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FINAL REPORT

URBAN TRANSPORT STRATEGY REVIEW

EXPERIENCES FROM GERMANY AND ZURICH

DEUTSCHE GESELLSCHAFT FÜR TECHNISCHE ZUSAMMENARBEIT (GTZ) GMBH, ESCHBORN

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0 EXECUTIVE SUMMARY

This survey provides an overview on the urban transport situation in Germany (and, to a certain extent, in Switzerland), with particular respect to best practices for making urban development more sustainable. The results of the study are intended to be integrated as a country-specific background paper into the World Bank project "Urban Transport Strategy Review".

The study begins by describing the results of an urban transport data survey in seven German cities (Dresden, Frankfurt, Freiburg, Hamburg, Karlsruhe, Munich and Münster) and in Zurich, Switzerland. The data was collected by means of a questionnaire and supplementary on-the-spot interviews. The main findings of that survey are:

- Land use for transportation purposes is still expanding in all selected cities, except Zurich.
- Most cities have been able to retard their yearly increases in car ownership over the past decade.
- While the supply of public transport remains at the 1970 level nearly everywhere, that level is 3 to 4 times higher in Zurich than in most German cities.
- Successful transportation policies have been able to reduce private-vehicle use to around 40% of all day-to-day personal trips (perhaps even as low as 28% in Zurich).

The second part of the study, i.e., the analysis of good practices in urban transport, revealed the large number of possible measures for promoting environment-oriented mobility approaches in various spheres of activity:

- In general, it can be said that successful hard (physical) and soft (planning, etc.) urban transport policy relies on integrated planning of measures that combine both hardware and software strategies.
- In particular, some of the approaches studied in the cities can be regarded as lessons learned in urban transport leading towards more sustainable development. Successful measures include integrated land use planning (Hanover, Hamburg), the promotion of bicycle traffic (Münster, Freiburg), and the improvement of public transport by connecting regional railway with tramway systems (Karlsruhe). Parking policy (Bremen) and traffic calming measures contribute toward more safety and less emissions .

Creating sustainable mobility structures is not merely a technical planning process, but also a long-term political and social one. The aim of sustainable mobility development can only be achieved if both the public's awareness of such problems and the necessary knowledge and acceptance of required measures are promoted at the same time.

1 INTRODUCTION

1.1 BACKGROUND

Persistent growth in the urban populations of developing countries is causing further deterioration of transport conditions, with increased congestion, adverse effects on the urban environment, and crumbling standards of accessibility to employment and urban facilities, particularly for the very poor. For German Technical Cooperation and the World Bank, urban transport has always constituted an integral part of the general urban poverty problem.

At the beginning of this new century there can be no doubt anywhere in the world about the urgent need for action designed to point the still predominantly unsustainable developments in most cities in a more sustainable direction. Rising to the challenge, the World Bank is now making a worldwide effort to elaborate an "Urban Transport Strategy Review".

Pursuant to a 1986 policy paper entitled "Urban Transport", which emphatically points out the importance of managing urban transport in a manner to ensure economically efficient mobility, the expressed objectives of the present World Bank Urban Transport Strategy Review are[1]:

- to develop a better common understanding of the nature and the magnitude of urban transport problems in developing and transitional economies,
- to articulate a strategy to assist national and city governments to identify urban transport problems and to point out the role of the World Bank and other agencies within the problem-solving process.

The expected outputs of this process are:

1. ... the availability of an extensive web-based knowledge base for urban transport data and strategies,
2. ... a series of volumes of background papers, e.g., the present report dealing with German experiences, and finally
3. ... a World Bank Urban Transport Strategy for the commencing decade.

[1] World Bank (2000): Urban Transport Sector Strategy Review (Concept Paper - Summary Version).

1.2 MISSION AND OBJECTIVES

The results of this expertise are to be integrated as a country specific background paper into the current World Bank Urban Transport Strategy Review. This paper, which tells lessons learned in urban transport in German and Swiss cities, was financed by the Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation - GTZ). The GTZ's contribution to the World Bank Urban Transport Strategy Review has two main aims: First, the collection of relevant data from seven cities in Germany and the city of Zurich in Switzerland was to complete the existing World Bank Urban Transport Database; and second, good practices were to be described, together with noteworthy aspects of urban transport strategies implemented in German and Swiss cities.

The following eight cities were chosen to be investigated:

- Dresden
- Frankfurt
- Freiburg
- Hamburg
- Karlsruhe
- Munich
- Münster
- Zurich (Switzerland)

The report is structured into four sections.

The first part describes the background of the study, its mission and objectives, and the applied methodology.

The second section presents the results of the urban transport data survey. The divergent development of urban transport in the examined cities is illustrated by inter-urban and inter-temporal cross-comparisons using some of the obtained key indicators.

Part three of the study presents and analyses a number of good practices for promoting environment-oriented mobility approaches in urban transport in German and Swiss cities.

Finally, part four summarizes the main findings of the study and puts forward some concluding remarks.

The survey does not claim to be exhaustive. Its intention is to offer a condensed synopsis of significant transportation policy appraisals in German cities and Zurich.

Special thanks are expressed to all persons and institutions that have made contributions to completing this study. Without the manifold help of several persons (see list of contacts in appendix A), the results described here certainly could not have been achieved.

The author is also indebted to Mr. Stephan Kritzinger (Prognos AG, Basel), Mr. Norbert Gorißen (German Ministry of Environment, Berlin) and Dr. Axel Friedrich (German Federal Environmental Agency, Berlin) and the staff of the GTZ Transport and Mobility Section, who provided additional inputs by supplementary reports. Their general remarks and complementary descriptions of lessons learned in German urban transport have helped to improve this report significantly.

1.3 METHODOLOGY

In October 1999 each of the cities to be surveyed was contacted by letter. The cities' department heads responsible for urban transport were informed about the background and objectives of the research activity. They were also invited to collaborate in this worldwide urban transport data survey by filling a questionnaire (see filled out charts in appendix B) – which was to serve as a basis for the Urban Transport Database. In addition, personal appointments were arranged with the department heads in order to obtain more indepth information on relevant aspects of pursued local transport strategies.

In addition meetings were arranged with high representatives of the municipal transport and/or planning authorities as well as with the public transport operators in each of the eight selected cities. These discussions focussed on the key factors for success or failure of implemented measures, the political and socio-demographic backgrounds, and the current political framework. The findings of these interviews and the analysis of the documents handed out by the authorities were completed by desk-research activities (literature and Internet research, additional expert interviews). But despite all efforts, many parts of the returned questionnaires still remained blank.

2 URBAN DEVELOPMENT TRENDS

2.1 URBAN TRANSPORT DATA SURVEY

A principal aim of the proposed World Bank urban transport database is that it be as consistent as possible with existing urban databases, so that existing urban transport data can be included. To make full use of the most comprehensive world-wide urban transport database, compiled 1989 by Newman and Kennworthy and updated in 1997[2], the expedient choice was to enhance the data on the German cities that are already included in this database, which are Frankfurt, Hamburg, and Munich. The GTZ additionally incorporated a few medium -sized German towns (Dresden, Freiburg, Karlsruhe and Münster) with interesting urban transport approaches. Due to the remarkable results of its often- discussed urban transport policy, the Swiss city of Zurich was also analyzed within this survey.

The outcome of the urban transport data survey is to provide background data for the urban transport strategy review. The data is to serve as indicators for the success of the applied strategies and measures in the respective city. The scheme of data to be collected within this survey, in line with those proposed by the World Bank, covers the following eight modules:

- Module 1: Area, population, employment and income
- Module 2: Urban transport infrastructure
- Module 3: Vehicle ownership
- Module 4: Urban transport pricing
- Module 5: Public financing for urban transport
- Module 6: Personal trip characteristics
- Module 7: Traffic performance indicators
- Module 8: Public transport operations

In addition, GTZ extended the survey by two further modules in order to characterize the effects of urban transport on the environment and on the health of the people (see the detailed items of the questionnaire in appendix B). The data was collected – as far as possible – for the four years 1970, 1980, 1990 and 1998. In cases where data for a certain year was not available, but rather for a year before or later, these data were also recorded, indicating the date of the data.

Most data was collected via the questionnaire. The data in module 8 referring to public transport operations stem from the Association of German Transport Companies (Verband Deutscher Verkehrsunternehmen, VDV), except for Zurich, where the data was delivered by the local public transport operator.

The comparison between the cities – data category by data category – underlines that, despite notable structural differences, e.g., in degree of motorization, population density, etc. first steps towards a sustainable mobility are possible irrespective of social or spatial structures. Lessons learned are therefore not limited to a certain type or size of city/agglomeration, but can be implemented in other cities as well.

[2] Kenworthy, J.; Laube, F.; Newmann, P.; Barter, P. (1997): Indicators of transport efficiency in 37 global cities.

2.2 DEMOGRAPHIC AND ECONOMIC INDICATORS

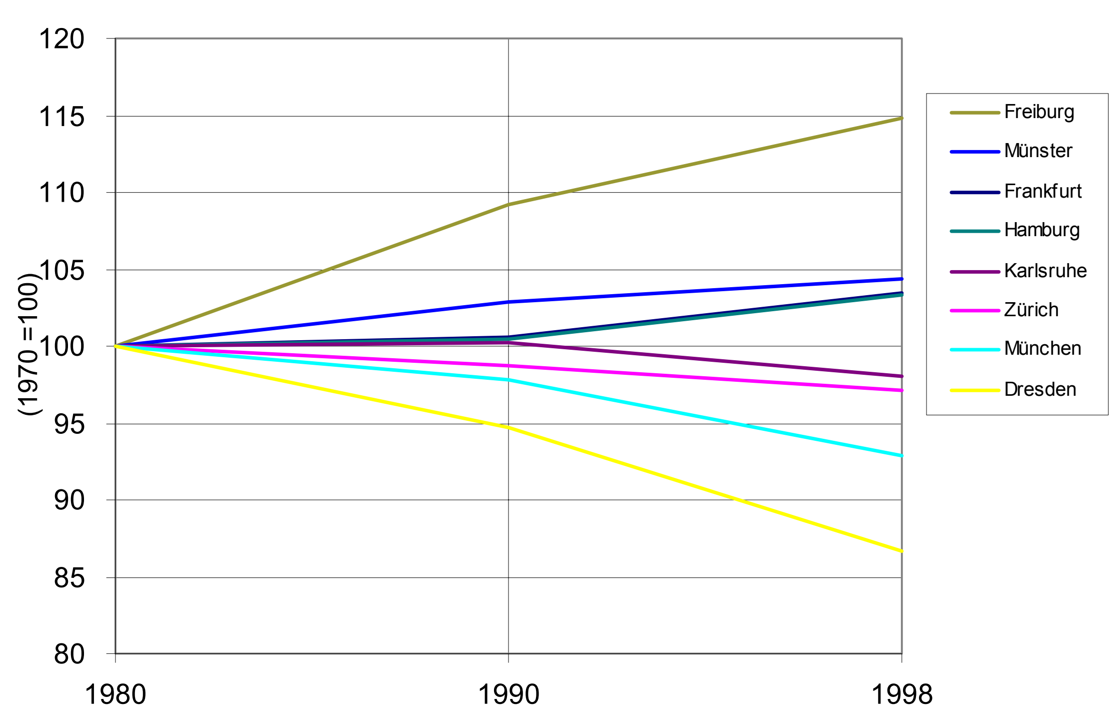
Except for Hamburg and Munich, all mentioned cities have less than one million inhabitants. The population density varies from c. 1,000 to 4,000 inhabitants per square kilometer.

Figure 2 reveals divergent developments of the population in the selected cities. Four of the cities have suffered a decrease in population during the last two decades, while in the other four cities the population has increased, as has happened in Münster and Freiburg, both attractive university cities with a high proportion of students, and in Frankfurt and Hamburg, two of Germany's most important business locations. Another peculiarity in Figure 2 is the increased population in some cities in the western part of Germany during the 1990s, which was caused by notable migration movements from East to West Germany after the re-unification in 1990. This also explains the considerable decrease of more than 8% in Dresden.

Figure 1: Population

city	inhabitants 1998 (x 1000)	density (inh./km^2)	population growth (1990-1998)
Dresden	447.0	1,886	-8.6%
Frankfurt	651.1	2,622	2.9%
Freiburg	201.0	1,314	5.2%
Hamburg	1'700.1	2,250	2.9%
Karlsruhe	264.6	1,525	-2.1%
Munich	1'206.0	3,885	-5.1%
Münster	279.2	924	1.5%
Zurich	359.1	3,908	-1.6%

Figure 2: Development in population 1980 - 1998



The first chapter of a new OECD study entitled "Urban Policy in Germany - Towards Sustainable Urban Development"[3] offers a brief empirical overview of general demographic tendencies in Germany. As in most western countries, the process of suburbanization is proceeding not only in terms of housing, but for economic and other functions as well. The loss of population in the town centers is outweighed by a migration from elsewhere in Germany and from abroad. The number of inhabitants remains almost stable, but the socio-demographic structure of the population is slightly changing. Families with children who can afford it move outwards to the surrounding municipalities, while young and underprivileged people remain in the town centers.

An appropriate indicator to illustrate this development is the significantly higher proportion of recipients of social security benefits in urban areas (see Figure 3). In some cities, this figure is twice as high as in the country as a whole (Germany, western part).

[3] OECD (1999): Urban Policy in Germany – Towards Sustainable Urban Development.

Figure 3: Recipients of social security

city	1980 (per 1000 inh.)	1990 (per 1000 inh.)	1998 (per 1000 inh.)
Dresden		10	16
Frankfurt	48	87	72
Freiburg	63	84	80
Hamburg	-	-	83
Karlsruhe	44	77	79
Munich	-	-	36
Münster	34	40	54
Zurich	8	19	28
Germany (western part)	*14*	*28*	*38*

2.3 URBAN TRANSPORT INDICATORS

Any transportation activity requires an appropriate infrastructure. This infrastructure in turn occupies space. Thus, the data concerning the development of the area devoted to transportation can serve as an indicator for the supply of transport infrastructure in the selected cities.

During the last 20 years in each of the sampled German cities this figure has risen, in some cases by nearly 25% (see Figure 4). In the selected cities the share of areas for transportation purposes in 1998 varied between 8% (Münster) and 17% (Frankfurt), compared to approx. 5% in the whole of Germany. Only in Zurich is a slight decrease in land use for transportation to be observed.

The dominant factor for this increase is clearly the extension of the private transport infrastructure. The area which serves specific public transport purposes is marginal compared to the land used for private transport purposes. Keeping in mind the fact that most of the substantial extensions of public transport networks during the last few years have consisted of underground line construction, their influence on the surface demand (e.g. for separate bus lanes) can be almost neglected.

Figure 4: Increase of area devoted to transport

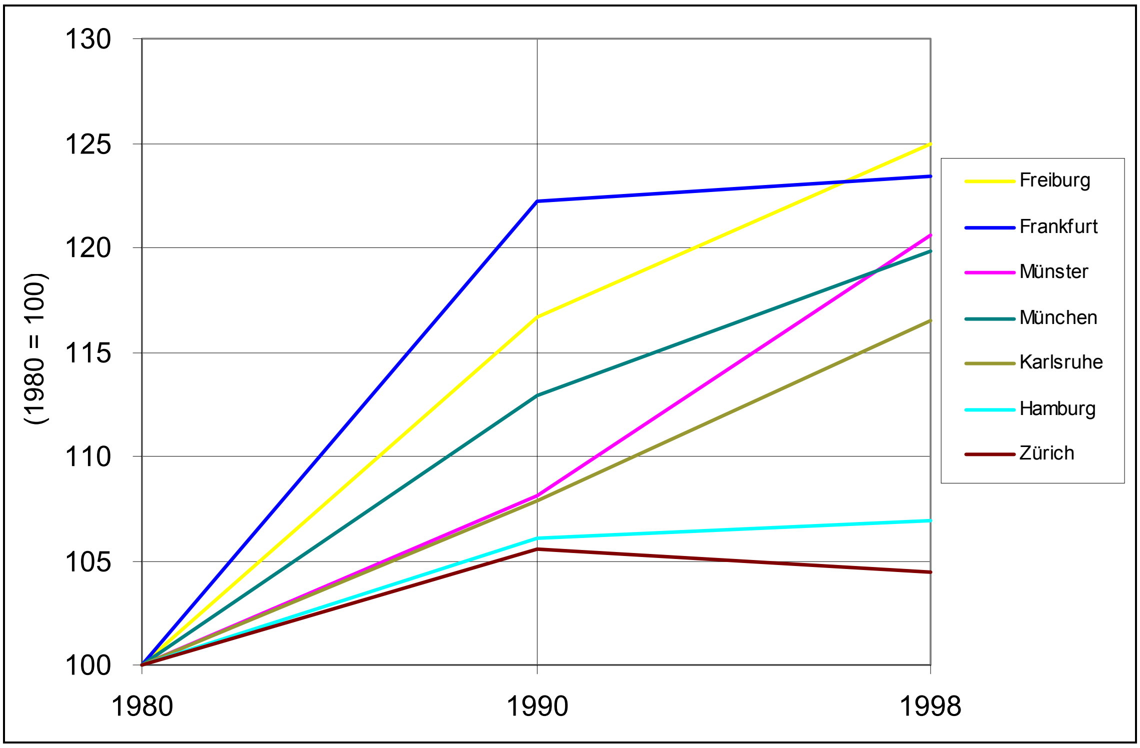
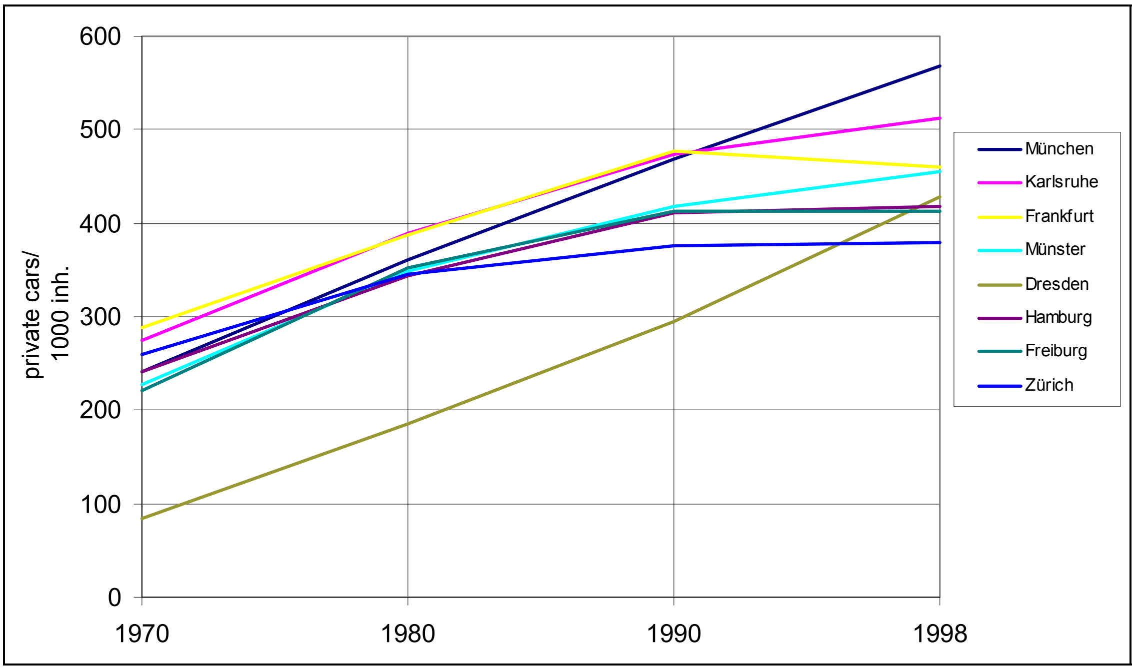


Figure 5: Development of private car ownership

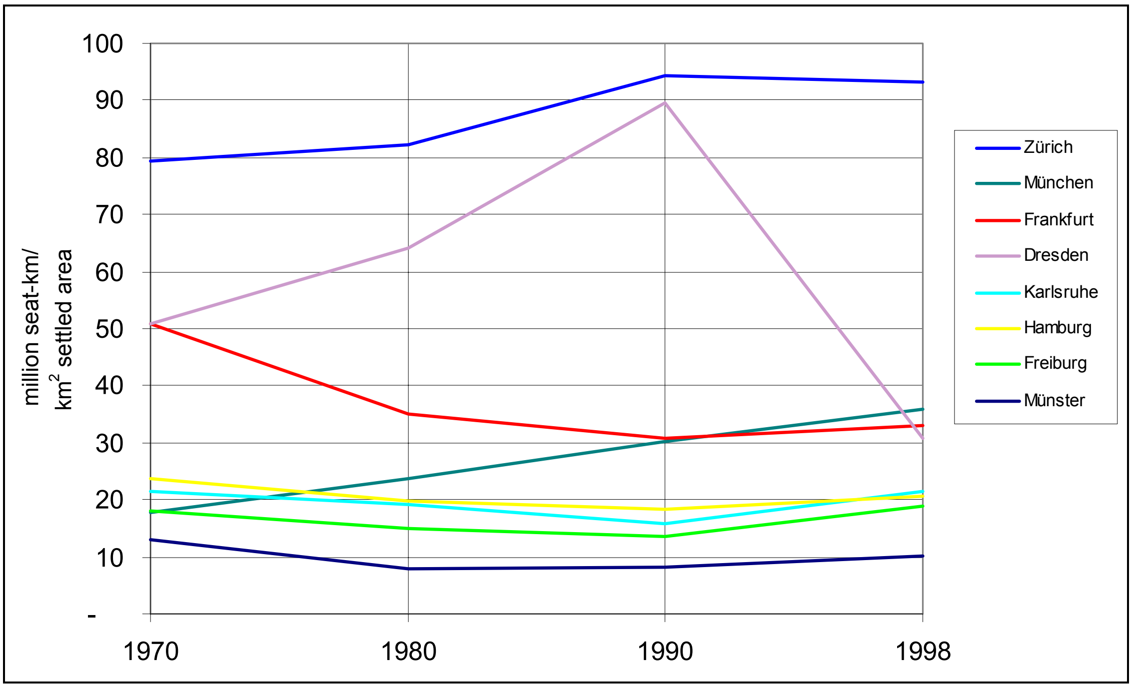


Looking at the development of private car ownership, the overall tendency is also that of steady growth. The average motorization (private cars per 1000 inhabitants) has nearly doubled in the last three decades (see Figure 5).

