Integrated Traffic Concept for European Metropolitan Areas: Review of Alternative Traffic Management and Transportation Development Scenarios for the Greater Stuttgart Area

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A vital general condition for conurbations is detectable, continued growth in the number of residents and the working population. What is needed is an integrated concept with a comprehensive catalog of measures concerning structural aspects of residential accommodation, planning, administration, and political regulation, pricing, and finance. There is a need for investment and technical measures that are mutually supportive and all aim in the same direction. The questions posed in an integrated traffic investigation about environmentally oriented concepts for residential structures with regard to the Greater Stuttgart area are examined in two scenarios and compared with those of a Trend scenario. In both scenarios, various measures as part of an integrated traffic infrastructure concept are examined with and without concepts for charging road usage fees (so-called road pricing). To validate the effects of the examined concepts, a complex traffic and effect model was developed and calibrated in the study area. The analyses based on this model demonstrate that road pricing can contribute to a substantial reduction in the existing overloads in the road network. Moreover, road pricing demands considerable extension of the public transport network and comprehensive integration of roads and public transport through multifunctional P + R terminals. It also necessitates realignment of the road network. The studies relating to the integrated transport concept also revealed substantial future demand for research, in particular with regard to knowledge and impacts of new measures relating to pricing and organizational policy on the traffic and location behavior of the population and companies.

The development of road traffic shows that, regardless of political aims, mobility in the form of motorized individual traffic is increasing in the conurbation areas. Concepts to improve and maintain the environment must take into consideration this development in mobility. What is needed is an integrated concept for measures concerning structural aspects of residential accommodation, planning, and administration as well as political regulation, pricing, and finance (*1*). There is a need for investment and technical measures that are mutually supportive and that aim in the same direction. This then was the point of entry into the initial draft plan of an integrated traffic concept for the greater Stuttgart area (*2*).

The term integration implies more than the integral examination of the different segmental traffic systems. Here, integration in addition means the integral examination of all individual measures and their packaging into concepts. That is, parallel to the operative and structural measures, it is particularly important to include measures of a financial, pricing, regulatory, and technical nature. Integration means also integral examination and evaluation of these concepts, considering ecological and economical aspects.

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ROAD PRICING AS A CENTRAL MEASURE OF AN INTEGRATED TRAFFIC CONCEPT

At the center of integrated traffic concepts are marketing instruments and pricing measures. There is general agreement that the variable costs of private motoring are too low. It has been demonstrated in the past that the previous scope for varying the price of motor fuel has had only slight effects on road usage and the choice of means of transportation. A medium- and long-term task is the development of a tool accommodating the supply-and-demand aspect, that is, road pricing or the road usage fee.

Electronic fee accounting and invoicing will be possible in a few years and can be introduced in the medium term. A road usage fee creates a new balance between supply and demand. Road pricing oriented toward shortages and scaled according to area and time would thus dampen demand and, consequently, would increase the quality of traffic flow.

In areas of agglomeration there is the opportunity to shift traffic to more environmentally friendly means of transport. However, at present there is no assured experience of road pricing on the basis of which the medium- and long-term consequences of such an area-related road usage fee can be forecast. Nevertheless, the idea of a market-oriented method of approach should be pursued further (*3*). In the Stuttgart area, parallel to the trend, two antagonistic scenarios were established.

SCENARIOS

Trend Scenario

The Trend Scenario describes a situation that anticipates a continuation of previous development up to 2010. This presages a continued growth in residential and working places with further dispersed growth of estates. The number of rail kilometers and the length of the road network for motorized individual traffic (MIT) will almost remain constant.

Scenario A

Scenario A is based on the assumption that a locally compressed residential structure demonstrates ecological and traffic advantages (Figure 1). This concept is aimed at reducing the distances between places of residence and work.

Such a scenario depends on increased cooperation between the various transportation systems. The road network will be expanded and integrated into the public transport system. Also, the public transport system network will be improved and extended, and large, high-capacity P + R terminals will be erected. The infrastructural measures were supplemented by zonal road pricing and parking space management.

With respect to freight transport the aim is to shift transportation to the railway by expanding the consolidation centers.

Scenario B

The strategically crucial point for Scenario B lies in the concentration of housing developments along the public transport axes. Parallel to this, road capacity will be reduced, that is, road space will be created for buses, taxis, and carpools (Figure 2). The urban railways and the regional railway systems will be improved and augmented. Fine-mesh coverage will be provided by a high-density system of bus routes. Further, additional consolidation centers will be expanded. In addition, a so-called conditional network for commercial road traffic will be introduced.

