a new line is not very promising normally. As I already mentioned, what greatly matters with the railways is the interaction of the elements in a system. This is especially true for an area with a polycentric structure, such as the Federal Republic of Germany. The demand for transport of the railways in passenger transport by rail many times forecast in the Federal Republic of Germany proved to be rather shortlived - apart from local developments. Goods transport by rail is subject to strong economic fluctuations, and it is very difficult to estimate the effects of shorter travel times on the demand for transport. In my opinion, the risk connected with the new construction or the improvement of railway lines is for these reasons higher than that connected with the construction of roads. Nevertheless, I think that the railways will have a chance not only in goods transport but also in passenger transport on the highly frequented lines. In the so-called co-ordinated investment programme for the Federal traffic routes until 1985, we have planned the new construction of two railway lines and the improvement of six other lines.

The work in connection with the Federal traffic infrastructure plan has shown various possibilities and necessities for methodical improvements, part of which concerns the sphere of forecasting. As I think to have observed, forecasts that have been set up to evaluate an individual project often have the drawback that they are not compatible with the development of the traffic in its totality in the country concerned. They tend to over estimate the influence of the project. More general forecasts which are in conformity with the economic and demographic development of the whole country, do a priori not have this disadvantage, but they are in most cases not capable of stating the influence of an individual project on the modal split or on the distribution of traffic. Moreover, they are often not sufficiently well subdivided regionally in order to allow project-specific statements. Therefore, what we need are methods which make it possible to differentiate demand forecasts of a general type regionally and as to time, and to demonstrate in how far the demand for transport depends upon the project. Such methods are available for short-distance passenger transport. The corresponding methods for longdistance passenger transport are not sufficiently reliable, however, mainly because of inadequate data. The study of the causes of the modal split in long-distance passenger transport is, therefore, an urgent task. The models that have hitherto been developed, are mostly using aggre-

gated data. My impression is that these models have reached a certain limit in their capacity of development. I hope that the elaboration of new models on the basis of disaggregated data will impart new impulses to the investigation in this field. The continuous ascertainment of behavioural patterns in passenger transport, within the framework of which approximately 1 million passenger trips were covered in a sample survey in the whole Federal territory since 1975, provides the data for the calibration of the models. There are also blank spaces in respect of the question of the capacity of railway lines. In road traffic we can rather precisely calculate beforehand how the expenditure in time and operating costs will change with increasing traffic volumes. In rail transport we know only little about the increase in the delay of trains due to an increasing volume of traffic on a line, and the loss of time for passengers and goods as a result of that. We are above all not in a position to quantify the reaction of passengers and shippers in the long term, if they find themselves faced with delayed and overcrowded trains. Although capacity bottlenecks occur only in few places in our railway network, the whole network is affected by them.

Another field of study is the interface between the areas "forecast" and "assessment". The project evaluation can meet today's requirements only through the employment of electronic data processing. This means for the area of forecast that the demand data for the "with" and "without" cases must be made available on data carriers. This is on account of the great number of projects, above all, a problem of quantity and expenditure. Methods must therefore be developed, which enable us to limit within an extensive traffic network the calculation of the distribution of traffic, the modal split, and traffic assignment to those parts of the network which are significantly influenced by the project under consideration. First moves to that effect have already been made.

Great progress has been made in the Federal Republic of Germany during the past years in respect of the question of an evaluation of investments in traffic routes. Now it is important to further standardize, formalize, and automate these methods. The bases of the evaluation must also be further investigated. It will above all be necessary to further examine the effects of new traffic routes on the regional economic structure. The evaluation of time savings should also be further studied, even if it is made in almost every cost-benefit study. With most road construction measures three quarters or even more of the benefits are time savings. The objective economic benefit on account of these time savings must be further analysed just as must the subjective benefit which they produce from the point of view of the road users.

The automation of the evaluation procedures does not take place for the sole purpose of reducing the expenditure in planning. It offers on the contrary new possibilities to let political bodies participate in the planning process. For the planning is to provide bases for decisiontaking and not the decisions themselves. The employment of electronic data processing makes it possible within a short time to demonstrate the effects of alternative evaluation parameters or alternative, regional weightings. It is only in this way that the political bodies are given the possibility to set the most important evaluation parameters according to their objectives.

The investigation of the above questions requires close co-operation between the sectors research, administration, and politics. This has already been practised in the Federal Republic in the past. This is why in this lecture I have mainly spoken of practical problems. Although I have concentrated wholly on the sphere of traffic route planning, I must say that research also plays

an important role in regulatory policy. As an example of this I should like to mention a simulation model for the goods transport market in the Federal Republic of Germany, which is intended to reflect the reaction of buyers and suppliers to measures of regulatory policy, e.g. the regulation of capacities and interventions in price or tax policy. Such a model exists already for the sphere of containerizable goods.

Allow me in conclusion to say some words on the international co-operation in the field of traffic research. The Federal Republic of Germany has concluded agreements on the mutual exchange of research results with many countries. In addition to that, there is active multilateral exchange of research results especially within the framework of the ECMT. With the so-called Action 33 the OECD, the ECMT, and the EC jointly worked out a prospective study of European long distance passenger transport for the years 1985 and 2000. A corresponding study for goods transport is being prepared. Such studies meet with considerable data problems, however, since the data of the individual countries are only very rarely comparable with one another. To investigate concrete projects, these demand forecasts must because of the rough regional subdivision be complemented by local studies.

Summing up, it can be said that the consulting traffic research will be faced with a wide range of tasks in the future. Their solution, which in many cases will only be possible through the co-operation between science and the administration, will not always be easy. In any case, however, the fields of research will be of high continuity and they will have a stimulating effect on science and will call for full personal initiative in the elaboration of solutions.

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#### FOOTNOTE

\* Co-ordinated investment programme for the traffic routes in the Federal Republic of Germany until 1985.