Due to the specific situation after re-unification, the motorization rate in Dresden in 1998 (426 cars/inh.) was 4.5 times higher than in 1970, yet still below the level of Munich (568), Karlsruhe (512), Frankfurt (460) and Münster (454). The lowest increase, and by far the lowest motorization level with 379 private cars per 1000 inhabitants, describes the situation in Zurich. These data are an adequate indicator of the success of the transport policy carried out in Zurich since the seventies.

A first explanation for the above mentioned development of the motorization rate is revealed by the observation of the parallel development in the supply of public transport (see Figure 6).

Figure 6: Development of public transport supply



Looking at the number of seat kilometers supplied per square kilometer settled area per year, the extraordinary quality of public transport in Zurich stands out immediately. This high supply level has been preserved since 1970 and even improved during the eighties. In all selected German cities except for Munich, the public transport supply reached the same level in 1998 as in 1970 after a continuous drop until 1990. The sharp fall of the supply in Dresden again illustrates the far reaching changes in East Germany.

An indicator which characterizes the user's reaction to the supply of public transport is the number of public transport trips per inhabitant and year (see Figure 7). In this category, Zurich also sets the benchmark in the field of surveyed cities. 531 public transport trips in 1998 is a difference of 200 trips to the best German city, which is Munich with 335. While the level of public transport use is still clearly lower than in Zurich, we are able to observe a positive trend in the last decade, corresponding to the development of supply. Except for Frankfurt (and Dresden), public transport demand in 1998 exceeded the demand of 1970. Exceptional increases between 1990 and 1998 were attained in Münster (+73%), Freiburg (+46%) and Karlsruhe (+32%).

Figure 7: Development of public transport demand

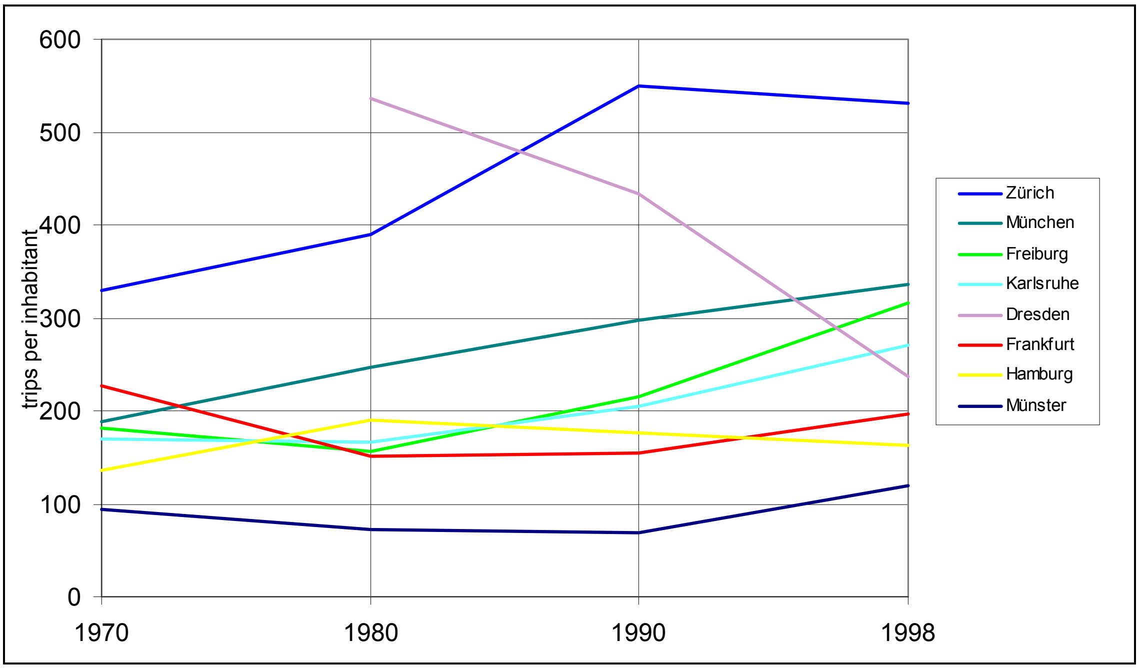
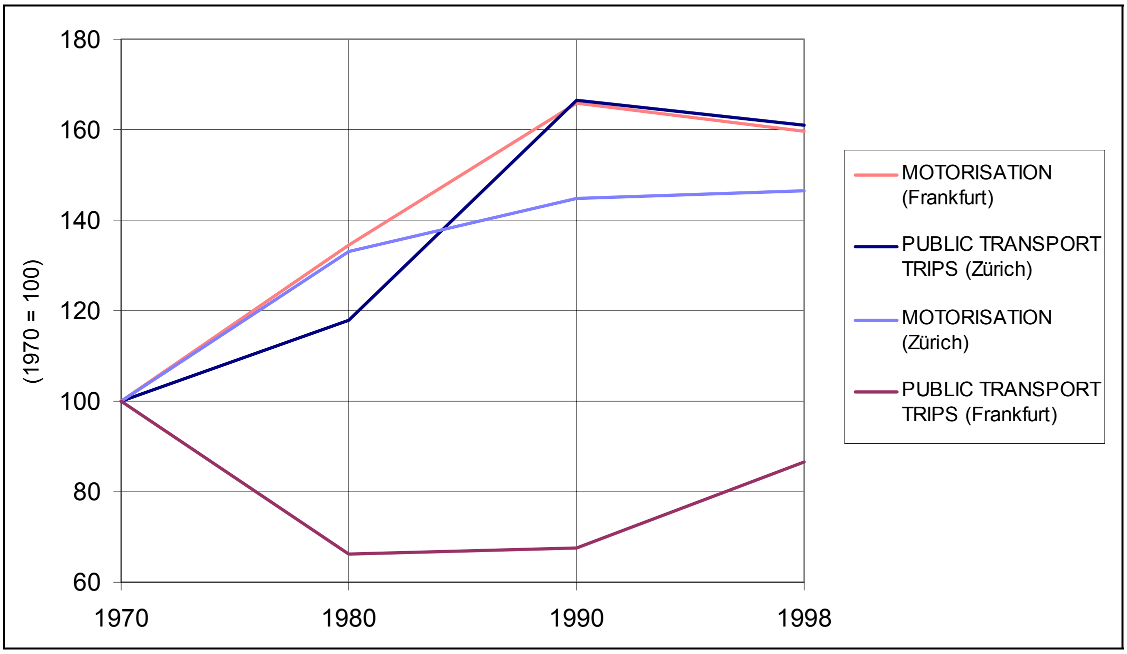


Figure 8 shows a comparison of the amazing development of motorization and public transport demand between 1970 and 1998 in Zurich and Frankfurt. The number of public transport trips in Zurich had grown in this 28-year period nearly parallel to the development of motorization in Frankfurt. While motorization in Zurich has grown at a 10% lower rate than the public transport demand, in Frankfurt the contrary took place.

Figure 8: Development of motorization and public transport demand in Frankfurt and Zurich

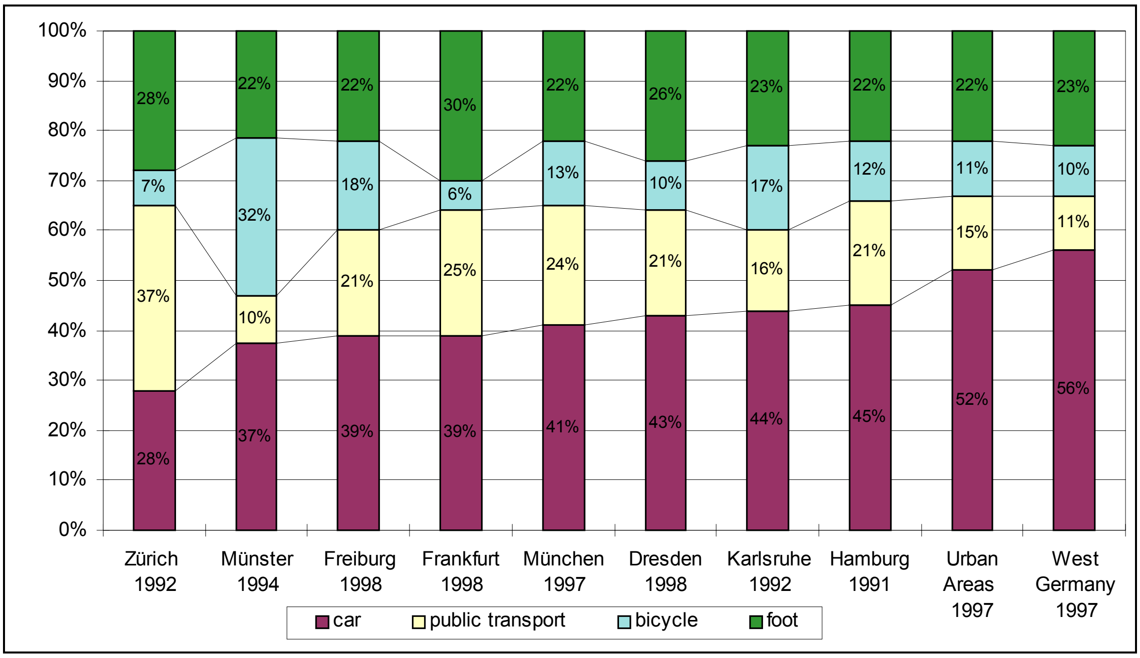


There, the gap between public transport demand and the development of private car ownership has grown wider, with motorization increasing by +60% and public transport trips per inhabitant decreasing by -14%.

Figure 9, which compares the modal split in the selected cities, can be seen as a conclusion of the above discussed urban transport characteristics. While the previous indicators are based on a more or less reliable statistical database, these modal split values were obtained from distinct surveys. Because of the different methods applied in these surveys, the results shouldn't be compared too neatly. But without doubt the existing values offer a good illustration of the prevailing situation of urban transport in a given city. Yet we always have to keep in mind that such comparisons generally describe the mobility behaviour of the inhabitants; the traffic caused by commuters and the through traffic is essentially not reflected in available modal split data. Another problem with comparisons are the different times (year, season) during which the surveys were carried out.

Figure 9 shows again the extraordinary position of Zurich, with a share of private car use smaller than 30 % and an enormous share of public transport use of nearly 40%. The share of the environmentally-friendly transport modes (walking, bicycle, public transport) oscillates in the selected German cities around 60%, compared to 48% in the totality of (west German) urban areas. The very high share of bicycle use in Münster (32%) is striking, as is the share of foot trips in Frankfurt (30%).

Figure 9: Modal split (trips of inhabitants)



If we look at the effects caused by different urban transport conditions, it is obvious that a strong correlation exists between the extent of private motor traffic and road safety.

Figure 10: Road Safety - Persons injured in traffic accidents

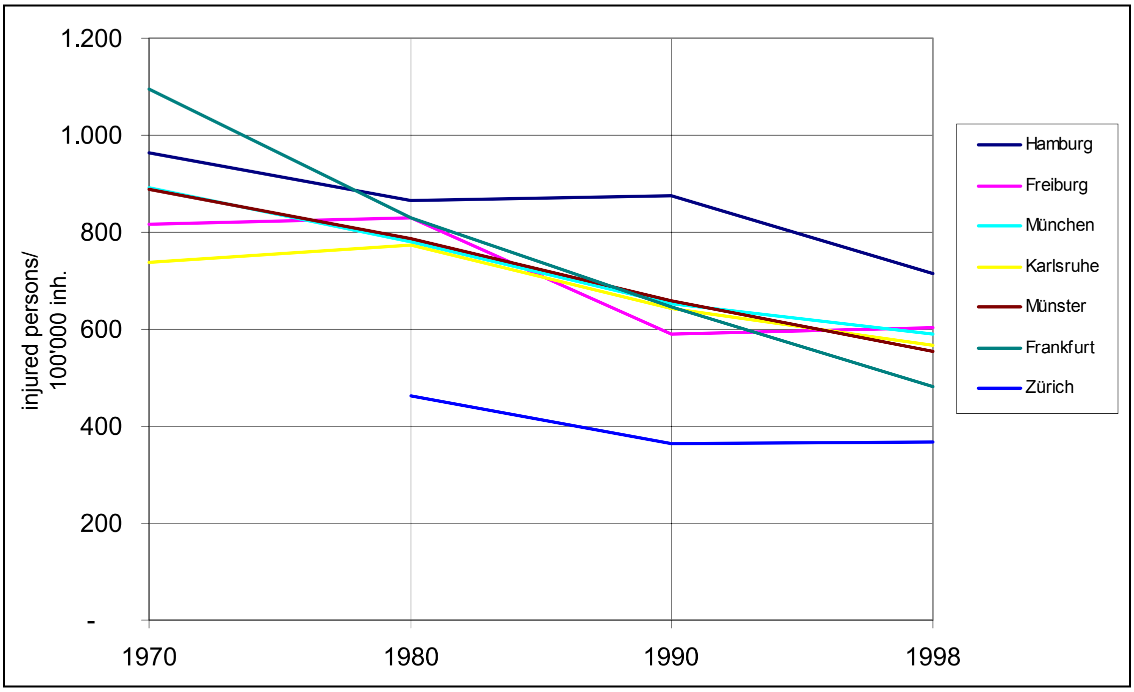


Figure 10 reveals the development of road safety, as expressed in the number of persons injured in traffic accidents per 100,000 inhabitants. The lowest number of victims was registered in Zurich, namely 316 per 100,000 inhabitants for a private car modal split share of 28%. In Hamburg, where private motorized transport holds a modal split share of 45%, nearly twice as many (716 per 100,000 inh.) persons were injured in road accidents.

In respect to the environmental effects of urban transport, similar correlations could be expected, but considering the lack of relevant data in most of the selected cities, analogue comparisons unfortunately cannot be drawn.

3 LESSONS LEARNED IN URBAN TRANSPORT

This section describes several noteworthy approaches to achieving more sustainable urban mobility patterns. The quoted examples are not explicitly limited to the eight selected cities of the urban transport data survey; rather, the aim is to give an overview of positive lessons learned in urban transport policy in German and Swiss cities. It can be expected that most of the strategies and measures mentioned do indeed have positive effects towards achieving the goal of sustainable transportation, even though this could not be verified, as in almost every case an ex-post evaluation of the measures' effectiveness was carried out. Nevertheless, the examples gathered certainly represent some first steps on the way to sustainable urban mobility.

The examples of the lessons-learned are structured according to:

- Institutional Activities (land use planning, funding of public transport)
- Transport Policy Activities (non-motorized traffic, public transport, motorized traffic)
- Mobility Concepts (mobility information services, car sharing)

In general, Institutional Activities (e.g. land use planning measures) as well as such "soft-policy“ measures as Mobility Concepts (e.g. mobility information services) can be seen as long-term strategies, while the implementation and benefits of Transport Policy Activities can be achieved within a short time.

General statements or assessments with regard to the transferability of the examples to other cities could hardly be made, as in most cases the benefits of a strategy or measure are closely related to particular on-site circumstances (economic, social, administrative, technological etc.) of the respective city. However, it is obvious that well proven transport policy and land use planning strategies can be applied to cities in developing and transitional countries. Ambitious and sophisticated mobility concepts, which at the moment, even under favourite conditions, seem to have only marginal influence on modal-split decisions, have not yet reached the status of being easily transferable to other cities.

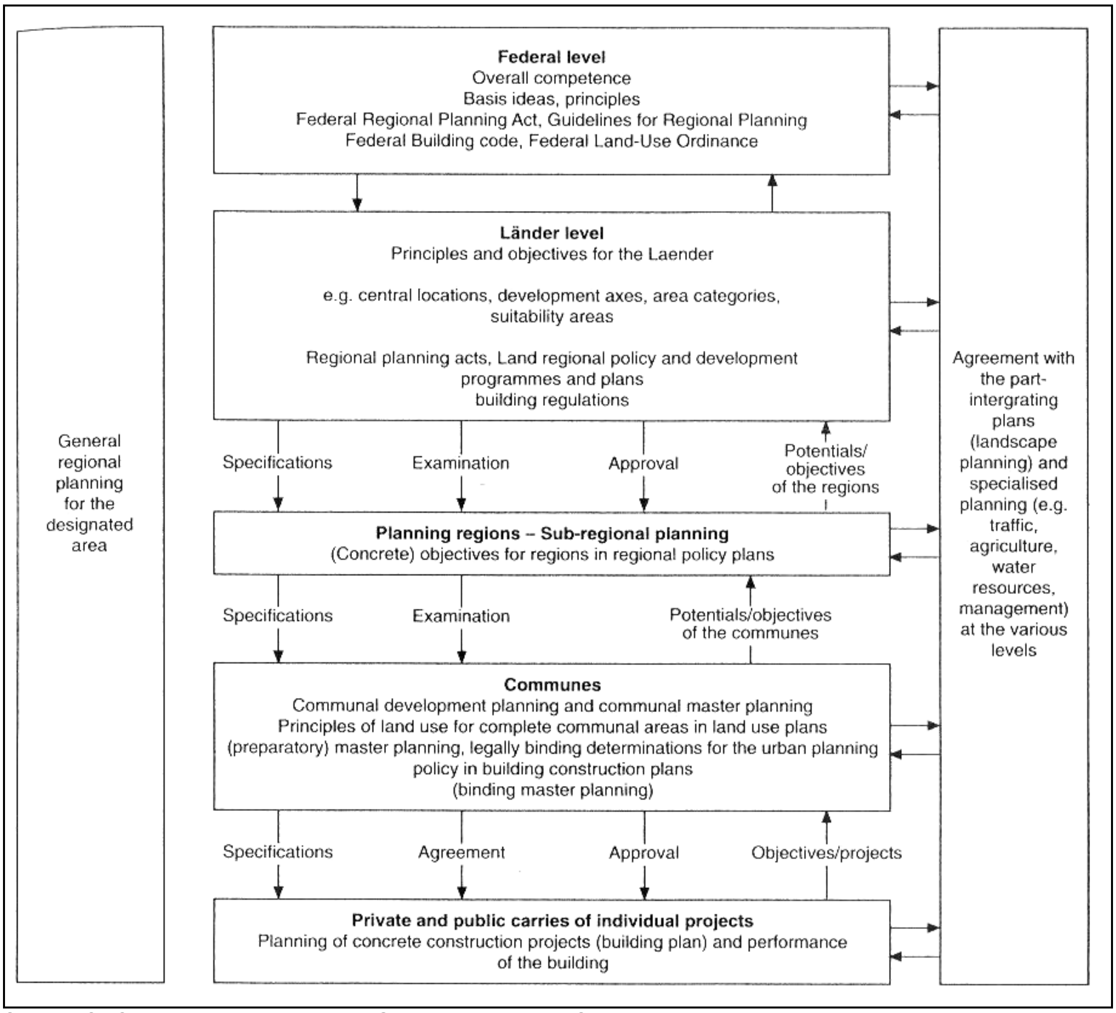
3.1 INSTITUTIONAL ACTIVITIES

3.1.1 LAND USE PLANNING

The administrative structure within federally-organized Germany is considerably more complex than in a centralized state. The contribution of tasks over different levels of administration (federal level, Länder level [individual federal states], local level) is an expression of the subsidiarity principle of the German federal system. Consequently, the responsibility for urban development and planning (land use plans, building construction plans) rests with the municipalities, while the federal government and the Länder are only responsible for the provision of a framework under which local governments exercise their planning authority. Figure 11 offers an overview of the spatial planning system in Germany.

The delegation of responsibilities for the different decision levels has led on the one hand to a beneficial competition between municipalities for the attractiveness of their locations. On the other hand, though, excessive competition could result in notably negative impacts on sustainability. It is not difficult to imagine that, against the background of competition, sustainability aims can easily be left behind. Making progress towards sustainability is, in the long term, in the interest of everyone, as is close co-operation between neighbouring municipalities in spatial and land use planning. The discussion of the results of the urban transport data survey in section 2 of this report reveals that space consumption and growth of traffic are mutually dependent. Therefore, any solution which appears conceivable should adopt a cohesive approach to both.