EFFECTS

General

Both Scenarios A and B were examined with and without a road pricing concept. A traffic and effect model was developed to illustrate the effects of the measures. The model was complex and iterative and addressed the aim and choice of transportation means simultaneously. To portray road pricing, the costs were interpreted as additional time resistances.

Trend Scenario

The Trend Scenario serves as a comparison with the current situation. With respect to the majority of aims, a serious deterioration in some cases is expected. The cause of such deterioration primarily lies in the unrestricted advance of suburbanization, in growing motorization (+300 percent), as well as in a global increase in population (+128,000) and the number of people employed (approximately 84,000) by 2010.

These changes lead to a 31 percent increase in the number of journeys in passenger traffic and a 14 percent increase in truck traffic. The mileage covered in MIT on the road network increases over the entire planning area.

Fuel consumption—a key indicator of climate-relevant CO_2 emission—will increase by 10 percent in conjunction with the continuing trend toward more powerful vehicles. With regard to other pollutant emissions, it is expected that technical efforts (changeover to LEVs in vehicle fleets) will considerably improve the current situation. The nitrogen oxide (NO_x) emissions from private traffic will be reduced by 61 percent. The NO_x emissions stemming from truck traffic have been increasing because no advances in technology have been identified. In addition, accessibility in the road network is being severely impaired, with the result that the attractiveness of the region as a commercial base appears to be in jeopardy.

Scenario A

The concept of "short" distances will lead to a justifiable result only if it is coupled with road pricing and a parking area management concept. In this case, a considerable proportion of traffic volume will be shifted to the local public transport system.

However, there is evidence of "escape" reactions in which the road pricing area will be avoided. In spite of the greater use made of the public transport services, MIT mileage in this scenario is 7 percent above the trend.

On inner urban routes sensitive to the residential environment, MIT mileage will drop disproportionately (by 23 percent) in con-

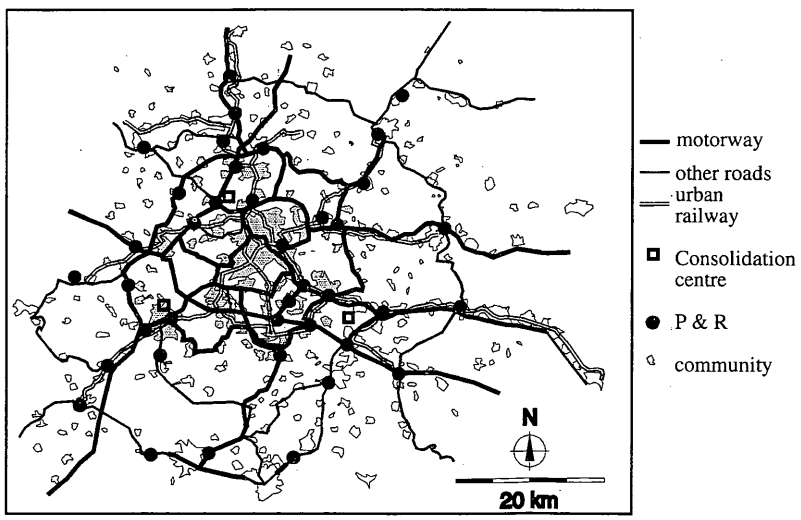

FIGURE 1 Traffic infrastructure in Scenario A.

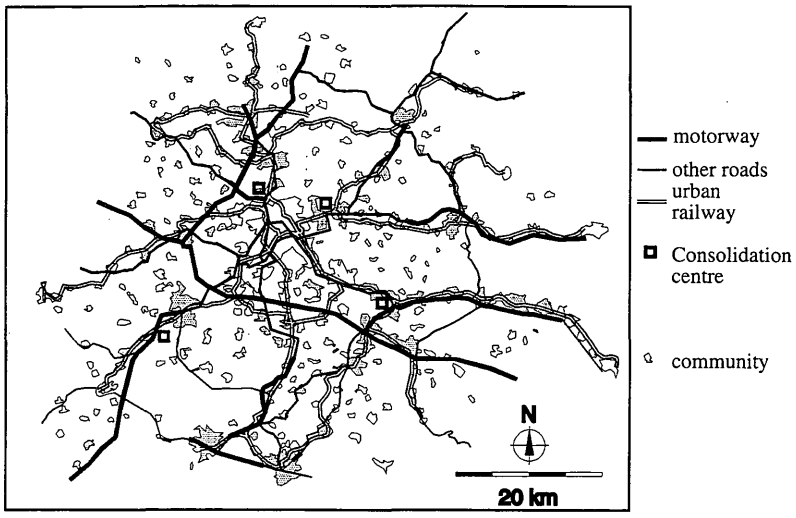

FIGURE 2 Traffic infrastructure in Scenario B.

junction with the new road-building measures. Reduction in MIT will be achieved within the network subject to road usage fees because road usage here will decrease by 24 percent.