Figure 11: Hierarchy of spatial planning and types of plan in Germany



Source: OECD (1999): Urban Policy in Germany – Towards Sustainable Development

The following sections discuss some single patterns out of the wide spectrum of measures applied in Germany to face the growing problems of sub-urbanization and to improve the integration of land use and transportation planning. The first two examples refer particularly to the problems and negative implications (space consumption, transportation needs, car dependency, etc.) of competition between central cities and their surrounding municipalities. In this respect, they are carrying out the widely discussed concept of decentral concentration. This concept intends to distribute and control settlement activities in a more sustainable way. On the one hand, unhealthy agglomerations should be avoided, and on the other hand, people should be able to live, work and spend their leisure time in their immediate surroundings without being obliged to drive long distances by car[4].

4 OECD (1999): Urban Policy in Germany – Towards Sustainable Urban Development.

Two different policy approaches toward the treatment of these problems were presented: a) the less courageous approach of the *Development Concept for the Hamburg Metropolitan Region* and b) the strong co-operation in the *Greater Hanover District Association.*

Development Concept for the Hamburg Metropolitan Region

In 1991 the governments of the City-State of Hamburg and the Länder of Lower Saxony and Schleswig-Holstein decided to re-inforce their co-operation. They intended to create a long term working basis for regional co-operation with the Hamburg metropolitan area . The first step in this direction was the elaboration of an integral *Regional Development Concept (REK).*

The Hamburg Metropolitan Region includes, besides the city of Hamburg, the surrounding districts (counties) of Cuxhaven, Harburg, Lüchow-Dannenberg, Lüneburg, Pinneberg, Rotenburg (Wümme), Segeberg, Soltau-Fallingbostel, Stade, Steinburg, Stormarn and Uelzen, as well as the economic region of Brunsbüttel. The Hamburg Metropolitan Region counts more than four million inhabitants and covers over 1,800 square kilometers.

The *Regional Development Concept* can be seen as an instrument with which to define the objectives and the basic conditions of regional co-operation. The *Regional Development Concept* is a rough framework that contains numerous space-relevant policy fields such as: settlement development, economic development, science and research, education, agriculture, transport, waste management and water provision. In contrast to the *Greater Hanover District Association,* the *Regional Development Concept* has no legally binding consequences for the local planning authorities. Hence, the success or failure of a co-ordinated regional planning policy ultimately depends chiefly on the good will of the institutions and persons involved.

The *Greater Hanover District Association* is the most advanced approach to regional co-operation. The following extract from its Internet homepage gives a short description of the conception and duties of the *Greater Hanover District Association*.

Greater Hanover District Association

Greater Hanover District

Together with the State Capital, the Greater Hanover district forms the heart of Lower Saxony. Over a million people live here in an area of some 2'300 square kilometers. More than a quarter of the gross domestic product of Lower Saxony is produced in the Greater Hanover area. Greater Hanover also represents one of the most advanced forms of regional partnership in Germany.

Greater Hanover District Association

The Lower Saxony State Parliament passed a motion on December 14th 1962 by which the State Capital Hanover, 3 rural districts and 210 towns and boroughs of the Hanoveranian economic area were to form the Regional Greater Hanover District Association "in order to organize the Hanover Regional District." The Association was empowered to "usefully structure the Hanover Regional District by employing uniform planning measures", to "lay down guidelines for the use of Land" and to employ other "development measures". The Greater Hanover District Association which exists today is the fourth Association solution in the Greater Hanover District (Law passed concerning the Greater Hanover District Association, 20th May 1992) (Kommunalverband Großraum Hanover). Its responsibilities are:

- **Local Transport**
- **Regional Planning**
- **Economic Development**
- **Recreation**

Exclusive responsibility for regional planning and local transport is legally anchored; the remaining responsibilities were transferred to the Greater Hanover Association by the other members of the association.

Constitution and Committees

The Greater Hanover District Association is a public corporation with the right to self-government. Its internal constitution follows the borough regulations for Lower Saxony. The State Capital Hanover and the Rural District of Hanover are members of the Association and they finance the Association by allocation. The ruling body of the Greater Hanover Association is the association assembly. It consists of 28 members, elected by the Council of the City of Hanover and the Council of the Hanover Rural District in equal parts. The association assembly has set up three special committees which act in a advisory function during the preparatory stages of resolutions. They are the Transport Committee, the Regional Planning and Recreation Area Development Committee and the Economic Development, Financial and Economic Participation Committee. The Assembly Committee is the second co-operative body within the Greater Hanover Association. It is made up of the chairman of the association assembly and eight other members who are entitled to vote and, in an advisory function, the managing director of the association, the chief mayor of the State Capital of Hanover and the chief town clerk of the Rural District of Hanover.

The third body in the Association is the managing director of the Association. The administration of the organization is subdivided into specialized divisions within its four areas of responsibility.

Responsibilities

Public Transport

Solving the problem of increased traffic and avoiding an absolute traffic standstill has become one of the more important duties in the last years. It can only be solved by integrated traffic planning and structured public transport. The Greater Hanover Association is solely and exclusively responsible for public transport and regional planning by law.

Regional Planning

The Greater Hanover District is marked by the close relationship between suburban areas and transport openings, economic development and environmental protection and recreation and protection of the countryside. Environmental demands and the needs of development projects often compete with each other. A multitude of problems and the conflict of interests have to be solved. Planning and co-ordination beyond local boundaries is the job of the Greater Hanover Association.

Economic Development

"Together with Association branches and regional towns and boroughs, the Greater Hanover Association is responsible for measures of regional importance in the establishment of trade and industry and the promotion of economic development."

Recreation

For an area with an urban concentration such as exists in the Hanover region the problem is posed how to create recreational possibilities within reach of urban areas, as well as maintaining significant country areas which reach out beyond the borders of the Hanover region. We intend to link these recreational areas by means of public transport, together with footpaths and cycle paths. The Hanover Regional Association supports the careful development of these areas.

Source and further information:
http://www.hannover-region.de/kgh.html

Two other successful approaches to the integration of settlement and transportation planning are found in the city of **Freiburg.** One approach – the *Rieselfeld* – is an urban expansion project. In this 320 hectare new city district, 4,500 new homes for 10,000 – 12,000 people are in the process of construction. With the simultaneous building of 90,000 square meters for commercial use, the city is attempting explicitly to locate residential and commercial purposes in one single area. As a lesson learned from the construction of monotonous multi-story building districts in the past, the mixture of functional and social levels (balanced mixture of rented and owner-occupied flats) in the *Rieselfeld* aims at avoiding the rise of bedroom communities with a problematic social structure. An integrated transport concept guarantees an optimal connection to the urban public transport system. At the end of 1997 when the first inhabitants moved to their new flats, an extension of an existing tram line was inaugurated at the same time; the maximum distance to one of the three new tram stops is 400 meters. In addition, traffic calming measures like a 30 km/h speed limit in the whole district, play streets and a dense bicycle infrastructure lead to an all in all very high quality of housing.

The second example to enforce the sustainability in Freiburg is the *Quartier Vauban*. The *Vauban* area is a 34-hectare city near an abandoned military site of the kind that exists in nearly every city in Germany. In this case, the area was fortunately not contaminated. The construction of 2,000 dwellings in the *Quartier Vauban* for approximately 5,000 people started in 1998. Like in the *Rieselfeld,* it aims at securing a balanced mixture of living and commercial purposes in the quarter. The reintegration of derelict land in the *Quartier Vauban* is a good example of efficient land use and reveals the possibility of reducing the pressure for greenfield development. Another aspect to be noted is that there are no parking sites for private cars inside the new district. Because of good public transport connections (frequent bus-line to the city-center, from a tram-line as of 2006) and the short cycling distances to the center, many of the future inhabitants will not own an individual car. If they ever needed one, they could easily use one of the provided car-sharing vehicles which are located outside the area at a maximum distance of 500 meters in two neighbouring garages (with a total of 500 parking lots) where the other private cars also have to be parked. Hence, the *Quartier Vauban* will be a nearly car-free city district.

3.1.2 TRANSPORT DEVELOPMENT PLANS

The first step in transport planning in Germany is the drafting of plans; the next step is to discuss these plans with stakeholders and finally a decision is taken by politicians. This assures on the one hand that the administration is controlled and guided by democratic processes; on the other hand, the planning and execution processes are organized in stepwise, taking into account local circumstances and available budgets, and aiming at achieving measurable targets (which are part of the plan).

In an integrated transport development plan („Integrierter Verkehrsentwicklungsplan") the state of current traffic of all transport modes is analyzed, and the perspectives of their future development are described along with any measures deemed necessary - all taking into account the future demand, economic development, town development, and the envisaged targets (quality of urban environment, town development, modal split values, etc.). An important part of such an overall plan is to define scenarios of the future development of transport (including all consequences on environment, finance and town development). These give decision-makers the clearest possible outlooks as a basis for their choice. In that context, all transportation modes are part of the evaluation process, and generally a balance between the different modes is aimed at.

More detailed plans describe in the next step the development of dedicated transport modes like public transport or bicycle. Public transport plans today are inevitable for German towns, because they describe the quality and quantity of public transport supply, to be obtained following competitive bidding. Restrictions are set mainly by the available budget. Differences concern the modes of transport (buses, trams, underground), the investments, the timetables, etc.. Bicycle transport plans analyze the current situation and describe which measures cities intend apply to increase the share of bicycle-traffic. Noise reduction plans analyze noise levels in towns, most of which are caused by transportation, in particular car and lorry traffic.

3.1.3 FUNDING OF URBAN TRANSPORT

The findings of the urban transport data survey in part 2 have demonstrated the exceptional supply and demand situation of public transport in Zurich. One reason for the different development in Zurich compared to most German cities is certainly to be found in the very different institutional arrangements in Germany and Switzerland. In both countries the local authorities have considerable political scope for action, but compared to German cities Swiss municipalities have evidently a higher fiscal autonomy. In combination with the right to launch a referendum, this factor seems to lead to higher cost efficiency in the transport sector. Local governments in Switzerland are able to finance transport investments by themselves via tax increases, although this solution has often been rejected by the citizens in referendums. Under these conditions, the local decision-makers have to convince the people of the benefit of investments in the transport system. A good example of what can happen under these circumstances is, again, Zurich. Two major projects for underground transport systems were rejected by the voters in 1962 and 1973. The second verdict was seen by the town council as a mandate to continue operating with the existing transport system, based on trams, trolley buses and motor buses, but also to further develop these modes into a modern, efficient and attractive transport system.

In Germany, the most important regulation governing urban transport issues is the *Gemeindeverkehrsfinanzierungsgesetz (GVFG)* [Municipal Transport Financing Law] which is the basis for federal financial assistance to local transport projects. Since 1967 municipalities can obtain federal subsidies for investments in local transport infrastructure for public transport improvements as well as for road construction. The GVFG funding is raised through a dedicated levy on the national excise duty on fuel (0.054 DM/liter). To receive federal financial assistance, each individual project has to be evaluated in a standardized macroeconomic cost-benefit analysis. If the expected benefits exceed the investment and operating costs of the project, the project is deserving of support. Including contributions from the federal state governments, 75% of the investment costs – in exceptional cases up to 90% - are covered by subsidies, and only the smaller part has to be financed by local authorities. This financial framework enables German cities to develop and implement large-scale transportation projects such as new underground and light-rail systems. Economists have often criticized the fact that the local decision-makers in office tend to obtain as much funding as possible for their own city, whereas the benefit of the planned project does not play a key role in the political process. This explains the fact that in the last three decades, German cities (e.g., Frankfurt, Munich, Dortmund, Hanover etc.) have given priority to expensive underground projects instead of modernizing existing tram networks. In the end, they also have to cover higher underground operating costs.

A different approach has been applied in Zurich. In a referendum held in 1973, the population of Zurich voted against an underground system. As a result, inner city public transport remained on the street level. Lower capital investment and lower operating costs imply lower investment per passenger and per inhabitant. For example, capital investment per inhabitant in cities with underground systems (Munich, Stockholm, Vienna) from 1960 to 1995 was more than two times higher than in Zurich. In general, the modal split in Zurich clearly shows a larger share of public transport[5], and revenue-to-cost-ratios in Zurich are much more favourable than in comparable German and Austrian cities.

Indisputably , the *GVFG* has also facilitated remarkable improvements in public transport in many cities which could not have been carried out without federal funding, including, for example, the well-known *Karlsruhe Modell* (light rail vehicles using railway tracks together with ordinary rail traffic) which will be discussed in more detail under 3.2.3.2.

[5] For example, in 1992 the share of public transport stood at 37 %, private motorized transport at 28 % and non-motorized at 35 % (source: Socialdata München).

3.1.4 PRIVATISATION OF ROADS, CONGESTION PRICING

Privatization of transportation and of road investments is continuously gaining in importance. Furthermore, road pricing schemes are being introduced particularly for new highways. In general, Germany and Europe have less experience with these instruments. Intelligent road pricing systems have the potential for reducing the demand for car traffic, supporting the shift to public transport and managing peak-hour traffic congestion. The following aspects are worthy of consideration:

- Car drivers strongly resist additional fees or charges on car traffic. This is a clear obstacle to introducing road pricing measures. However, the German government decided—despite the sharp increase in oil prices in the year 2000—to continue with the policy of adding a so-called “ecological tax” of 6 pfennigs (approx. 3 US-cents) per liter gasoline and diesel every year from January 2000 to January 2003.
- Experience with road pricing schemes in Germany and Switzerland is limited. The better experiences are to be found elsewhere in the world (especially the example of Singapore). Nevertheless, this approach is gaining more support in Germany. One of the first steps is the German government’s approval for the regulation that, from the year 2003 onwards, there will be an additional charge for trucks over 12 tonnes for the use of the German motorway system. All domestic and international trucks using German motorways will be charged accordingly. The additional charge will be 25 pfennigs per vehicle/km (approx. 12 US-cents). Revenues are expected to total some 4–5 billion DM per year.
- Experiences on the highway network in France demonstrate that car drivers try to avoid road duties. This leads to unfavourable traffic situations on parallel secondary roads and in particular to increased through traffic in towns. In France, therefore, highway charges are exempted in metropolitan areas to avoid people using inner city roads. This might be a lesson for developing countries to avoid unfavourable traffic situations in towns where highways are privately financed and charged.
- An interesting experience is the restructuring of the entire German (annual) vehicle taxation system taking environmental concerns into consideration (see Appendix C). For example, charges on cars older than Euro 1 Standard vehicles (gasoline) are five times higher than Euro 3 and 4 types (as of January 1, 2001). In addition, there is a further tax incentive for owners investing in new low-consumption vehicles with a CO_2 emission below 140 g/km, and a further tax reduction for owners of vehicles below 90 g/km. (DM 1,200 reduction for less than 90 g/km and DM 600 reduction for less than 140 g/km)

3.2 TRANSPORT POLICY ACTIVITIES

3.2.1 PEDESTRIAN TRAFFIC

In Germany over 30% of all daily journeys are undertaken on foot or by bicycle. Nevertheless the proportion of walking and cycling is often neglected by local authorities. Against all adversity of continually deteriorating conditions for pedestrians and cyclists in most urban environments, the modal split share of these environmentally sound means of transport stands at 53% in Münster (see Figure 9).

The most popular measure to attract public urban areas for users or pedestrians is the creation of pedestrian zones, an approach applied mainly in shopping streets, and initially only in city centers, like the first pedestrian zone in Germany, the „Hohe Strasse“ in Cologne. Due to the success of the initial examples, especially for the retailers located in these areas, pedestrian zones have also been constructed little by little in local centers and smaller towns. Today, almost every town in Germany has some kind of pedestrian zone.

A really impressive example for the successful transformation of a city center is Munich.[6] Back in 1966 one part of the main radial street was closed to vehicle circulation and declared a pedestrian zone. This first stage was soon expanded with the result that the city center is now dominated by characteristic and attractive pedestrian zones - with a total of 160 hectares, the largest in Germany. The public transport accessibility of these areas is excellent. Eight suburban rail lines circulate in underground level below the main pedestrian axis, another four subway lines and tram lines cross the zone. This explains the extraordinarily high public transport share (74%) for shopping trips into the city. Only 11% of the customers of city center shops use a car or motorcycle.[7]

One aspect of the success of pedestrian zones certainly is the positive impacts on local shopping. According to research into the success of pedestrian zones in German cities, average increases in turnover of up to 80% in shops, 60% in restaurants and 30% in hotels have been achieved[8]. In spite of this success, proposals to enlarge existing pedestrian zones have often aroused conflicts with certain exponents of the business community who still believe that their economic existence depends solely on car accessibility.

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6 Sang-Don Row (1993): Fussgängerzonen und öffentlicher Raum: Deutschland und Korea.

7 Umweltschutzreferat der Landeshauptstadt München (1991) München setzt auf den Umweltverbund – Kennziffern der Mobilität.

8 Forschungsstelle für den Handel Berlin (FfH) (1979): Die Bedeutung der Fussgängerzonen für den Einzelhandel.

Obviously, pedestrian zones are not the only option for improving the conditions for pedestrians in urban areas. Promoting walking as a traffic mode can be accomplished by a variety of measures. Generally, any kind of measure which reduces car use has positive impacts on pedestrian traffic. Hence, spatial planning or traffic calming measures are to be seen as priority pedestrian measures.

In 1988, the city of Zurich started a five year campaign entitled "On Foot in Zurich“ with a credit volume of 1.85 million CHF.[9] The intention was, in addition to the usual planning work, to analyze the existing weak points in pedestrian traffic, to check the suitability of crossings and junctions for pedestrians, and especially to remedy – as far as possible – any deficits that were discovered. Districts were examined with participation of the residential population. Many of their suggestions for improvement have been tied into bundles of measures. Immediate measures requiring little planning effort were realized as early as 1989. Lowering kerbs, creating pavement noses and refuges, and also providing handrails on stairs, were carried out as necessary activities. By the end of 1992 one third of the more than 1,300 proposals had been implemented, another third was in the phase of implementation, and the rest were regarded as not feasible due to financial restrictions, competition with public transport, or the responsibility of the authorities of the canton.

3.2.2 BICYCLE TRAFFIC

Besides being economical, flexible and environmentally-friendly – all bicycles are zero emission vehicles (ZEVs) –most importantly, cycling is the healthiest transport mode of all. Most daily car users lack physical activity, which often impairs their personal well-being and health. Despite this knowledge, transportation planners habitually tend to neglect bicycle interests and its unexploitive traffic potentials. A status report of the German Federal Ministry of Transport revealed that cycling in Germany is a popular everyday transport mode.[10] Almost 2/3 of cycling trips are for shopping (29%), commuting (19%) and educational purposes(14%). But in the minds of many political decision-makers and planners, bicycles still stand for leisure or sport.

Considerable changes in traffic behaviour could be achieved by shifting short car trips to the bicycle. In Western Germany, about 6% of all car trips do not even cover a distance of one kilometer, and 40% of all car trips do not exceed 5 kilometers. The importance of this transformation potential stems from the experience that average car travel distances are becoming shorter and shorter, while the respective travel times are

[9] S.T.E.R.N. Gesellschaft für behutsame Stadterneuerung (editor) (1998): Guide local mobility management, Berlin.

[10] Bundesministerium für Verkehr, Bau- und Wohnungswesen (1998): Erster Bericht der Bundesregierung über die Situation des Fahrradverkehrs in der Bundesrepublik Deutschland.

increasing. Comparing the average door-to-door travel time in current urban traffic circumstances, the bicycle is the fastest transport mode for trips below 6 kilometers[11].

According to some estimates, nearly 30% of all private car trips in German metropolitan areas could be shifted to the bicycle. Thus, the transformation potential to the bicycle is higher than to public transport. The empirical analysis of changes in travel behaviour emphasize this point of view. In Munich, the modal split share of bicycle traffic has more than doubled during the last two decades (from 6% in 1976 to 13% in 1997), and in Freiburg the bicycle share has increased during the same time from 11% to 18%. Even the exceptionally high bicycle use in Münster of 29% in 1982 had expanded to 32% by 1994. These figures demonstrate very clearly the potential outcome of consistent strategies to encourage the use of bicycles.

In the case of Münster, the flatness of the terrain and the high percentage of students in the population has helped give cycling a popularity that the subsequent provision of an ample cycling infrastructure has helped to retain. This success can be put down to a variety of proven and innovative planning components. Münster has a dense network of on- and off-street bicycle lanes along all main streets and a unique bicycle ring road around the historical center. Special left-turn lanes and preferential positioning areas (on the road) for cyclists have helped reduce accidents at crossings and junctions. Some streets in the city center have been declared "bicycle streets“, where bicycles can use the whole road space and car traffic is only allowed at cycling speed. Making one-way streets accessible for cycling in both directions offers cyclists shorter journeys without detours. Good experience with this planning measure - successfully proven in many Dutch cities - has also been made in Saarbrücken. In a pilot program, transportation planners in Saarbrücken combined the introduction of 30 km/h zones with the opening of every one-way street for bi-directional bicycle traffic within these areas at the beginning of the nineties. Since 1998 a modification in the German road traffic code officially permitted this very useful measure. It has been revealed that bi-directional bicycle traffic in one-way streets does not cause more accidents – not a surprising fact - as four eyes (face to face) can see better than two!

Münster was one of the first cities in Germany to establish so-called eco-lanes, i.e., combined bus and bicycle lanes. Cycling in the pedestrian zone in Münster is allowed from 7 p.m. to 7 a.m.. The most recent highlight is the bicycle station at Münster central station. The parking garage for bicycles was opened in summer 1999. It offers 3,000 supervised parking lots (parking fees 1 DM per day, 12 DM per month and 120 DM per year), a bicycle maintenance service, a bicycle shop, rent-a-bike, lockers and a bicycle-wash daily from 5:30 a.m. to 11:30 p.m.. The bicycle station in Münster is the largest of about a hundred similar projects in the Land of North-Rhine Westphalia. Bicycle stations aim to facilitate the combined use of rail and cycling.

[11] Mohnheim, H.; Mohnheim-Dandorfer R.(1990): Strassen für alle.

The new opened bicycle station at Freiburg main rail station (with 1,000 parking places, parking fees 1.50 DM per day, 15 DM per month and 150 DM per year) also represents an integral part of the mobility center "Mobilé“. The mobility center offers additional services such as: travel information for the whole transport chain, ticket sale for rail and public transport, reservation of rental cars, and accommodations. Together with Münster, Bremen and Erlangen, Freiburg counts among the most advanced bicycle cities in Germany. With large investments of about 40 million DM between 1976 and 1996, Freiburg created an extensive system of tracks (29 km in 1972 to 160 km in 1995) and parking facilities, which are very well adapted to cyclists' needs. The payoff of this policy is a very low level of car use amounting to about 39% of daily journeys.

Another successful strategy to improve bicycle use is the development of a network of straight bicycle routes. These routes interconnect important starting places and destinations of cycling traffic. Schools, office and industrial districts, important leisure-time facilities and suburban railway/underground stations should be connected directly. Signposting should indicate route number or colour and distances to destinations along the route. The routes should mainly follow secondary streets with negligible car traffic in 30 km/h zones or green areas. Munich is currently implementing such an integral bicycle route network. Eleven routes are completely signposted, and another seven are planned. Between 1972 an 1998, the bicycle share on all daily journeys in Munich increased significantly, from 6% to 13%.

Supportive measures for bicycle traffic need not be an expensive investment: intelligent planning and raising of the public’s interest can do a lot (particularly if prominent personalities set an example and promote biking) . The bicycle is the most cost-effective of all urban transportation modes.

3.2.3 PUBLIC TRANSPORT

Improved public transport is no doubt the backbone of urban transport policy. Higher frequencies, improved regularity, more effective communication with passengers, the provision of new busses, trams or entire LRT systems, as well as competitive and easily comprehensible fare levels, are principal elements of the various packages of urban transport policies. This section describes selected practices in cities in Germany, Switzerland and France. It is structured into four – partly overlapping – aspects:

- Improvement of Existing Tram and Bus Systems
- Introduction of New Light-Rail-Tram Systems (LRT)
- Fares and Ticketing
- Innovative Vehicle Concepts

3.2.3.1 Improvement of existing Tram and Bus Systems

The excellent quality of public transport supply in Swiss cities is well-known. To identify key factors for this success, the public transport systems of Zurich and Bern are presented n more detail.

The success of public transport in **Zurich** can be demonstrated via the following five aspects:[12]

(1) Street Level

As mentioned earlier, the population of Zurich voted against proposals for very expensive underground transport systems in two referendums. As a result, the inner city public transport remained on street level. The physical presence gives the public transport a real and visible predominance in the streets and squares of the city. Because of the frequent tram and bus circulation in the streets, this space cannot be occupied by cars - as happens in many German cities where public transport has been put underground.

(2) Quality of Service

As the results of the data survey revealed (see, for example, Figure 6), good service in terms of area and time coverage is ensured in Zurich. The network of trams (13 lines) and buses (7 trolley and 22 motor-bus lines) works on a 7.5- to 12-minute frequency between 5:30 a.m. and 0:30 a.m.. Due to line-overlapping, the frequency in the center is much higher. A high frequency is the backbone of the network effect. With an operating frequency of twenty minutes, people commonly do not change from one line to another. Easily visible timetables at every stop enable easy checking of the departure times of busses and trams.

(3) Monitoring Systems (telematics)

Zurich has a conventional vehicle park of trams and busses. Basically, the new software is the driving force behind the highly efficient public transport supply. At more than 90% of the 280 traffic-light-regulated intersections, trams and busses obtain green light priority with almost no waiting time. The so-called SESAM system works with individual signal transmitters in the vehicles and induction loops in the carriageway. The light signal control system is separate from the operational monitoring system and can be used by every tram and bus, independent of its timetable. The monitoring concept was developed in 1975 and has been fully operational since 1982. The whole system costs about the same as half a kilometer of a metro-tunnel.

[12] Hüsler (1993): Public Transport in Zurich, in TCPSS Proceedings 1993.

(4) Integrated Networks and Timetables

In 1990 the regional metro system (with 14 "S-Bahn“ [suburban railway] lines) went into service, nine years after the voters in the Zurich canton approved the 2 billion CHF project investment. The extension of Zurich central rail station and the construction of a through station in the underground provide direct connections to the city center with each suburban railway line at 15-, 30- or 60-minute intervals. Both networks – trams/busses and the "S-Bahn“– are completely integrated in the fare system of the ZVV (Zurich integrated public transport association)[13], and their timetables are co-ordinated.

(5) Communication

Soft policies, publicity and image are crucial. Most public transport services are better than their reputation. In Zurich, much innovative work has been done to anchor public transport as a positive image in the minds of people. One reason for this development is certainly the supply of attractive fares like the *Rainbow-Card* launched in 1984. A significant proportion of the phenomenal increase of passengers per year on trams and busses during the nineties (from 218 million [1980] to 306 million in 1990) was achieved by this measure.

The quantitative dimension of the success of the public transport system can also be observed in the data tables in appendix B.

The capital of Switzerland, **Bern**, is a city of 130,000 residents. Nearly 200,000 inhabitants live within reach of the municipal public transport company SVB. The SVB network consists of 3 tram, 5 trolley-bus and 12 bus lines, most of them feeding directly into the historic city center (UNESCO world heritage) and offering frequencies even slightly better than in Zurich (every 6 minutes during the day, and every 12 minutes in the evening). As a consequence, the popularity of public transport – with 648 trips per inhabitant and year in the urban transport region of Bern (SVB area) – claims an unsurpassed position in comparison with other European cities.[14] Similar to the traffic light control system in Zurich, trams and busses in Bern obtain priority at most traffic lights. Public transport is reaching a share of 33% of daily trips by Bern’s residents. In 1995 the SVB achieved a revenue-to-cost ratio of 73.2% (over 82% when taking various subsidies of other communities into consideration). The urban tram and bus network is being supplemented by a suburban rail network with four diameter lines running at regular intervals of 30 minutes.

German examples for improvement of existing tram and bus networks include, among others, Freiburg, Munich and Münster.

[13] For more details referring to the advantages of integrated public transport systems – like the ZVV – see the following subtitle "Fares and Ticketing“.

[14] Car Free Cities (editor) (1997): Tramway Systems in European Cities.

In Germany as well as in the European context, **Freiburg** is famous for its environmentally-friendly transportation policy, primarily due to the provision of innovative and attractive fare concepts (for more details see below). In contrast to comparable cities, Freiburg was able to resist the temptation of a shutdown of the entire tramway network at the end of the sixties. During the eighties and nineties the network was modestly extended to a present count of 24 km. The construction of a new bridge exclusively for trams, bicycles and pedestrians over the railway tracks at the central station is an exemplary way of connecting long-distance, regional and urban public transport systems. The usual daily frequencies are 6-to 15-minute intervals, and every two minutes during peak hours.

The available data revealed an amazing increase in public transport use in **Münster** between 1990 and 1998 (+76%). A considerable part of this successful improvement strategy was achieved by a comprehensive bus acceleration program. This program consists of the construction of additional separate bus lanes and, especially, of bus prioritization at traffic lights with infrared radio communication between the bus and a fixed detector prior to the traffic light. A significant increase of average bus speed was also achieved by the transformation of bus stops. In many places, the common bus bays were converted into bus capes, with the effect that busses do not have to wait for a gap in the floating car traffic after their stop; now the opposite is true: private cars have to wait at the bus stops behind the bus. This measure simultaneously increases comfort and safety for bus passengers, but often provokes harsh opposition from car drivers.

3.2.3.2 Introduction of new Light Rail Tram Systems (LRT)

One of the most widely recognized German examples of a successful urban transport strategy is the public transport system of **Karlsruhe**. The so-called Karlsruhe Model attracts interest Europe-wide. The innovative aspects of this approach can be outlined as follows:[15]

- a vehicle able to use both regional DB (German railway) tracks and light rail tracks in the city center,
- DB tracks connecting to a tramway system (in the case of Karlsruhe, an existing network),
- construction of new stops on existing ordinary rail lines, which can be operated without extending journey times, thanks to the improved acceleration of light rail vehicles.

[15] Ludwig, Kühn (1995):Das Karlsruher Model und seine Übertragbarkeit, in: Der Nahverkehr 10/95, 12-22.

Light rail services using DB railway tracks started in 1992 between Karlsruhe and Bretten. With a total length of 28 kilometers, the light rail trams first use 5 km of the city tram network jointly with ordinary trams on a power supply of 750 V DC. Shortly after the city boundary, the traction power supply changes to 15 kV 16 2/3 Hz, and the LRTs run on a newly constructed 3 km section of double track laid parallel to the intensively used DB line Karlsruhe - Heidelberg/Stuttgart. For the remaining 21 km, the LRTs run on a newly electrified DB regional line. To facilitate access, the LRTs serve eight additional stops, one of which is situated at the town center of Bretten. In accordance with the GVFG (Municipal Transport Financing Law), up to 85% of the total cost (80 million DM) of the infrastructure works and the acquisition of 10 LRTs (42 million DM) was paid by grants from the federal government and the Land of Baden-Württemberg. Only the remaining 15% were contributed by the local communities to the LRT-line. Available figures point out the huge success of the new light rail service. Ridership has increased by 500% compared to the situation before. Unfortunately, the statistical analysis of the changes in ridership does not allow segregation of the various effects of replacing the existing bus and rail services with the new LRT system: improvement in services (frequencies, comfort of the vehicle), changes in pricing due to the new operator (introduction of a single tariff, establishment of the Karlsruhe Transport Association KVV in 1994), changes in the patterns of feeder services, discontinuation of direct services to the city center, the image effect of rail services, etc.[16] Nevertheless, the prior ridership expectations were surpassed immensely, leading to a faster build-up of demand and services than anticipated.

Encouraged by the success of the first step, the expansion of the LRT system has been pursued continuously. The opening of the tangential line Bruchsal – Bretten (21 km) in 1994, Karlsruhe – Baden-Baden in 1996 (32 km jointly with national and international passenger and freight traffic), Karlsuhe – Pforzheim in 1997 (31 km, jointly with heavy rail traffic) and, in 1997, the crossing of the Rhine with the line Karlsruhe – Wörth (13 km, with a newly built connection to a large residential area) were the most noteworthy network and service extensions. All these new lines are running outside the town on existing DB rail tracks, using the high voltage power supply. At the city entrance they filter into the ordinary Karlsruhe tram network. This creation of fast and direct connections for many people living in the growing metropolitan area to the city center can be seen as the key factor for the success of the Karlsruhe Model.

As a consequence of this success, the transferability of the Karlsruhe Model has been discussed – or is still under discussion – not only in numerous cities of Germany and Austria, but also in France, Great Britain, the Netherlands, Luxembourg, Slovenia,

16 Axhausen, Brandl (1999): Dynamics of LRT growth: Karlsruhe since 1975, in: Transportation Reviews, Vol. 19, No. 3. 221-240.

Switzerland and other countries. Studies made in this context revealed that the Karlsruhe Model is not suitable in large agglomerations such as Berlin, Munich or Frankfurt, where a metro is already running and an S-Bahn (suburban railway) network is in service. Adopting the model is ideal where standard-gauge-tracks exist in the city as well as in the surrounding region, and where regional lines are electrified.These circumstances do not always apply, so in many German cities in the seventies, existing tram networks were removed. The fact that this may not be as disadvantageous as it might seem is demonstrated by the case of **Saarbrücken**.

Saarbrücken, capital of the federal state of Saarland, with 200,000 inhabitants, situated directly at the French border about 120 kilometers west of Karlsruhe, was the first imitator of the Karlsruhe Model. The LRT system was inaugurated in 1997, 32 years after the shutdown of the former tram network. Except for the missing tram tracks in the city, the starting conditions for the new light rail were almost ideal. Within a 20 km radius around Saarbrücken, some 180 km of conventional railtracks are available to public transport, of which some 160 km are electrified.[17] The first step was the construction of 5 km of new tracks (using 750 V DC) through the city center and their connection with the existing railway line (15 kV 162/3 Hz) toward the French border town of Sarreguemines. Newly developed dual-system low floor vehicles are serving a 19 km line at intervals of 7.5 minutes in the city and 15 to 30 minutes in the outside region. The enlargement of this first section is currently in progress. 14 km of additional tracks are under construction, combined with another 11 km of existing (out of service and not electrified) DB tracks. This first construction phase (44 km) will conclude in 2002. The investment of 418 million DM for the first 19 km section has been guaranteed thanks to the generous funding rules of the GVFG. The federal state covers 57%, Saarland 29%, and only 14% had to be contributed by the city owned operator.[18] It is planned to also convert numerous other stretches of line to light rail operation. Additional border-crossing connections to France using the SNCF route network are also under consideration.

Strasbourg, a city of 264,000 inhabitants and seat of the European Parliament, located in the north-eastern part of France at the German border (only 90 kilometers south of Karlsruhe), also stands for an exceptionally successful case of public transport improvement. In 1960 the tramway ran its last journey in Strasbourg. It was replaced by steadily increasing car traffic. According to a survey in 1988 three quarters of motorized journeys in the Greater Strasbourg Area were made by private cars, whereas public transport and two-wheeled vehicles accounted for only 11% and 15%, respectively.[19] During the eighties the building of an automatic light rail system

17 Verband deutscher Verkehrsunternehmen VDV (1997): Sustainable Mobility – Public Transport in Germany.

18 Saarbahn GmbH: Die Saarbahn – Ein Nahverkehrskonzept für die Zukunft.

19 Strasbourg City Council: The Tram in Greater Strasbourg.

(comparable to that in Lille) was discussed. The decision in favour of a new tramway system was taken not only for economic reasons. By re-introducing the tram, the city of Strasbourg also saw an opportunity to improve public space. It was to be the centerpiece of a comprehensive policy which aims anew at influencing the modal split between the different means of transport by reducing the dominant part played by private cars to the benefit of more environment-friendly modes – i.e. public transport, bicycles, and walking.[20]

In 1994 the 12.6-kilometre line A was inaugurated. The trams run every 3 minutes during the day. In 1998 trams carried 70,000 passengers daily, whereas this figure was initially estimated at 50,000. The total cost for the first tram line and 26 trams was about 300 million Euros, of which about 50% were funded by the state, regional governments, and so-called "transport contributions", a tax paid by companies with more than 9 employees. By the end of the year 2000 another 12-km tram line (costing 250 million Euro) will be opened.

3.2.3.3 Fares and Ticketing

Finally, attractive fares are just as important as an attractive urban transport infrastructure and good quality of service. Transport operators all over Germany have invested considerable efforts in the systematic and consistent development of their fare concepts. It is a well-known fact that the need to purchase single tickets each time they enter a train or a bus is a constraint preventing people from using public transport more frequently. Due to the negative economic impacts on public transport operators in terms of low fare revenues caused by this so-called "out-of-pocket effect", they seek to offer comparatively low-priced season tickets. Another very important strategy for minimizing the necessity of monetary outlays for passengers is to offer through tickets that are valid in all means of public transport in a given city or an entire metropolitan area. It is certainly not convenient for people to buy several tickets every day, e.g. first a train ticket to the main station, then an underground ticket, and finally a bus ticket, and then, in the evening, the whole thing vice versa. Buying a season ticket that allows the utilization of all different public transport vehicles in the range during its period of validity (usually one month) is much more suitable. This concept of integrated public transport associations with simple and clearly designed fare structures is nowadays commonly applied all over Germany and other European countries (e.g. Switzerland, the Netherlands, Denmark etc.). About 37% of Germany's land surface – with more than half of the German population (57%) – is covered by one of the 25 integrated public transport associations. Almost every city with more than 100,000 inhabitants is

[20] Freani (1999): Managing car use in cities: the case of Strasbourg, paper presented at the ECMT/OECD workshop on managing car use for sustainable urban travel, Dublin, December 1-2, 1999. (http://www.oecd.org/cem/UrbTrav/Workshops/Carscities/Freani.pdf).

part of such a scheme. This kind of formal co-operation of public transport operators is a very important element of the often more attractive public transport in Europe (compared to North and South America).

Based on frequent passenger counts regional integrated public transport associations negotiate the shares they get from the overall revenues and from state subsidies. These can be very tricky negotiations, but it is clearly a lesson transport operators and administration can learn from Europe. The different systems are integrated, and the timetables are co-ordinated. Competition is between public and private transport - not between different means of public transport.

The first integrated public transport association in Germany was created in Hamburg in 1965. The Hamburger Verkehrsverbund (HVV) started with the slogan "one timetable, one tariff, one ticket“. The HVV introduced an integrated timetable and co-ordinated the transport capacity it offered; it worked out a collective fare system, planned the entire public transport network, spread the fare revenues over the operators involved , and was responsible for the marketing and public relations issues.[21]

The responsibility for the tasks described above still characterize every integrated public transport association in Germany. Whereas at the beginning transport operators formed the administrative body of integrated public transport systems, nowadays the regional or local authorities have assumed this role.

Developments in the European Union (EU) and the regionalization of public transport that has taken place in Germany since 1996 have introduced elements of competition with the public transport market. Consequently, the responsibilities in the organization of the public transport supply have to be strictly divided into sovereign and operational tasks. The *Bundesländer* (federal states) or the local authorities are authorized to determine the quantity and quality of the public transport supplied. Frequently, this responsibility is transferred to specially established associations of local authorities that constitute integrated public transport associations in metropolitan areas. Liberalization of public transport services, however, should not lead to a deterioration of the existing convenient ticket systems, which may be improved even further. In the Netherlands, for example, there is one single ticket system for public transport - the "nationaale strippenkaart“. The ticket can be used in any town, while in Germany each metropolitan region offers its own ticket system.

Competition is already unrestricted in the regional rail sector. In the rest of the public transport sector, competition has to be applied only in those places where transport operators are unable to provide economically viable transport services themselves. This is regularly the case in urban public transport. The integrated public transport associations offer a specialized public transport supply for a single line or a total

[21] Hamburger Verkehrsverbund HVV (1995): 30 Jahre HVV.

network following competitive bidding. The operator submitting the best offer – i.e. the lowest requirements for subsidies – obtains a concession to supply the specified public transport services for a fixed number of years. This removal of the former monopolistic market has led to significant cost savings, especially for regional rail services.

A pioneer for an innovative fare concept was the Swiss city of **Basel**. In March 1984 the cantons of Basel-City and Basel-Landscape accepted the launch of a so-*called "Eco-Ticket*". The price for a monthly ticket was decreased dramatically from 65 CHF to 35 CHF. At the same time, the *Eco-Ticket* became transferable to other persons and offered unlimited travel on a 370-km tram and bus network. Intensive promotional activities, the remarkable reduction and simplification of fares combined with additional benefits caused a more than 20% increase in ridership during the first three years after the introduction of the *Eco-Ticket*. In 1985 there was even a measurable reduction of car traffic crossing the city border. It was estimated that 16% of the *Eco-Ticket* holders were previously car users.[22] Despite the required subsidies, total public expenditures for public transport remains at a nearly constant level.

The first German successor to this successful tariff revolution was Freiburg. Only six months later, in October 1984, the city of Basel (70 km north) offered an *Eco-Ticket* as well. In Freiburg, the price for a monthly season ticket was cut from 51 DM to 34 DM. The Freiburg *Eco-Ticket* likewise led to an increase in public transport passengers of approximately 40% between 1984 and 1988. In September 1991, the area of validity was significantly extended. The renamed "*Regio-Card*" is now valid for all means of public transport, including DB services (German Railway) in the city of Freiburg and the two neighbouring countries. The *Regio-Card* is freely transferable. On Sundays and public holidays, two adults and up to four children under 18 can ride with only one ticket. For the inhabitants of the neighbouring countries, the *Regio-Card* cuts prices in half compared to the old tariffs. A study revealed a 16% increase in public transport trips in the traffic region of the *Regio-Card,* while car trips decreased by about 5%. The modal split share of public transport for Freiburg-oriented journeys rose from 21% to 30%.[23]

After some initial hesitation, the idea quickly found a growing number of proponents among urban transport operators. Within a few years, it had snowballed to the point where *Eco-Tickets* had become almost the standard season ticket (monthly or annually) in fare structures in German cities by around the end of the eighties. Due to lower public interest in ecological issues by that time, they were often given more fashionable names.