However, critical questions must be posed concerning the zonal arrangement of the P + R concept examined here. The structural consequences for areas with high road usage fees are currently difficult to assess. For instance, trends toward migration to "cheaper" areas are just as conceivable as increases in the attractiveness of areas enjoying considerably less MIT.

Scenario B

In Scenario B, the aims of reducing MIT mileage and increasing the share of public transport in overall traffic volume (+31 percent) are achieved without road pricing. The MIT mileage falls by 12 percent, although at the cost of greater traffic jam frequency and duration. Commercial traffic reliant on MIT will also be affected in particular. Under road pricing conditions, only marginal improvements can be seen in contrast to Scenario A because the potential for MIT transfer already has been largely exhausted through construction and operating measures.

Regarding MIT loads, Scenario B demonstrates clear relief in the conurbation core as well as additional relief on the axes served by public transport. However, these reductions contrast with increases in mileage in the areas between the axes.

Whereas in Scenario B positive effects are achieved with respect to the human and natural environment, one must assume that, distinctly, these will have negative effects on the commercial structure.

An important factor in both Scenarios A and B is costs. The investment costs compared with the trend amounted to 12.2 thousand million DM (36 percent road, 35 percent public transport, 29 percent P + R) in Scenario A and 11 thousand million DM (0 percent road, 100 percent public transport) in Scenario B. There are also the additional operating costs, which could be approximately 168 million DM in Scenario A and about 574 million DM in Scenario B. As already mentioned, the costs of investing in and implementing a road pricing concept still have to be considered.

CONCLUSIONS

The following conclusions can be drawn from the investigation of the integrated traffic concept for Stuttgart:

1. A significant increase in the overall cost of traffic through "internalization" of external costs is necessary to sharpen awareness of the consumption of resources connected with traffic.
2. The previous investment as well as restrictive measures did not achieve their goal: the frequency and duration of traffic jams also increased, as did pollution of the environment.
3. The necessary quality of the road network can, however, be recovered through incisive road usage fees scaled according to time and area.
4. A road pricing concept must be coupled with a generous expansion concept for the local public transport system to facilitate migration away from MIT to the public system.
5. The transfer points for P + R in passenger traffic and consolidation centers in long-distance goods traffic are vital components of a future traffic concept.
6. Promotion of carpools takes on special importance in high-occupancy-vehicle concepts. Testing such concepts appears to be extremely interesting.
7. The intelligent utilization of such a complex traffic system is only conceivable on the basis of a comprehensive information system available in a fully updated form at any time and place.
8. Significantly, more must be invested in the transportation infrastructure. The road pricing concept can be fully integrated into financial planning.
9. Planning responsibilities in conurbations of this sort must be regulated anew.

FINAL COMMENTS

Even if the best possible use is made of all strategies and instruments it will not be possible to reduce environmental pollution to the extent envisaged by the federal German government. The catalog of measures must be supplemented by a further requirement

relating to the technical possibilities. The greatest potential for savings with respect to energy consumption and pollutant emissions can be achieved by making technical modifications to vehicles themselves. However, these measures also must be flanked by appropriate political regulatory and financial concepts.

REFERENCES

1. Schönharting, J., H. G. Retzko, P. Sahling, et al. Abschätzung des Verlagerungspotentials des städtischen motorisierten Individualverkehrs. Auftrag der Forschungsgesellschaft für Strassen- und Verkehrswesen. Stuttgart, Germany, 1993.
2. Steierwald, G., J. Schönharting, G. Heimerl, et al. Ansätze für ein integriertes Verkehrskonzept für den Verkehrsraum Stuttgart. Auftrag des Verkehrsministeriums Baden-Württemberg. Stuttgart, Germany, 1993.
3. Schönharting, J., T. Pischner, G. Heimerl, et al. Generalverkehrsplan Baden-Württemberg, Satellitenuntersuchung S1: Verkehrsmanagement. Stuttgart, Germany, 1993.

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