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22 Apel (1993): Verkehrskonzepte in Europäischen Städten – Erfahrungen mit Strategien zur Beeinflussung der Verkehrsmittelwahl.

23 Verkehrsgemeinschaft Freiburg VGF (1993): Die Regio-Umweltkarte.

Another commonly offered ticket category are off-peak-tickets, which offer all the advantages of a standard monthly ticket but stipulate that they may not use public transport during peak hours on working days. In return, holders generally receive a 30% discount compared with a ticket with unlimited validity.[24] One of the first off-peak cards was the *CC-Card* offered by the Hamburg integrated public transport association HVV since 1979. It is valid on working days between 9 a.m. and 4 p.m. and from 6 p.m. on. There are no restrictions in use on weekends and on public holidays. A 50% price reduction compared to the standard season ticket and additional benefits, like validity for express busses, access to the first class of suburban railways and free accompaniment by up to 3 children under 12 years, have made the CC-Card a great success.[25]

In contrast to off-peak tickets, so-called job tickets target the needs of employees. Like Eco-Tickets, they are designed above all for car commuters and provide an attractive alternative to individual transport. The basic principle behind job tickets is a blanket agreement – to run for at least one year – between the employers and local transport operators or the integrated public transport associations. Under this blanket agreement, all company staff are eligible for unrestricted use of bus and rail services. The tickets are sold and paid directly through the employer. The blanket nature of this type of ticket and the elimination of sales costs allow customers to easily obtain a job ticket with an advantageous discount.

In addition to the design of appropriate and attractive fares, the marketing of these fare offers is crucial. The introduction of the *Rainbow Card* in Zurich in 1985 was accompanied by a very successful marketing strategy. Many major companies were induced to buy *Rainbow Cards* and distribute them to their employees. A veritable competition for the best sales between re-sellers of *Rainbow Cards* was started. Developments in sales were a regular topic in local media and were visualized by special array of *Rainbow Barometers* at all important places in the city. According to the Zurich transportation authorities, marketing and a self-confident style on the Zurich transport market probably contributed just as much to public transport use as did infrastructural improvements and tariff policy.[26]

3.2.3.4 Innovative Vehicle Concepts

A successful urban transport strategy also includes improvement of the vehicles in use. This applies to public transport vehicles as well as to private vehicles, in order to reduce the emission of air pollutants and noise.

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24 Verband deutscher Verkehrsunternehmen VDV (1997): Sustainable Mobility – Public Transport in Germany.

25 Hamburger Verkehrsverbund HVV (1997) Geschäftsbericht 1997.

26 Stadtplanungsamt Zurich.

The frequently very high concentrations of benzene, nitrogen dioxide and diesel particles (black soot) in German cities was the reason for Germany's "Clean Air Act" (Federal Immission Control Act = *Bundesimmissionsschutzgesetz, BImSchG*) being changed in 1995 in order to allow local communities to take action to reduce the level of pollutants. In the 23rd ordinance to the BimSchG, air quality levels for benzene, black soot and nitrogen dioxide were defined. If the concentrations in city streets exceed these guideline values, the air quality authorities together with relevant transport authorities have to introduce measures to reduce the levels of the air contaminants to below the guideline values. Besides the improvement of traffic management, it is stated in the ordinance that the use of cars without catalytic converters can be restricted. Up to now, only extensive measurements and calculations of the level of the three pollutants as defined in the ordinance are being performed. No city has imposed restrictions on the use of non-catalyst passenger cars and old diesel cars and trucks. In lengthy discussions the transport authorities argued that restrictions of private car use are unacceptable to the users. In the meantime, the concentrations of benzene and nitrogen oxide are declining due to the replacement of non-catalyst cars by advanced three-way-catalyst cars. Thanks to this development, the concentration of benzene has fallen below the guideline value of 8 micrograms per cubic meter annual mean in nearly all German city streets. Nor is the guideline value for nitrogen dioxide normally being exceeded either. The remaining air pollution problem is the black soot, mainly caused by emissions from diesel cars, trucks and busses.

Frustrated by the inactivity of the authorities, citizens went to court in order to reach a decision. Two rulings ordered local communities to take action to reduce the concentration of black soot. In Berlin, the government was forced to influence the public transport company to retrofit the bus fleet with diesel filters and to employ traffic management instruments.

Compared with gasoline engines, diesel engines have the advantage of better fuel efficiency. However, from an environmental point of view, there are also two major drawbacks: the emissions of ultra-fine particulates and much higher nitrogen oxide emissions. In order to demonstrate the environmental advantage of public transport compared to individual cars, the public transport companies in Germany (under public pressure) introduced busses with alternative forms of propulsion. Natural gas, for example, has made major progress as a fuel for city busses in the last years. This development has been supported by a reduced fuel tax for natural gas and through promotion by the Ministry of the Environment and the *Umweltbundesamt* (German Federal Environmental Agency). Thanks to the reduced fuel tax, the use of compressed natural gas (CNG) today is also an economically favourable option for city bus corporations. The city of Saarbrücken, for instance, has decided to only purchase buses fueled with natural gas. With the use of an advanced three-way-catalyst system, the emission of particulates remains below the detection limit, and the nitrogen oxide emissions are about 6 to 7 times lower than with a diesel bus certified under EURO II. One disadvantage caused by the change from a diesel engine to an otto cycle engine is that fuel consumption is about 20% to 25 % higher than with new diesel busses. The overall emission of carbon dioxide emissions, however, is about the same as for diesel busses due to the lower carbon content of natural gas.

A further advantage is the lower noise emission caused by the different combustion principle. It has to be stated expressly that this emission advantage is mainly attributable to aftertreatment with a three-way catalyst with closed-loop control of the air-fuel ratio. Besides Saarbrücken, Hanover, Augsburg and Nuremberg all using CNG buses with great success.

It has to be stressed that the low emission of CNG busses can only be guaranteed if the aftertreatment system is checked on a regular basis. In a large CNG trial test conducted by the Ministry of the Environment / *Umweltbundesamt* the most common problems were caused by such minor technical troubles as defective lambda oxygen sensors or failed connections. The failure of the three-way catalyst was very rare.

Filtration of the exhaust gas can reduce the major drawback of the diesel engine (i.e. the particulate emissions). After a mileage of 300 km it is necessary to regenerate the filter in order to reduce the exhaust backpressure. Increasing exhaust backpressure leads to higher fuel consumption. Successful onboard regeneration of the soot filter is therefore a prerequisite for the use of a such filters. In the case of CNG, the Environmental Ministry and the *Umweltbundesamt* launched a large trial for an extensive long-term test of particulate filters in city busses and distribution trucks.

Today it can be stated that particulate filters in city busses are state of the art. About 10,000 diesel filter systems (mainly retrofitted) are used throughout Europe. Therefore diesel filters are used extensively in city bus fleets in Germany to reduce particulate emissions. Two different systems were successfully tested for city busses. The so-called CRT systems using the oxidation of nitrogen monoxide oxidation catalyst to nitrogen dioxide, and the nitrogen oxide oxidizes the diesel soot. As the oxidation catalyst makes use of a noble metal as a catalyst, the sulfur content in the diesel fuel has to be in the range of 10 to 20 ppm, since sulfur reduces the efficiency of noble metal catalysts.

The other system uses metal additives like iron or cerium to reduce the temperature for the ignition of diesel soot. It has to be ensured that no metal oxides from the metal additives can escape into the air. Other solutions, like using a diesel fuel burner to ignite soot, have proven too expensive to gain a relevant market share.

Cities like Munich and Wiesbaden have retrofitted nearly all city busses and are now only ordering busses with filters. The filters work practically maintenance-free. They merely have to be cleaned with hot water, which takes about 2 hours every 1 or 2 years. The reduction rate of diesel particulates is about 90% of the mass of diesel soot and more than 99% of the number of diesel particulates.

One last point. Improved comfort busses is an important issue if one wants to make public transport more attractive. Low-floor busses, for example, are now standard in all cities, and some cities use busses with devices to lower the bus in order to ease boarding by the passenger.

3.2.4 MOTORISED TRAFFIC

Parking policy

In addition to being of great importance for local land-use and settlement planning, German city parking regulations are the most widely applied and effective instrument to influence urban transport demand. In principle, the municipal authorities can manage parking demand by a) limiting the total number of public parking spaces, b) levying parking fees or c) establishing residential parking areas. In practice, various combinations of these measures are utilized.

The following example from Bremen, which has been taken from the very useful

Parking regulations in city and district centers in Bremen:

Measure, Aim and Outcome:

The main goals of this measure are to increase the quality of life in the city center and to put the space to attractive usage for pubs and cafes and for bicycle parking. One objective also was to increase the usage of the parking garages and obtain more fees. Nevertheless, accessibility to these centers by car for customers and visitors has been ensured.

Since 1993 all parking spaces in the city center and in the district centers are regulated via parking meters. The parking fee is DM 1 to 1.50 for half an hour. Parking spaces are reserved for deliveries.
Parking tickets may be used by two persons as public transport tickets for trips within the city center during the parking time.

A dynamic park guidance system has been installed to inform drivers of parking availability in parking garages. This will eliminate "searching" traffic. Currently, 15 parking garages are included in the system. Fees average, 2 DM per hour during the first two hours and then 2.50 DM for each subsequent hour.

Implementation Process:

The City Council has decided not to allow parking disks. There is resistance against this decision. The retailers believe that the disks are an easy guarantee of parking availability for customers.

One main instrument of the parking policy is the city owned parking company BREPARK which owns 80 % of the parking spaces in city center garages . A contract between BREPARK and the city ensures that the parking concepts will be implemented.

Parking regulations were to be enforced by the state's interior ministry (Senator des Inneren), but there have not been enough personnel for an effective enforcement. Currently, a solution is not in sight but urgently necessary.

database of the LEDA-project[27], describes a typical parking regulation in a German city.

During the eighties and nineties, nearly every German city introduced parking regimes favouring local residents in the use of public parking lots along the streets. The residents are eligible for a parking permission entitling them to unlimited parking in specially marked zones. At the same time, the parking fees on public ground in the city centers were increased to a minimum price of 2 DM per hour, in Munich even to 5 DM per hour.

In Freiburg, for example, approximately 60% of all public parking lots are exclusively reserved for residents. The annual price for the necessary parking allowance is 60 DM. For the rest of the inner-city public parking spaces, the parking duration is limited to two hours, with a fee of 2 DM per hour. Since 1991, the city's 2,700 municipal employees have to pay 35 DM (70 DM in a parking garage) per month for a parking lot. As an alternative, they can buy a 20 DM price-reduced monthly ticket ("Regio Card") for public transport in Freiburg and its surrounding region.

These measures aim at avoiding long-time parking by commuters. On the other hand, parking options for residents, customers and visitors to the city-centers are to be assured. For the growing number of commuters, many cities have set up park and ride (P+R) facilities at public transport stations in the periphery. In the catchment area of Munich, more than 18,000 parking lots are supplied in P+R facilities. Many P+R facilities are directly connected to a motorway, thus offering both free parking and short travel times to the city center. A decisive factor for the success of P+R is the distance to the center. If only insignificant time is saved using public transport compared to a private car journey, car users are not willing to change their behaviour.

Traffic Calming

Traffic Calming („Verkehrsberuhigung"), a concept developed in the eighties and nineties, is now widely accepted and has been successfully implemented in many German towns. The concept has been successful in improving the living quality of entire city districts and can enhance the attractiveness of the districts and thus improve not only the environmental situation, but the economic situation as well, and even attract new developments. In a lot of big cities in developing countries, liberalized town

[27] LEDA is a research project on legal and regulatory measures to promote sustainable transport in urban areas. LEDA is a cooperation of 10 institutes from 9 EU-countries. LEDA covers not only legal measures in the (passenger) transport sector, but also in related areas such as land use planning and environment. LEDA sets out with assessment of the national legal system pertaining to transport, traffic and related areas (land use planning, environment, energy). The idea is to determine the scope of action for cities in each country and to identify 'best practises'. Moreover, policy documents regarding transport in cities are screened to identify current policy goals. The 'best practises' database is located at: http://www.ils.nrw.de/netz/leda/index.html.

development policies are following the US-example. An adaptation of the German (and European) example of traffic calming could also be a very expedient example to be followed.

Successful traffic planning has to be introduced on networks of urban roads in center district areas rather than on single streets. Traffic planning schemes should address all relevant town development aspects linked to transportation: access, security, environment and green spaces. Measures and, in particular, investments should always be cost-efficient and cover the largest area possible with a given amount of money. If traffic calming is introduced successfully, a participation process has to be started to involve local public and commerce, communal services and users of the different means of transport.

Traffic calming aims at achieving an improved quality of life in towns, to allow redevelopment, accessibility of local services, attractiveness for the inhabitants, and a balanced social structure. It is intended to improve the design of streets, preserve historic sites and increase green spaces. Upgrading the environmental situation is a major intention of traffic calming: reduction of noise and air pollution, improvement of the local climatic situation, and reconverting space formerly used by car traffic. Better traffic conditions are a further intention of traffic calming, in particular by reducing the frequency and severity of accidents and giving priority to pedestrians, bikes and public transport. Car and lorry traffic is to flow slowly but smoothly and in a "civilized" manner in order to respect the local situation. This includes parking management, with parking lots designed to leave space for other purposes (street space used not only for traffic but for communication, for playing children , etc.). Parking badges, issued against a yearly fee, give priority to resident car owners in the district. Through traffic is concentrated along arterial roads, which need special attention.

The main elements of traffic calming in a broader sense are:

- redesigning of streets and reducing speed (30km/h maximum speed instead of 50 km/h);
- supporting public transport, bike traffic and walking, enhancing the social quality and vitality of cities in that pedestrians can experience as much freedom and as little disturbance as possible;
- management of car traffic (routing concepts, parking management, signaling, etc.);
- communication and participation by the public;
- surveillance and sanctions.

Tests conducted in a sampling of cities of different size have proven that traffic-calming significantly reduces noise levels and the number of accidents and citizens benefit from a more hospitable neighbourhood. Such elements are now being introduced in many other cities. Traffic legislation has been amended to accommodate the successful experiences. Successful measures which have been tested and are now being broadly applied are:

- The introduction of „tempo 30 zones"; designated networks of residential streets, where a maximum speed of 30 km/h is signposted. This is very often supported by redesign investments in streets (wider sidewalks, newly structured pavements, bumpers, narrowing of lanes, and roundabouts instead of intersections);
- Support for and facilitation of walking, in particular by giving pedestrians more and safer opportunities to cross streets, closing subways, reorganizing parking areas to create space for walking, redesigning intersections, adapting traffic lights (longer phases of „green", avoidance of conflicts with right-turning vehicles, "all-green" phases);
- Support for biking by introducing of bike networks, bike lanes on main roads, colouring of pavement, attributed signaling, safe parking spaces, and service stations (parking, maintenance, bike shop, travel agency); crucial elements here include a detailed analysis of critical intersections and the development of measures to improve safety;
- The reorganization of street space provides more room for green niches. Formerly car-dominated planning modes destroyed the historic dimensions and structures of towns. Redesigning intersections into plazas, planting of trees and plant beds, new pavements (e.g., cobbles) were adapted more closely to local situations

In the context of introducing 30 km/h speed-limit zones, Freiburg again plays a leading role. As early as 1985, Freiburg participated with 10 residential areas in the nationwide "30 km/h zone" pilot study. At the end of this trial in 1990, the city council decided to make use of the increased local scope of action and declared all residential areas as 30 km/h zones. As a result, 90% of Freiburg's inhabitants are now living in speed-reduced areas. Excluded from this standard is an approximately 160-km network of main streets and a few streets in industrial areas, where the 50 km/h speed limit was retained[28].

Good experience with 30 km/h zones has also been gathered in Heidelberg, as the following quotation from the LEDA-database reveals:

[28] Bratzel (1999): Erfolgsbedingungen umweltorientierter Verkehrspolitik in Städten.

These experiences have shown that 30 km/h zones are a cost-efficient measure to reduce noise and air pollution while significantly increasing road safety for pedestrians and cyclists.

A synopsis of the experience gained from a 10-year demonstration project and monitoring program to test traffic calming measures (with examples in Berlin, Freiburg, Heidelberg, Lübeck, Mainz, Münster and 10 other cities) has been published in a study conducted by Germany's Federal Environmental Agency[29].

30 km/h zones in all residential areas in Heidelberg:

Measure, Aim and Outcome:

Main aims: to increase traffic safety, especially for pedestrians and cyclists, to reduce noise emissions, and to reduce the relative speed of cars compared with the speed of greener modes.

Here, the City of Heidelberg also included through-traffic roads. Only a few main traffic axes with a low share of local traffic remained where speeds up to 50 km/h are allowed. The new rules were implemented by traffic signs and pictograms on the road. All priority roads were abolished. At the beginning and end of the area, the roads were narrowed.

Implementation Process:

The measure was implemented on the basis of an agreement between the city administration and the city council.. - first in an experimental phase involving 5 new housing areas, and then in existing quarters. The information policy was of major importance. A competition was held to find a slogan for all campaigns: information in newspapers, folders, stickers, etc., for the public as well as for residents, companies and car drivers.

Following implementation, these groups were informed of the results (as measured in driven speeds). The average speed was reduced by 10 to 20 km/h. Today, the average speed is between 25 and 34 km/h. Road safety has been increased: the number of crashes decreased by about 70%; the number of injuries by 55% (with the situation one year after and one year before the measure serving as the basis of comparison).

29 Umweltbundesamt (1992): Konzepte flächenhafte Verkehrsberuhigung.

3.3 MOBILITY CONCEPTS

It is becoming more and more questionable as to whether traditional transport policy instruments – new infrastructure, technical measures and legal regulations – are strong enough to achieve the desired changes in attitudes to transport. In addition, the parallel approach to infrastructural investments in road and public transport, which has been in practice for a long time, is not sustainable at the local level. For these reasons, alternative approaches that try to change transport–users' attitudes by way of mobility awareness are increasingly being given priority in local transport debates.[30] Some selected examples demonstrate the variety of concepts and measures actually carried out in the field of local mobility management, even though their transferability to other cities in transitional countries may still be restricted.

3.3.1 MOBILITY INFORMATION SERVICES

Mobility information stations were developed in Germany and Switzerland in the early nineties, mostly with the financial support of national and/or international institutions. Their aim is to provide travel information for all means of transport primarily at local/regional levels . Based on insights of various studies dealing with the discrepancy between attitudes and behaviour towards traffic, the leading idea is to inform clients about alternatives to the normal use of their own cars. These solutions offer individual advantages and simultaneously benefit the environment.

Institutionally, mobility information services were frequently introduced in close co-operation with public transport undertakings, as they are already experienced in mobility consultancy, although limited to their own line of public transport business. The new concept of mobility information services tries to go further: Non-motorized means of transport are included along with railways, taxis, car sharing or car pooling. The approach aims to generate an awareness for undertaking urban trips on foot, by bicycle, via public transport, or by taxi – and even by private car - or by a combination of these individual modes. Intelligent modal mix stands for a case-to-case decision in traffic behaviour favoring those means of transport which offer the greatest benefits for the individual and for the environment. The mobility station helps in decision-making. Its instruments are face-to-face contacts, the internet, the telephone, and sundry printed materials handed out either by the station staff itself or by other agencies.

30 S.T.E.R.N. Gesellschaft für behutsame Stadterneuerung (editor) (1998): Local Mobility Management. (This publication offers a current overview of approaches and implementation strategies of local mobility management measures in Germany).

Mobility information stations were set up in agglomerations and in large and medium-sized cities. Concept details vary from town to town but generally follow the same strategy as described above. While most of them are working successfully in terms of persons consulted, the majority of people moving in agglomerations do not see any need to ask for mobility information. This is one of the reasons why the concept of mobility information stations is still in its pre-test phase, another being the unsatisfactory financial situation.

The following lessons learned represent three selected examples of the wide range of mobility information stations in Germany:

- **Frankfurt am Main**: The "Verkehrsinsel" was created within the framework of the ENTERPRICE[31] research project (financed by the European Commission in Brussels).
- **Wuppertal**: "MobiCenter", a brainchild of the Wuppertaler Stadtwerke AG, is an outsourced information station of the local public transport corporation, whose undertaking has been upgraded by additional services for local flexible transport systems, information for railways, car-sharing and exhibitions, reservations and ticketing.
- **Münster**: "Mobilé" - this mobility information station, recently developed by the city of Münster, aims to support environmentally-friendly means of transport. As cycling plays a dominant role in Münster, its services are oriented to this means of transport. Other offers are also being elaborated: co-operation with German Railways, mobility information package for new residents, and the design and management of local mobility fairs.

3.3.2 CAR SHARING

An average car in Germany is only driven for about 44 minutes a day. For more than 23 hours per day it stands idle. Thus, it makes sense to look for ways of using cars more efficiently. Even if a car is driven very little, huge environmental resources are necessary for its production. Even when it is parked, it is taking up space and still costs money (tax, insurance). In most larger cities in Germany, newly founded co-operatives or companies now offer car-sharing as a professional service. But, despite the indisputable advantages of car-sharing, its market penetration is still at a negligible level. In 1999 there were only 30,000 car-sharing users in Germany. However, there is a large potential for this intelligent and efficient way of car use, especially if it is

[31] ENTERPRICE: Enhanced Network for Traffic Services and Information Provided by Regional Information Centres in Europe.

combined with public transport.[32] In the recent years, public transport companies have recognized that a side effect of promoting car-sharing could be an increased use of public transport. Thus, innovative public transport operators gave up their reservations about private transport and started to engage in different degrees of co-operation with car-sharing companies, e.g., in Hamburg, Dresden and Frankfurt. For example, in 1998, the car-sharing company in Dresden "stadt*mobil*" and the local public transport operator DVB introduced a highly advanced technological solution for booking and billing journeys. After reserving a car by telephone, a user opens a safe at the location of the reserved car with a chip-card and a PIN (personal identification number). S/he then retrieves the car key and the data key for the on-board-computer (which controls an electronic immobilizer). Stadt*mobil* Dresden – DVB's public car service" is clearly defined as a professional service. The main reasons inciting users to participate are, firstly, the attractive prices, secondly, the variety of the car fleet, and - only in third place - ecological arguments.[33]

While car sharing in Germany is organized on a very diffused basis, with lots of independent companies in almost every city (only in the last two years has a gradual concentration process started with some mergers of operators), in Switzerland, there is only one single active car-sharing company named „Mobility“. Compared to the situation in Germany, where car-sharing still has the touch of a grassroots movement, the Swiss car-sharing company „Mobility“ clearly sees itself as a professional service provider. Their nation-wide presence has allowed beneficial co-operation at the national level, for example with the Swiss railways SBB. As a result, car-sharing usage in Switzerland is 10 times higher than in Germany, in relation to the number of inhabitants.

„Mobility's corporate information“ below details the idea of car-sharing and its implementation.

32 A study for the German Ministry of Transport estimates the potential for car-sharing at 2.5 million users. Baum, Pesch (1995): Car-Sharing als Lösungskonzept städtischer Verkehrsprobleme.

33 Holm (1999): Der Beginn einer wunderbaren Freundschaft: Öffentliche Autos, Busse und Strassenbahnen, in: Nahverkehrspraxis 11/99.

What is CarSharing?

Mobility CarSharing is keeping up with the times.

Diversified. There is not just one car at your access, but a fleet of cars. Choose one to suit your needs: a small car, a family car, a 7-seat van, a transporter or a convertible.

Easy and convenient. A car on call is conveniently booked by phone and internet, 24 hours a day. Reserve, pick up and drive. You will be invoiced regularly.

Low costs. If you drive less than 15000 km per year and combine Mobility with public transportation, you can save up to CHF 250.- per month compared to driving your own private car.

Ecologically sound. The combination of public transportation and «car on call» is a highly modern form of mobility, because it uses resources more efficiently. Up to 57% energy is saved and less strain is put on the infrastructure.

Equipped for the future. More and more people want greater independence from material goods and see transportation from a practical viewpoint. They choose an ideal mode of transport, enjoy changing cars and do not mind driving a car which is not their own.

How does CarSharing work?

Mobility CarSharing is easy to use:
Low-cut prices. All inclusive.

Use per hour. Everything from petrol to depletion, parking fees, VAT and comprehensive insurance,is included in our prices. Between 23.00 p.m. and 7.00 a.m. we do not charge an hourly rate. Special rates apply for commercial use and holiday trips.

Mobility CarSharing is easy and convenient.

1. **Reserve.** Via our personally and automatically operated call center or the Internet, you can reserve your Mobility car all over Switzerland 24 hours a day, 7 days a week. You are immediately informed when a car is free at the nearest location.
2. **Driving.** Using your personal Mobility key or from January 1999 onwards with an electronic Mobility chip card, you can access your car at any time and drive it as long as you have booked. At the end of your trip you enter the driven kilometers in the log book. These data will be transferred into our accounting system.
3. **Billing.** Detailed invoices are sent out on a regular basis.

Mobility CarSharing Switzerland

This is Mobility car on call in Switzerland: 1200 cars at 700 locations in 330 communities for 30000 customers. (November 99)

On the move using all means of transport. Mobility CarSharing begins where the efficient public transport ends. Where an individual vehicle will bring you further. At this point, Mobility closes the cycle of tram, bus, train and «car on call». Mobility is at your disposal like public transportation, facilities and in addition, it can be used like a private car.

Mobility CarSharing is diversified. Mobility cars are ideal for the following purposes: wherever public transportation can't reach, takes too long or is inconvenient, for journeys outside the public transport network and out of the timetable.

- for the family
- for commercial use
- for shopping
- for holiday and weekend trips

source :http://www.mobility.ch/e/ueberuns.cfm

A modification of the basic principle of car-sharing is a concept called „*Incars*“. *Incars* was developed to establish car-sharing as a regular service of housing companies for their tenants or flat-owners. In the German city of Giessen, a first pilot project was started in 1998. The GSW housing company offers three cars exclusively for their tenants. Due to the modern applied technology (smart-cards, on-board-computers, data keys) and the proximity of the car pool to the housing area, *Incars* offer a new quality of car-sharing, especially because cars can be used spontaneously and open end, without any additional reservation. Advantages for housing companies could be: better image by providing a modern service to their tenants, and reduction of car dependency amongst tenants, resulting in less space requirement for cars.[34] A second co-operation project between car-sharing and housing companies was launched in Dresden in October 1999.

Another interesting mobility concept is „*cash-car*“. *Cash-car* is offered by *Choice*, a subsidiary company of the Social Science Research Center Berlin (WZB), the local car-sharing firm *StattAuto*, the German Railway DB, and Audi car manufacturer. *Cash-car* provides any type of car under a full-service leasing contract, plus a 15% discount on the VBB (Berlin integrated public transport association) season ticket, and a *Bahn-Card* (50% fair reduction card of the German railways). As well as having a car at their exclusive disposal, *Cash-car* participants are given the additional option of putting the car at the disposal of a local car-sharing fleet whenever it is not in use. Depending on the number of days which the car was hired out and the number of driven kilometers, participants receive a bonus. The level of this income is based on demand: car-sharing cars are in greater demand in the evening and at weekends, thus gaining more income for the participants. Target group for *Cash-car* are in the first place companies with a firm-owned car fleet. *Cash-car* provides an opportunity for a more efficient management of company induced transport activities.[35]

4 CONCLUDING REMARKS

Overall cities in Germany and Switzerland are confronted with the same dominating challenge: the increase of urban sprawl and suburbanization. This deconcentration is still inducing continued growth in car traffic, which in turn increasingly exacerbates ecological and social problems. Faced with these megatrends, cities have only a limited portfolio of instruments and measures with which to organize urban transport in a more environmentally oriented manner. But the variety of implemented measures and the large differences in the analyzed urban transport indicators described in part two of this survey illustrate the fact that there is still a considerable scope for action even at the local level. The description of best practice examples has reveals that well designed urban transport policies can make remarkable positive contributions to the cities' sustainability and competitiveness.

The use of pricing instruments in German and Swiss municipalities is limited solely to the control of parking fees on public areas. Fuel and car ownership taxation is at the

[34] Fischer, Hiestermann (1999): Moderne Mobilität, in: Zukünfte Frühjahr 1999. Some information in English can be found on the Internet (www.urban21.de/english/08-project-forum/1-incars.htm).

[35] More information on cash-car can be found in the Internet: www.choice.de.

national or cantonal level; the same is true for road pricing, which is not yet being applied either in Germany nor in Switzerland. The municipal influence on public transport pricing has declined, since in most cases the integrated public transport associations have become responsible for price levels and tariff structures of public transport fares.

Since the principle of subsidiarity applies to land use planning, local authorities are the dominant players. This delegation of planning authorities, which is intended to bring policy and decisions closer to those most affected, implicates on the one hand chances for strategies to strengthen a sustainable development. On the other hand, however, the opposite could take place. If one city has a strongly restrictive inner-city development concept, whereas others in the vicinity are competing for investments or customers with vast greenfield developments, the dilemma of subsidiarity is obvious. A promising path towards solving this problem can be seen in the closer co-operation among municipalities within a metropolitan region in order to co-ordinate transport and land use planning and make more strategic use of economic instruments. Crucial for a more sustainable urban development are policies that make cities more attractive and draw people to live and work in them because they want more of what cities offer.

Quality of life in urban areas is closely correlated with transport. The analysis of experience obtained with traffic calming measures and the promotion of non-motorized transport modes reveals higher quality of life and enhanced road safety in almost every case. Although environmentally oriented transport policies are increasingly perceived as an important local policy aim, and although public opinion polls indicate a broad acceptance for measures promoting non-motorized and public transport options for reducing private transport volume, the implementation of environmentally friendly measures often progresses very slowly. Important obstacles to such implementation are caused by deep-rooted patterns of thinking and habits, by resistance from interested parties, and by political and administrative deficits.[36]

Thus, practical strategies in urban transport have to meet not just technical and conceptual requirements, but also and primarily political and social ones. The main aim is to create acceptance among the general public and various interest groups for an environment-oriented transport policy. To tackle these problems and requirements, a multitude of so-called soft policies like information, co-operation, effective organization and participation have to be carried out.

An important element in achieving sustainable mobility patterns in a city is, first of all, the elaboration of a realistic framework of local environmental, economic and social targets and appropriate strategies and programs for action. Defining quantifiable targets and strategies sets the general but binding path for the local authority to take. Based on a general framework of defined elementary standards and fundamental

[36] S.T.E.R.N. Gesellschaft für behutsame Stadterneuerung (editor) (1998): Local Mobility Management.

statements about the nature and scope of desirable traffic, basic concepts can be developed for pedestrians, cyclists, public transport and car traffic. Measures should only be elaborated and operationalized after an accord concerning the targets has been reached. In the process of defining targets and measures. All relevant stakeholders should be involved from the outset.

To overcome the above-mentioned obstacles to political implementation, co-operative and participatory strategies are now increasingly used instead of traditional „top down“ planning approaches, especially in the transport sector (e.g. transport forums in Heidelberg, Lübeck and Munich). These forms of planning have been given a new impetus at the local level, particularly in terms of the discussions revolving around Local Agenda 21.[37]

Finally, the example of Zurich, where expensive projects for underground transport systems were twice rejected at the polls, reveals impressively that the participation of the residents may not be an obstacle to transportation planning but instead an exceptional chance to implement a more sustainable transportation system. Compared to the erstwhile planned, highly sophisticated underground system, the actual tram- and bus-based Zurich transport system is probably

- economically more efficient (lower investment and operating costs),
- ecologically more effective (less space for air polluting and noisy private cars) and
- socially more equitable (superior accessibility and public security)

Thus, it meets the principal aims of sustainable urban development.

[37] Ibid.

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Important data on the Internet

„Best examples“ of municipal ecological measures and projects in the sphere of „mobility/transport“. Current collection from the Deutsches Institut für Urbanistik (Difu)
http://www.difu.de/stadtoekologie/praxis/mobilitaet/

The collection of examples under the heading „Surban“ from the European Academy of the Urban Environment (EA.UE) provides access to detailed information on cases of good practice in European urban development (English).
http://www.eaue.de/winuwd/list.htm

Database with descriptions of implemented legal and regulatory measures for sustainable transport in cities LEDA (English)
http://www.leda.org/database/index.htm
http://www.ils.nrw.de/netz/leda/deliverable.htm

Appendix A:

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Appendix B:

Results of the urban transport survey

1) Indicators of urban transport
2) Available original data

World Bank - Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

Urban Transport Strategy Review, Urban Transport Database for World Cities

		Dresden				Frankfurt				Freiburg				Hamburg			
		1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998	1970	1990	1990	1998
Module 1. Area, Population, Employment																	
total population	(`000)	504,0	516,0	489,0	447,0	651,1	629,2	632,5	651,1	162,0	175,0	191,0	201,0	1.793,6	1.645,1	1.652,4	1.700,1
Area	km2	222,0	226,0	226,0	237,0	194,7	248,9	248,3	248,3	79,9	153,0	153,0	153,0	753,2	754,7	755,3	755,5
population density	pers/km2	2.270	2.283	2.164	1.886	3.345	2.528	2.547	2.622	2.028	1.144	1.248	1.314	2.382	2.180	2.188	2.250
area devoted for transport (share of total area)	%	13,5%	13,7%	9,3%	10,5%	15,8%	14,1%	17,2%	17,4%	12,5%	7,8%	9,2%	9,8%	10,3%	10,9%	11,6%	11,7%
employed population (share of total population)	%	-	-	63,0%	59,1%	-	-	-	50,5%	40,7%	-	38,2% 4)	-	46,2%	45,5%	45,6%	46,3%
job density (per settled area)	jobs/km2	3,2	2,7	2,5	2,0	-	-	-	4,1	-	-	-	-	-	1,8	1,7	1,6
share of social welfare recipients	/1000 inh.	-	-	10	16	25	48	87	72	37	63	84	80	-	-	-	83
Module 2. Urban Transport Infrastructure																	
roads per square kilometre settled area	km/ha	-	10,2	9,8	10,7	11,3	10,8	9,4	9,6	11,2	11,3	10,9	10,4	10,4	8,8	8,9	8,8
expressways per square kilometre settled area	km/ha	0,1	0,1	0,1	0,1	0,4	0,6	0,5	0,5	0,2	0,4	0,3	0,3	0,1	0,1	0,2	0,2
length of metro rail tracks per square kilometre settled area	km/km2	-	-	-	-	-	-	-	-	-	-	-	-	0,2	0,2	0,2	0,2
length of light rail/tram tracks per square kilometre settled area	km/km2	1,9	1,4	1,3	1,1	1,5	1,2	0,9	0,8	0,5	0,4	0,5	0,5	0,2	-	-	-
Modul 2b: Road accidents																	
road accidents per 100000 inhabitants		-	-	-	3.936,2	4.067,8	3.615,6	3.644,9	2.344,1	2.688,3	3.164,0	2.484,3	2.071,6	1.974,3	3.114,0	3.977,5	3.313,2
injured persons per 100000 inhabitants		-	-	-	600,4	1.096,2	829,8	647,2	482,3	816,0	830,9	589,0	603,5	964,9	866,5	875,4	716,3
killed persons per 100000 inhabitants		-	-	-	6,9	23,8	11,4	5,4	3,2	18,5	13,1	5,2	1,0	21,1	12,6	6,4	2,6
Module 3. Vehicle Ownership																	
vehicles per 1000 inhabitants	veh./1000 inh	167	271	388	483	319	428	527	524	252	389	460	473	263	376	446	468
private cars per 1000 inhabitant	cars/1000 inh	85	186	294	429	288	387	478	460	221	353	412	413	241	345	411	419
vehicles per road network kilometre	veh./km	-	137	178	184	205	214	260	256	133	159	192	198	125	166	189	202
vehicles per square kilometre transport surface	veh./km2	2.800	4.506	9.038	8.628	6.743	7.680	7.795	7.892	4.076	5.666	6.272	6.340	6.062	7.503	8.424	9.010
Module 6. Person Trips (mainly from O-D survey)		*1972*	*1982*	*1991*						*1976*	*1982*	*1989*		*1978*	*1982*	*1991*	
average trips per person per day		-	-	-	3,0	-	-	-	2,8	-	-	-	3,2	2,9	2,9	2,9	-
modal split for all person trips																	
walk	%	34%	39%	36%	26%	-	-	-	30%	30%	35%	22%	22%	38%	31%	22%	-
bicycle	%	0%	6%	6%	10%	-	-	-	6%	11%	15%	18%	18%	8%	9%	12%	-
public transport	%	38%	32%	22%	21%	-	-	-	25%	15%	11%	16%	21%	22%	22%	21%	-
private motorized transport	%	22%	23%	36%	43%	-	-	-	39%	44%	39%	44%	39%	32%	39%	45%	-
taxi																	
modal split for peak-hour trips	%	33%	38%	37%	22%	-	-	-	-	-	-	-	-	-	-	16%	-
walk	%	6%	6%	6%	8%	-	-	-	-	-	-	-	-	-	-	14%	-
bicycle	%	40%	36%	26%	27%	-	-	-	-	-	-	-	-	-	-	28%	-
public transport	%	21%	20%	31%	43%	-	-	-	-	-	-	-	-	-	-	42%	-
private motorized transport	(`000)	16,0	18,0	18,0	32,0	-	-	-	-	2,8	-	7,5	12,0	18,0	42,0	52,0	59,0
commuting trips (incoming) per 1000 inhabitants	(`000)	44,0	35,0	30,0	75,0	-	-	-	-	28,5	-	43,6	45,9	135,0	207,0	242,0	269,0
Module 8. Public Transport Operations																	
number of PT trips per inhabitant and year	/inh.	-	536	434	238	228	151	154	197	181	156	216	316	136	189	177	162
vehicle kilometre per square kilometre settled area	(`000)	573	509	472	343	404	288	257	258	162	134	138	153	312	249	221	234
seat kilometre per square kilometre settled area	(`000)	50.931	64.141	89.447	30.726	50.757	34.967	30.663	33.066	18.172	14.959	13.596	18.922	23.678	19.676	18.241	20.689
seat kilometre per 1000 inhabitants	km/1000 inh.	-	10,8	16,6	6,0	5,8	4,1	4,3	6,0	2,8	2,8	2,7	4,3	3,6	4,8	4,4	4,9
fixed route kilometres per square kilometre settled area	km/km2	-	-	4,0	4,7	7,0	4,6	4,1	4,3	3,0	4,2	4,4	5,4	6,4	6,0	4,5	3,9
fare revenues per passenger	DM	-	0,11	0,77	0,98	0,42	0,90	1,41	2,09	0,35	0,73	0,87	1,12	0,52	0,86	1,19	1,45
fare revenues per passenger kilometre	DM/Pkm	-	-	0,13	0,20	0,10	0,20	0,37	0,55	0,11	0,18	0,22	0,32	0,08	0,14	0,23	0,28
average utilisation rate (occupancy)	%	-	-	16%	19%	17%	17%	14%	13%	21%	22%	31%	25%	24%	24%	20%	17%

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

World Bank - Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

Urban Transport Strategy Review, Urban Transport Database for World Cities

		Karlsruhe				Muenster				Munich				Zurich			
		1970	1980	1990	1998	1970	1980	1990	1998	1970	1990	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment																	
total population	(`000)	258,9	269,8	270,3	264,6	203,6	267,4	275,2	279,2	1.359,4	1.298,7	1.270,6	1.206,0	423,0	369,5	365,0	359,1
Area	km2	122,8	173,5	173,4	173,5	74,0	302,1	302,3	302,2	310,5	310,4	310,5	310,5	91,7	92,1	91,6	91,9
population density	pers/km2	2.108	1.555	1.558	1.525	2.750	885	910	924	4.378	4.184	4.093	3.885	4.615	4.012	3.985	3.908
area devoted for transport (share of total area)	%	12,4%	11,0%	11,8%	12,8%	12,5%	6,8%	7,3%	8,2%	13,5%	13,7%	15,5%	16,4%	11,2%	13,0%	13,8%	13,6%
employed population (share of total population)	%	49,6%	-	42,5%	-	-	-	-	-	-	-	-	-	53,9%	52,8%	55,1%	-
job density (per settled area)	jobs/km2	3,2	2,5	2,5	2,1	-	1,3	1,6	1,5	-	-	-	-	-	5,1	6,5	6,4
share of social welfare recipients	/1000 inh.	-	44	77	79	29	34	40	54	-	-	-	36	7	8	19	28
Module 2. Urban Transport Infrastructure																	
roads per square kilometre settled area	km/ha	-	9,5	9,1	8,7	-	-	-	16,4	-	9,6	9,5	9,5	-	-	-	-
expressways per square kilometre settled area	km/ha	-	0,0	0,3	0,2	-	-	-	0,4	-	-	0,3	0,3	-	-	-	0,3
length of metro rail tracks per square kilometre settled area	km/km2	-	-	-	-	-	-	-	-	0,0	0,1	0,2	0,3	-	-	-	-
length of light rail/tram tracks per square kilometre settled area	km/km2	-	-	-	-	-	-	-	-	0,6	0,5	0,4	0,3	1,4	-	1,4	-
Modul 2b: Road accidents																	
road accidents per 100000 inhabitants	/1000 inh.	2.973,3	3.590,4	3.815,4	2.704,5	2.733,1	2.730,8	2.845,4	3.033,9	3.379,8	3.382,0	4.049,6	3.372,0	-	2.162,3	1.720,5	1.550,7
injured persons per 100000 inhabitants	/1000 inh.	736,6	774,6	644,1	566,5	887,6	786,1	657,5	553,3	891,4	781,0	653,4	590,8	-	462,8	363,6	367,6
killed persons per 100000 inhabitants	/1000 inh.	18,5	14,8	4,1	7,2	15,7	15,3	8,4	3,2	18,1	9,0	4,4	2,6	-	11,6	5,2	2,5
Module 3. Vehicle Ownership																	
vehicles per 1000 inhabitants	veh./1000 inh	304	437	534	599	250	381	456	515	276	414	542	647	293	390	440	452
private cars per 1000 inhabitant	cars/1000 inh	274	389	473	512	227	349	418	454	241	361	468	568	259	345	375	379
vehicles per road network kilometre	veh./km	-	180	215	220	-	-	-	109	-	248	304	342	-	-	-	-
vehicles per square kilometre transport surface	veh./km2	5.187	6.185	7.030	7.138	5.487	4.976	5.668	5.830	8.973	12.607	14.324	15.274	12.025	12.019	12.748	12.982
Module 6. Person Trips (mainly from O-D survey)				*1992*			*1982*	*1990*	*1994*	*1976*	*1982*	*1989*	*1997*		*1984*	*1989*	*1992*
average trips per person per day		-	-	-	-	-	3,5	3,6	3,5	-	-	-	-	-	-	-	-
modal split for all person trips																	
walk	%	-	-	23%	-	-	25%	21%	22%	31%	29%	24%	22%	-	29%	25%	28%
bicycle	%	-	-	17%	-	-	29%	34%	32%	6%	10%	12%	13%	-	5%	7%	7%
public transport	%	-	-	16%	-	-	7%	7%	10%	19%	22%	24%	24%	-	32%	32%	37%
private motorized transport	%	-	-	44%	-	-	39%	38%	37%	44%	39%	40%	41%	-	34%	36%	28%
taxi																	
modal split for peak-hour trips	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
walk	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
bicycle	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
public transport	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
private motorized transport	(`000)	6,7	-	13,6	-	-	-	-	-	19,0	-	57,0	-	17,2	17,9	28,4	-
commuting trips (incoming) per 1000 inhabitants	(`000)	58,8	-	84,8	-	-	-	-	-	152,6	-	290,0	-	92,3	129,9	160,3	-
Module 8. Public Transport Operations																	
number of PT trips per inhabitant and year	/inh.	170	166	205	270	94	72	69	119	188	247	297	335	330	389	550	531
vehicle kilometre per square kilometre settled area	(`000)	155	131	132	141	133	80	84	101	354	339	389	376	662	640	706	652
seat kilometre per square kilometre settled area	(`000)	21.490	19.237	15.871	21.392	13.037	8.008	8.310	10.235	17.687	23.731	30.191	35.770	79.375	82.100	94.355	93.211
seat kilometre per 1000 inhabitants	km/1000 inh.	3,6	4,2	3,5	5,7	2,0	2,3	2,2	3,0	2,4	3,9	5,3	6,7	5,6	6,9	8,2	8,7
fixed route kilometres per square kilometre settled area	km/km2	6,1	4,9	4,5	4,8	5,4	3,9	6,3	5,4	5,4	3,2	3,4	3,7	5,9	5,0	5,0	5,0
fare revenues per passenger	DM	0,35	0,71	0,83	1,07	0,43	1,03	1,18	1,15	0,51	0,69	0,97	1,21	0,30	0,52	0,50	1,40
fare revenues per passenger kilometre	DM/Pkm	0,10	0,18	0,21	0,24	0,11	0,25	0,18	0,18	0,09	0,17	0,22	0,27	0,50	0,65	0,65	0,74
average utilisation rate (occupancy)	%	17%	16%	23%	21%	18%	13%	21%	25%	45%	27%	25%	23%	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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DRESDEN

		City of Dresden				Dresden Metropolitan Area			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment and Income									
Area	km^2	222,0	226,0	226,0	237,0	1.028,0	1.028,0	1.028,0	4.877,0
settled area	km^2	87,0	99,5	108,5	109,3	-	-	-	-
devoted for transport	km^2	30,0	31,0	21,0	25,0	-	-	-	-
total population	(`000)	504,0	516,0	489,0	447,0	905,0	892,0	854,0	1.250,0
employed population	(`000)	-	-	308,0	264,0	-	-	-	-
jobs	(`000)	278,0	272,0	276,0	215,0	304,0	300,0	295,0	527,0
per capita income	DM/a	-	-	-	-	-	-	-	-
social welfare recipients	(`000)	-	-	5,0	7,0	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network		-	-	-	-	-	-	-	-
length of expressways	km	10,0	10,0	10,0	10,0	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	177,0	241,0	251,0	315,0	-	-	-	-
other roads	km	-	768,0	807,0	845,0	-	-	-	-
length of total road network	km	-	1.019	1.068	1.170	-	-	-	-
number of tolled bridges		-	-	-	-	-	-	-	-
juctions with signaling		28	45	90	185	-	-	-	-
Parking in the city center						-	-	-	-
off street parking spaces		7.900	10.400	12.200	18.400	-	-	-	-
on street parking spaces		5.100	6.500	6.100	5.600	-	-	-	-
commercial parking spaces		-	700	1.100	9.100	-	-	-	-
Fixed track system		-	-	-	-	-	-	-	-
metro rail tracks	km	-	-	-	-	-	-	-	-
of which, underground	km	-	-	-	-	-	-	-	-
light rail tracks/tram	km	163	143	137	125	-	-	-	130
suburban passenger rail	km	-	35	35	39	-	-	-	91
segregated busways	km	-	-	-	5	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	-	-	-	-	-	-
carbon monoxide	t/a	-	-	-	-	-	-	-	-
sulphur dioxide	t/a	-	-	-	-	-	-	-	-
hydroccarbons	t/a	-	-	-	-	-	-	-	-
nirtogen oxides	t/a	-	-	-	-	-	-	-	-
Modul 2b: Road accidents									
road accidents		-	-	-	17.595	-	-	-	-
injured persons		-	-	-	2.684	-	-	-	-
killed persons		-	-	-	31	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	42,8	96	144	191,6	-	-	-	-
motorcycle	(`000)	32,1	30,6	30,4	5,9	-	-	-	-
truck, bus, others	(`000)	9,1	13,1	15,4	18,2	-	-	-	-
all motor vehicles	(`000)	84	139,7	189,8	215,7	-	-	-	-
bicycles	(`000)	-	-	-	-	-	-	-	-
Module 4. Urban Transport Pricing									
average prices									
economy car	DM	14.000	17.000	28.000	32.000	-	-	-	-
standard bus	DM	60.000	90.000	600.000	700.000	-	-	-	-
minibus	DM	-	-	-	400.000	-	-	-	-
bicycle	DM	300	400	750	900	-	-	-	-
price of gasoline	DM/l	1,50	1,50	1,50	1,70	-	-	-	-
price of diesel	DM/l	1,40	1,40	1,00	1,30	-	-	-	-
bus fare for a 5 km trip	DM	0,20	0,20	0,50	2,70	0,4	0,4	0,90	2,70
metro fare for a 5 km trip	DM	-	-	-	-	-	-	-	-
taxi fare for a 5 km trip	DM	5,00	8,00	11,00	15,00	5	8	11	15
one hour parking fee in CBD	DM	-	-	1,00	2,00	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	-	-	-	-	-	-
of which for urban road	Mio. DM/a	-	-	-	-	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	-	-	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	-	-	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)		*1972*	*1982*	*1991*				*1987*	
average trips per person per day		-	-	-	3,0	-	-	-	-
modal split for all person trips									
walk	%	34%	39%	36%	26%	-	-	36%	-
bicycle	%	0%	6%	6%	10%	-	-	13%	-
public transport	%	38%	32%	22%	21%	-	-	17%	-
private motorized transport	%	22%	23%	36%	43%	-	-	34%	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	33%	38%	37%	22%	-	-	-	-
bicycle	%	6%	6%	6%	8%	-	-	-	-
public transport	%	40%	36%	26%	27%	-	-	-	-
private motorized transport	%	21%	20%	31%	43%	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	16	18	18	32	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	44	35	30	75	-	-	-	-
mean travel time to work	km	-	-	-	-	-	-	-	-
mean travel distance to work	min	-	-	-	-	-	-	-	-
vehicle kilometres travelled	km/a	-	11	12	15	-	-	-	-

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DRESDEN

		City of Dresden				Dresden Metropolitan Area			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	30	25	17	16	-	-	-	-
av. off peak hour auto speed	km/h	35	28	18	18	-	-	-	-
av. peak hour bus speed	km/h	22	23	23	20	-	-	-	-
av. off peak hour bus speed	km/h	23	24	24	22	-	-	-	-
av. metro speed	km/h	-	-	-	-	-	-	-	-
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1	-	-	-	-
number of vehicles		130	205	224	191	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	26.360	16.763	-	-	-	-
total fixed route-kilometres	km	-	-	154,6	271,5	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	8,9	12,9	13,1	11,7	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	729,0	1.455,0	1.569,0	1.032,0	-	-	-	-
passengers per year	Mio.	-	-	-	-	-	-	-	-
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1	-	-	-	-
number of vehicles		856	873	742	470	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	99.834	41.739	-	-	-	-
total fixed route-kilometres	km	312,2	266,5	280,9	242,6	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	41,0	37,7	38,2	25,8	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	3.702	4.927	8.136	2.326	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Suburban rail operation									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total train-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
all public transport									
inhabitants in traffic region	('000)	-	593,4	586,2	557,2				
total vehicle-kilometres travelled	Mio. km/a	49,8	50,7	51,3	37,5	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	1.510,0	642,0	-	-	-	-
total seat kilometres travelled	Mio. km/a	4.431,0	6.382,0	9.705,0	3.358,0	-	-	-	-
average utilisation rate (occupancy)	%	-	-	16%	19%	-	-	-	-
total ridership (number of passengers)	(`000)	-	318.000	254.249	132.345	-	-	-	-
total fixed route-kilometres	km	-	-	436	514	#WERT!	#WERT!	#WERT!	#WERT!
total fare revenues	1000 DM/a	33.871	35.772	195.006	129.495	-	-	-	-
public transport stops (total of all operating modes)		-	-	-	-	-	-	-	-
operating costs	1000 DM/a	-	-	-	-	-	-	-	-
revenues per passenger	DM	-	0,11	0,77	0,98	-	-	-	-
revenues per passenger kilometre	DM/Pkm	-	-	0,13	0,20	-	-	-	-
Taxi									
number of taxis	Mio. km/a	127	160	360	530	-	-	-	-
total taxi-kilometres	km/a	-	-	-	2,15	-	-	-	-
total ridership	(`000)	-	-	-	1400	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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FRANKFURT

		City of Frankfurt				FVV-area (1998 RMV-area) (FVV/RMV: Frankfurt integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment and Income									
Area	km^2	194,7	248,9	248,3	248,3	2.100,0	2.100,0	2.100,0	14.000,0
settled area	km^2	89,8	117,0	136,1	138,0	-	-	-	-
devoted for transport	km^2	30,8	35,1	42,8	43,2	-	-	-	-
total population	(`000)	651,1	629,2	632,5	651,1	2.400,0	2.450,0	2.480,0	5.000,0
employed population	(`000)	-	-	-	329,0	-	-	-	-
jobs	(`000)	-	-	-	561,0	1.060,0	-	-	-
per capita income	DM/a	-	-	-	-	-	-	-	-
social welfare recipients	(`000)	16,0	30,0	55,0	47,0	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	39,9	65,5	69,4	70,7	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	941,2	1.160,9	1.185,2	1.238,0	-	-	-	-
other roads	km	32,4	31,4	28,3	20,9	-	-	-	-
length of total road network	km	1.014	1.258	1.283	1.330	-	-	-	-
number of tolled bridges		-	-	-	-	-	-	-	-
juctions with signaling		-	-	-	-	-	-	-	-
Parking in the city center									
off street parking spaces		-	-	24.231	-	-	-	-	-
on street parking spaces		-	-	2.769	-	-	-	-	-
commercial parking spaces		-	-	27.000	-	-	-	-	-
Fixed track system									
metro rail tracks	km	-	-	-	-	-	-	-	-
of which, underground	km	-	11	18	19	-	-	-	-
light rail tracks/tram	km	133	136	121	116	-	-	-	159
suburban passenger rail	km	-	-	-	-	-	-	-	221
segregated busways	km	-	-	-	-	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	-	-	-	-	-	-
carbon monoxide	t/a	-	-	-	-	-	-	-	-
sulphur dioxide	t/a	-	-	-	-	-	-	-	-
hydroccarbons	t/a	-	-	-	-	-	-	-	-
nirtogen oxides	t/a	-	-	-	-	-	-	-	-
Modul 2b: Road accidents									
road accidents		26.485	22.748	23.055	15.262	-	-	-	-
injured persons		7.137	5.221	4.094	3.140	-	-	-	-
killed persons		155	72	34	21	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	187,5	243,7	302,2	299,5	-	970,0	1300,0	2500,0
motorcycle	(`000)	1,739	6,5	10,2	15,3	-	-	-	-
truck, bus, others	(`000)	18,414	19,3	21,2	26,2	-	-	-	-
all motor vehicles	(`000)	207,68	269,5	333,6	340,9	-	-	-	-
bicycles	(`000)	-	-	-	-	-	-	-	-
Module 4. Urban Transport Pricing		-							
average prices		-	-	-	-	-	-	-	-
economy car	DM	-	-	-	-	-	-	-	-
standard bus	DM	-	-	-	-	-	-	-	-
minibus	DM	-	-	-	-	-	-	-	-
bicycle	DM	-	-	-	-	-	-	-	-
price of gasoline	DM/l	0,56	1,17	1,14	1,55	-	-	-	-
price of diesel	DM/l	0,57	1,12	1,02	1,29	-	-	-	-
bus fare for a 5 km trip	DM	0,80	1,60	2,30	3,60	0,8	1,6	2,30	3,60
metro fare for a 5 km trip	DM	0,80	1,60	2,30	3,60	0,8	1,6	2,3	3,6
taxi fare for a 5 km trip	DM	-	-	-	-	-	-	-	-
one hour parking fee in CBD	DM	0,20	1,00	2,00	3,00	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	-	-	-	-	-	-
of which for urban road	Mio. DM/a	-	-	-	-	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	-	-	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	-	-	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)									
average trips per person per day		-	-	-	2,76	-	-	-	-
modal split for all person trips									
walk	%	-	-	-	30%	-	-	-	-
bicycle	%	-	-	-	6%	-	-	-	-
public transport	%	-	-	-	25%	-	-	-	-
private motorized transport	%	-	-	-	39%	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	-	-	-	-	-	-	-	-
bicycle	%	-	-	-	-	-	-	-	-
public transport	%	-	-	-	-	-	-	-	-
private motorized transport	%	-	-	-	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	-	-	-	-	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	-	-	-	-	-	-	-	-
mean travel time to work	km	-	-	-	-	-	-	-	-
mean travel distance to work	min	-	-	-	-	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-	-	-	-	-

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FRANKFURT

		City of Frankfurt				FVV-area (1998 RMV-area) (FVV/RMV: Frankfurt integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour auto speed	km/h	-	-	-	-	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	19,9	-	-	-	-
av. off peak hour bus speed	km/h	-	-	-	19,9	-	-	-	-
av. metro speed	km/h	-	-	-	27,4	-	-	-	-
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1	-	-	-	140
number of vehicles		240	232	244	268	-	-	-	2.098
maximum capacity (seated and standing (4p/m2))		16.700	17.400	18.718	18.856	-	-	-	-
total fixed route-kilometres	km	333,2	324,2	352,5	424,7	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	11,0	11,5	12,4	13,0	-	-	-	90,1
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	760,0	790,0	855,0	872,0	-	-	-	-
passengers per year	Mio.	-	-	-	-	-	-	-	-
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1	-	-	-	-
number of vehicles		544	418	375	353	-	-	-	1377
maximum capacity (seated and standing (4p/m2))		65.000	56.000	54.786	57.830	-	-	-	-
total fixed route-kilometres	km	298,4	210,8	209,5	174,1	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	25,3	22,3	22,6	22,7	-	-	-	80,65
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	3.800,0	3.300,0	3.318,0	3.690,0	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Suburban rail operation									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total train-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	32
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
all public transport									
inhabitants in traffic region	('000)	784,3	1.003,6	979,1	763,0				
total vehicle-kilometres travelled	Mio. km/a	36,3	33,7	35,0	35,7	-	-	-	-
total passenger kilometres travelled	Mio. km/a	784,0	698,0	579,0	572,0	-	-	-	-
total seat kilometres travelled	Mio. km/a	4.560,0	4.090,0	4.173,0	4.562,0	-	-	-	-
average utilisation rate (occupancy)	%	17%	17%	14%	13%	-	-	-	-
total ridership (number of passengers)	(`000)	178.524	151.585	150.791	150.181	-	-	-	570.000
total fixed route-kilometres	km	632	535	562	599	-	-	-	-
total fare revenues	1000 DM/a	74.624	136.156	213.039	313.364	-	-	-	-
public transport stops (total of all operating modes)		-	-	-	772	-	-	-	-
operating costs	1000 DM/a	-	293.300	391.000	-	-	-	-	-
revenues per passenger	DM	0,42	0,90	1,41	2,09	-	-	-	-
revenues per passenger kilometre	DM/Pkm	0,10	0,20	0,37	0,55	-	-	-	-
Taxi									
number of taxis		-	-	-	-	-	-	-	-
total taxi-kilometres	km/a	-	-	-	-	-	-	-	-
total ridership		-	-	-	-	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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FREIBURG

		City of Freiburg				RVF-area (RVF: Freiburg integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment and Income									
Area	km^2	79,9	153,0	153,0	153,0			2.211,3	221,3
settled area	km^2	27,5	37,8	42,1	46,2				
devoted for transport	km^2	10,0	12,0	14,0	15,0				
total population	(`000)	162,0	175,0	191,0	201,0			533,5	585,5
employed population	(`000)	66,0	-	73,0 [4)]	-				
jobs	(`000)	-	-	-	-				
per capita income	DM/a	-	-	-	-				
social welfare recipients	(`000)	6,0	11,0	16,0	16,0				
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	5,0	14,0	14,0	14,0				
of wich, tolled	km	-	-	-	-				
length of arterial roads	km	45,0	68,0	73,0	81,0				
other roads	km	257,0	346,0	370,0	385,0				
length of total road network	km	307,0	428,0	457,0	480,0				
number of tolled bridges		-	-	-	-				
juctions with signaling		69	138	194	203				
Parking in the city center									
off street parking spaces		3.053	4.309	3.614	3.696				
on street parking spaces		5.003	9.227	12.874	13.882				
commercial parking spaces		-	-	-	7.382				
Fixed track system									
metro rail tracks	km	-	-	-	-				
of which, underground	km	-	-	-	-				
light rail tracks/tram	km	14,5	14,0	20,1	24,1				
suburban passenger rail	km	-	-	-	-				
segregated busways	km	-	-	-	-				
Module 2a. Air Quality Module									
particulates	t/a	-	-	54 [4)]	-				
carbon monoxide	t/a	-	-	17.900 [4)]	-				
sulphur dioxide	t/a	-	-	197 [4)]	-				
hydroccarbons	t/a	-	-	2.100 [4)]	-				
nirtogen oxides	t/a	-	-	3.600 [4)]	-				
Modul 2b: Road accidents									
road accidents		4.355	5.537	4.745	4.164				
injured persons		1.322	1.454	1.125	1.213				
killed persons		30	23	10	2				
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	35,9	61,7	78,7	83,1				
motorcycle	(`000)	1,3	1,9	4,5	6,3				
truck, bus, others	(`000)	3,6	4,4	4,6	5,7				
all motor vehicles	(`000)	40,8	68,0	87,8	95,1				
bicycles	(`000)	-	-	-	-				
Module 4. Urban Transport Pricing									
average prices									
economy car	DM	-	-	-	-				
standard bus	DM	-	-	-	-				
minibus	DM	-	-	-	-				
bicycle	DM	-	-	-	-				
price of gasoline	DM/l	-	-	-	-				
price of diesel	DM/l	-	-	-	-				
bus fare for a 5 km trip	DM	-	-	-	-				
metro fare for a 5 km trip	DM	-	-	-	-				
taxi fare for a 5 km trip	DM	-	-	-	-				
one hour parking fee in CBD	DM	-	-	-	4,00				
toll for CBD entrance	DM	-	-	-	-				
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	-	-				
of which for urban road	Mio. DM/a	-	-	-	18,2				
annual O&M expenditures	Mio. DM/a	-	-	-	3				
of which, for mass transit	Mio. DM/a	-	-	-	-				
Module 6. Person Trips (mainly from O-D survey)		*1976*	*1982*	*1989*					
average trips per person per day		-	-	-	3,2				
modal split for all person trips									
walk	%	30%	35%	22%	22%				
bicycle	%	11%	15%	18%	18%				
public transport	%	15%	11%	16%	21%				
private motorized transport	%	44%	39%	44%	39%				
taxi	%	-	-	-	-				
modal split for peak-hour trips									
walk	%	-	-	-	-				
bicycle	%	-	-	-	-				
public transport	%	-	-	-	-				
private motorized transport	%	-	-	-	-				
taxi	%	-	-	-	-				
commuting trips (outgoing) per 1000 inhabitants	(`000)	2,8	-	7,5 [4)]	12,0				
commuting trips (incoming) per 1000 inhabitants	(`000)	28,5	-	43,6 [4)]	45,9				
mean travel time to work	km	-	-	-	-				
mean travel distance to work	min	-	-	-	-				
vehicle kilometres travelled	km/a	-	-	-	-				

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FREIBURG

		City of Freiburg				RVF-area (RVF: Freiburg integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-				
av. off peak hour auto speed	km/h	-	-	-	-				
av. peak hour bus speed	km/h	-	-	-	-				
av. off peak hour bus speed	km/h	-	-	-	-				
av. metro speed	km/h	-	-	-	-				
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1				
number of vehicles		68	106	93	100				
maximum capacity (seated and standing (4p/m2))		8.548	10.693	8.019	9.488				
total fixed route-kilometres	km	58,0	135,8	150,0	215,4				
total vehicle-kilometres travelled	Mio. km/a	2,8	3,8	4,0	4,6				
total passenger kilometres travelled	Mio. km/a	-	-	-	-				
total seat kilometres travelled	Mio. km/a	274,0	368,0	295,0	388,0				
passengers per year	(`000)	-	-	-	-				
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1				
number of vehicles		55	37	45	53				
maximum capacity (seated and standing (4p/m2))		6.979	5.174	6.530	10.511				
total fixed route-kilometres	km	24,9	23,5	36,9	34,8				
total vehicle-kilometres travelled	Mio. km/a	1,7	1,3	1,9	2,4				
total passenger kilometres travelled	Mio. km/a	-	-	-	-				
total seat kilometres travelled	Mio. km/a	225	197	277	486				
passengers per year		-	-	-	-				
Rail operation (subway)									
number of operators		-	-	-	-				
number of vehicles		-	-	-	-				
maximum capacity (seated and standing (4p/m2))		-	-	-	-				
total fixed route-kilometres	km	-	-	-	-				
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-				
total passenger kilometres travelled	Mio. km/a	-	-	-	-				
total seat kilometres travelled	Mio. km/a	-	-	-	-				
passengers per year		-	-	-	-				
Suburban rail operation									
number of operators		-	-	-	-				
number of vehicles		-	-	-	-				
maximum capacity (seated and standing (4p/m2))		-	-	-	-				
total fixed route-kilometres	km	-	-	-	-				
total train-kilometres travelled	Mio. km/a	-	-	-	-				
total passenger kilometres travelled	Mio. km/a	-	-	-	-				
total seat kilometres travelled	Mio. km/a	-	-	-	-				
passengers per year		-	-	-	-				
all public transport									
inhabitants in traffic region	('000)	177,0	199,6	208,8	203,1				
total vehicle-kilometres travelled	Mio. km/a	4,5	5,1	5,8	7,0				
total passenger kilometres travelled	Mio. km/a	105,0	125,0	176,0	221,0				
total seat kilometres travelled	Mio. km/a	499,0	565,0	572,0	874,0				2.857,0
average utilisation rate (occupancy)	%	21%	22%	31%	25%				
total ridership (number of passengers)	(`000)	32.106	31.222	45.044	64.186			64.390	94.920
total fixed route-kilometres	km	83	159	187	250	0	0	0	0
total fare revenues	1000 DM/a	11.256	22.883	39.137	71.797				
public transport stops (total of all operating modes)		-	-	-	-				
operating costs	1000 DM/a	-	-	-	-				
revenues per passenger	DM	0,35	0,73	0,87	1,12				
revenues per passenger kilometre	DM/Pkm	0,11	0,18	0,22	0,32				
Taxi									
number of taxis		-	201	201	206				
total taxi-kilometres	km/a	-	-	-	-				
total ridership		-	-	-	-				

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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HAMBURG

		City of Hamburg				HVV-area (HVV: Hamburg integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1996
Module 1. Area, Population, Employment and Income									
Area	km^2	753,2	754,7	755,3	755,5 2)	3.000,0	3.000,0	3.000,0	3.000,0
settled area	km^2	362,3	421,8	436,5	446,4 2)	-	-	-	-
devoted for transport	km^2	77,9	82,5	87,5	88,2 2)	-	-	-	-
total population	(`000)	1.793,6	1.645,1	1.652,4	1.700,1	2.480,0	2.440,0	2.470,0	2.600,0
employed population	(`000)	828,0	748,0	754,0	787,0	-	-	-	-
jobs	(`000)	-	767,0	749,0	731,0	-	-	-	-
per capita income	DM/a	-	-	-	-	-	-	-	-
social welfare recipients	(`000)	-	-	-	141,0	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	35,0	58,0	79,0	82,0	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	157,0	257,0	845,0	833,0	-	-	-	-
other roads	km	3.588,0	3.415,0	2.967,0	3.021,0	-	-	-	-
length of total road network	km	3.780	3.730	3.891	3.936	-	-	-	-
number of tolled bridges		-	1	1	1	-	-	-	-
juctions with signaling		539	878	1.049	1.101	-	-	-	-
Parking in the city center						-	-	-	-
off street parking spaces		12.600	13.700	12.800	14.700	-	-	-	-
on street parking spaces		7.500	6.000	6.400	6.100	-	-	-	-
commercial parking spaces		7.600	8.000	7.900	9.700	-	-	-	-
Fixed track system									
metro rail tracks	km	88,5	89,4	95,6	98,0	88,5	89,4	95,6	98,0
of which, underground	km	-	-	-	-	-	-	-	-
light rail tracks/tram	km	82,7	-	-	-	-	-	-	-
suburban passenger rail	km	-	-	-	-	190,0	196,0	198,0	200,0
segregated busways	km	-	-	-	40,0	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	380	-	-	-	-	-
carbon monoxide	t/a	-	-	91.800	-	-	-	-	-
sulphur dioxide	t/a	-	-	850	-	-	-	-	-
hydroccarbons	t/a	-	-	17.100	-	-	-	-	-
nirtogen oxides	t/a	-	-	16.900	-	-	-	-	-
Modul 2b: Road accidents									
road accidents		35.412	51.228	65.723	56.327	-	-	-	-
injured persons		17.307	14.254	14.464	12.178	-	-	-	-
killed persons		379	207	105	45	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	433,0	567,0	679,0	712,0	-	-	-	-
motorcycle	(`000)	3,3	13,2	20,4	37,2	-	-	-	-
truck, bus, others	(`000)	35,9	38,6	37,8	45,8	-	-	-	-
all motor vehicles	(`000)	472,2	618,8	737,2	795,0	-	-	-	-
bicycles	(`000)	-	-	-	-	-	-	-	-
Module 4. Urban Transport Pricing									
average prices									
economy car	DM	-	-	-	-	-	-	-	-
standard bus	DM	-	-	-	-	-	-	-	-
minibus	DM	-	-	-	-	-	-	-	-
bicycle	DM	-	-	-	-	-	-	-	-
price of gasoline	DM/l	0,56	1,17	1,14	1,55	-	-	-	-
price of diesel	DM/l	0,57	1,12	1,02	1,29	-	-	-	-
bus fare for a 5 km trip	DM	0,60	1,20	2,10	2,70	-	-	-	-
metro fare for a 5 km trip	DM	0,60	1,20	2,10	2,70	-	-	-	-
taxi fare for a 5 km trip	DM	-	-	-	14,00	-	-	-	-
one hour parking fee in CBD	DM	0,10	0,50	2,00	4,00	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport		-	-	-	-	-	-	-	-
annual capital outlays	Mio. DM/a	219,2	219,7	145,6	110,3	-	-	-	-
of which for urban road	Mio. DM/a	118,8	1383,7	105,5	102,2	-	-	-	-
annual O&M expenditures	Mio. DM/a	26,8	55,7	36,7	31,1	-	-	-	-
of which, for mass transit	Mio. DM/a	60,1	240,8	376,4	428	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)		*1978*	*1982*	*1991*					
average trips per person per day		2,9	2,9	2,9	-	-	-	-	-
modal split for all person trips									
walk	%	38%	31%	22%	-	-	-	-	-
bicycle	%	8%	9%	12%	-	-	-	-	-
public transport	%	22%	22%	21%	-	-	-	-	-
private motorized transport	%	32%	39%	45%	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	-	-	16%	-	-	-	-	-
bicycle	%	-	-	14%	-	-	-	-	-
public transport	%	-	-	28%	-	-	-	-	-
private motorized transport	%	-	-	42%	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	18	42	52	59	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	135	207	242	269	-	-	-	-
mean travel time to work	km	-	-	-	-	-	-	-	-
mean travel distance to work	min	-	-	45	-	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-	-	-	-	-

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HAMBURG

		City of Hamburg				HVV-area (HVV: Hamburg integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1996
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour auto speed	km/h	-	-	-	28	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. metro speed	km/h	-	-	-	-	-	-	-	-
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1	4	5	4	4
number of vehicles		794	1.017	861	789	1.118	1.392	1.341	1.275
maximum capacity (seated and standing (4p/m2))		48.600 6)	67.400 6)	63.700 6)	62.781	87.549	123.770	127.118	-
total fixed route-kilometres	km	2.108,6	2.436,3	1.877,9	1.642,4	2.261,4	2.565,7	2.912,4	3.085,1
total vehicle-kilometres travelled	Mio. km/a	44,9	54,2	45,9	42,4	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	964,2	1.259,4	894,4	877,3
total seat kilometres travelled	Mio. km/a	2.242,0 6)	3.750,0 6)	3.377,0 6)	3.438,2	3.262,6	5.060,7	4.817,7	5.573,6
passengers per year	Mio.	-	-	-	-	-	-	-	260,3
Rail operation (Light Rail, Tram)									
number of operators		1	-	-	-	1	-	-	-
number of vehicles		285	-	-	-	285	-	-	-
maximum capacity (seated and standing (4p/m2))		32.097	-	-	-	32.097	-	-	-
total fixed route-kilometres	km	123,6	-	-	-	123,6	-	-	-
total vehicle-kilometres travelled	Mio. km/a	13,279	-	-	-	13,279	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	1475	-	-	-	1475	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		1	1	1	1	1	1	1	1
number of vehicles		812	835	887	807	812	835	887	807
maximum capacity (seated and standing (4p/m2))		72.000 6)	74.000 6)	79.500 6)	76.381	72.000	74.000	79.500	76.381
total fixed route-kilometres	km	102,5	89,4	95,6	100,7	102,5	89,4	95,6	100,7
total vehicle-kilometres travelled	Mio. km/a	54,8	50,8	50,7	61,9	54,8	50,8	50,7	61,9
total passenger kilometres travelled	Mio. km/a	-	-	-	-	1.069,5	978,6	955,3	-
total seat kilometres travelled	Mio. km/a	4.860,9 6)	4.548,8 6)	4.586,0 6)	5.797,0	4.860,9	4.548,8	4.586,0	5.797,0
passengers per year		-	-	-	-	-	-	-	169,1
Suburban rail operation									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	504	575	615	646
maximum capacity (seated and standing (4p/m2))		-	-	-	-	108895	124457	135833	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total train-kilometres travelled	Mio. km/a	-	-	-	-	9,91	11,02	12,88	14,6
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	1795
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	11638,1
passengers per year		-	-	-	-	142,7	142,7	152,4	179,6
all public transport									
inhabitants in traffic region	('000)	2.379,0	1.740,0	1.793,4	1.867,0				
total vehicle-kilometres travelled	Mio. km/a	113,0	105,0	96,5	104,3	-	-	-	205,3
total passenger kilometres travelled	Mio. km/a	2.031,0	1.983,0	1.629,0	1.572,0	3.808,2	3.663,8	3.398,5	3.684,7
total seat kilometres travelled	Mio. km/a	8.577,9 6)	8.298,8 6)	7.963,0 6)	9.235,2	-	-	-	22.915,6
average utilisation rate (occupancy)	%	24%	24%	20%	17%	-	-	-	16%
total ridership (number of passengers)	(`000)	322.579	329.066	317.375	302.913	-	-	-	-
total fixed route-kilometres	km	2.335	2.526	1.974	1.743	-	-	-	-
total fare revenues	1000 DM/a	169.045	283.528	376.319	438.892	-	-	-	674.800
public transport stops (total of all operating modes)		2.496	2.682	2.882	3.138	-	-	-	-
operating costs	1000 DM/a	-	-	-	-	-	-	-	-
revenues per passenger	DM	0,52	0,86	1,19	1,45	-	-	-	#WERT!
revenues per passenger kilometre	DM/Pkm	0,08	0,14	0,23	0,28	-	-	-	0,18
Taxi									
number of taxis		-	-	-	-	-	-	-	-
total taxi-kilometres	km/a	-	-	-	-	-	-	-	-
total ridership		-	-	-	-	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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KARLSRUHE

		City of Karlsruhe				KVV-area (KVV: Karlsruhe integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment and Income									
Area	km^2	122,8	173,5	173,4	173,5	-	-	-	3.323,4 2)
settled area	km^2	52,6	69,2	74,2	82,6	-	-	-	-
devoted for transport	km^2	15,2	19,1	20,5	22,2	-	-	-	-
total population	(`000)	258,9	269,8	270,3	264,6	1.085,6	1.100,8	1.150,2	1.235,5
employed population	(`000)	128,4	-	114,8 4)	-	-	-	-	-
jobs	(`000)	166,6	175,0	184,7	170,9 1)	-	-	-	-
per capita income	DM/a	-	-	-	-	-	-	-	-
social welfare recipients	(`000)	-	11,9	20,7	20,8 2)	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	-	0,0	20,5	20,5	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	-	16,2 3)	18,9	20,4	-	-	-	-
other roads	km	-	639,1 3)	633,0	679,8	-	-	-	-
length of total road network	km	-	655,3	672,4	720,7	-	-	-	-
number of tolled bridges		-	-	-	-	-	-	-	-
juctions with signaling		-	-	-	-	-	-	-	-
Parking in the city center									
off street parking spaces		-	-	-	-	-	-	-	-
on street parking spaces		-	-	-	-	-	-	-	-
commercial parking spaces		-	-	-	-	-	-	-	-
Fixed track system									
metro rail tracks	km	-	-	-	-	-	-	-	-
of which, underground	km	-	-	-	-	-	-	-	-
light rail tracks/tram	km	-	-	-	-	-	-	-	-
suburban passenger rail	km	-	-	-	-	-	-	-	-
segregated busways	km	-	-	-	-	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	168	158 5)	-	-	-	-
carbon monoxide	t/a	-	-	19.353	11.507 5)	-	-	-	-
sulphur dioxide	t/a	-	-	335	298 5)	-	-	-	-
hydroccarbons	t/a	-	-	2.465	1.451 5)	-	-	-	-
nirtogen oxides	t/a	-	-	5.415	4.419 5)	-	-	-	-
Modul 2b: Road accidents									
road accidents		7.698	9.687	10.313	7.156 1)	-	-	-	-
injured persons		1.907	2.090	1.741	1.499	-	-	-	-
killed persons		48	40	11	19	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	71,1	104,9	128,0	135,5	-	442,3	597,1	670,2
motorcycle	(`000)	1,1	4,5	5,9	9,7	-	22,2	29,8	52,8
truck, bus, others	(`000)	6,5	8,3	10,6	13,2	-	77,1	66,8	76,3
all motor vehicles	(`000)	78,7	117,8	144,4	158,5	-	541,6	693,7	799,3
bicycles	(`000)	-	-	-	-	-	-	-	-
Module 4. Urban Transport Pricing									
average prices									
economy car	DM	-	10.955	17.460	25.700	-	-	-	-
standard bus	DM	-	-	-	-	-	-	-	-
minibus	DM	-	-	-	-	-	-	-	-
bicycle	DM	-	-	-	-	-	-	-	-
price of gasoline	DM/l	-	-	-	1,50	-	-	-	-
price of diesel	DM/l	-	-	-	1,10	-	-	-	-
bus fare for a 5 km trip	DM	-	-	2,00	3,00	-	-	-	-
metro fare for a 5 km trip	DM	-	-	-	-	-	-	-	-
taxi fare for a 5 km trip	DM	-	-	12,60	18,00	-	-	-	-
one hour parking fee in CBD	DM	-	-	-	4,00	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	-	-	-	-	-	-
of which for urban road	Mio. DM/a	-	-	-	-	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	-	-	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	-	-	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)				*1992*					
average trips per person per day		-	-	-	-	-	-	-	-
modal split for all person trips									
walk	%	-	-	23%	-	-	-	-	-
bicycle	%	-	-	17%	-	-	-	-	-
public transport	%	-	-	16%	-	-	-	-	-
private motorized transport	%	-	-	44%	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	-	-	-	-	-	-	-	-
bicycle	%	-	-	-	-	-	-	-	-
public transport	%	-	-	-	-	-	-	-	-
private motorized transport	%	-	-	-	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	6,7	-	13,6 4)	-	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	58,8	-	84,8 4)	-	-	-	-	-
mean travel time to work	km	-	-	-	-	-	-	-	-
mean travel distance to work	min	-	-	-	-	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-	-	-	-	-

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KARLSRUHE

		City of Karlsruhe				KVV-area (KVV: Karlsruhe integrated transport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour auto speed	km/h	-	-	-	-	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. metro speed	km/h	-	-	-	-	-	-	-	-
Bus operation									
number of operators		1	1	1	1	-	-	-	-
number of vehicles		66	98	100	99	-	-	-	-
maximum capacity (seated and standing (4p/m2))		5.318	8.429	6.567	7.018	-	-	-	-
total fixed route-kilometres	km	241,2	267,4	254,4	291,3	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	2,4	3,8	4,2	4,0	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	197,0	305,0	260,0	288,0	-	-	-	-
passengers per year	Mio.	-	-	-	-	-	-	-	-
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1	-	-	-	-
number of vehicles		137	103	141	206	-	-	-	-
maximum capacity (seated and standing (4p/m2))		20.603	19.633	23.116	-	-	-	-	-
total fixed route-kilometres	km	79,3	75,2	78,7	104,1	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	5,727	5,326	5,664	7,661	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	934	1.027	917	1.479	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Suburban rail operation									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total train-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
all public transport									
inhabitants in traffic region	('000)	315,1	316,2	338,9	308,6				
total vehicle-kilometres travelled	Mio. km/a	8,2	9,1	9,8	11,7	-	-	-	-
total passenger kilometres travelled	Mio. km/a	190,0	211,0	272,0	364,0	-	-	-	-
total seat kilometres travelled	Mio. km/a	1.131,0	1.332,0	1.177,0	1.767,0	-	-	-	-
average utilisation rate (occupancy)	%	17%	16%	23%	21%	-	-	-	-
total ridership (number of passengers)	(`000)	53.588	52.468	69.534	83.305	-	-	-	-
total fixed route-kilometres	km	321	343	333	395	-	-	-	-
total fare revenues	1000 DM/a	18.632	37.440	57.740	89.171	-	-	-	-
public transport stops (total of all operating modes)		-	-	-	-	-	-	-	-
operating costs	1000 DM/a	-	-	-	-	-	-	-	-
revenues per passenger	DM	0,35	0,71	0,83	1,07	-	-	-	-
revenues per passenger kilometre	DM/Pkm	0,10	0,18	0,21	0,24	-	-	-	-
Taxi									
number of taxis		154	198	216	215	-	-	-	-
total taxi-kilometres	km/a	-	-	-	-	-	-	-	-
total ridership		-	-	-	-	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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MUENSTER

		City of Muenster			
		1970	1980	1990	1998
Module 1. Area, Population, Employment and Income					
Area	km^2	74,0	302,1	302,3	302,2
settled area	km^2	34,9	75,8	72,2	80,8
devoted for transport	km^2	9,3	20,5	22,1	24,7
total population	(`000)	203,6	267,4	275,2	279,2
employed population	(`000)	-	-	-	-
jobs	(`000)	-	102,0	115,0	120,0
per capita income	DM/a	-	-	-	-
social welfare recipients	(`000)	6,0	9,0	11,0	15,0
Module 2. Urban Transport Infrastructure					
Road Network					
length of expressways	km	-	-	-	29,5
of wich, tolled	km	-	-	-	-
length of arterial roads	km	-	-	-	144,4
other roads	km	-	-	-	1.295,0
length of total road network	km	-	-	-	1.324,5
number of tolled bridges		-	-	-	-
juctions with signaling		-	-	-	-
Parking in the city center					
off street parking spaces		-	-	-	-
on street parking spaces		-	-	-	-
commercial parking spaces		-	-	-	-
Fixed track system					
metro rail tracks	km	-	-	-	-
of which, underground	km	-	-	-	-
light rail tracks/tram	km	-	-	-	-
suburban passenger rail	km	-	-	-	-
segregated busways	km	-	-	-	-
Module 2a. Air Quality Module					
particulates	t/a	-	-	-	-
carbon monoxide	t/a	-	-	-	-
sulphur dioxide	t/a	-	-	-	-
hydroccarbons	t/a	-	-	-	-
nirtogen oxides	t/a	-	-	-	-
Modul 2b: Road accidents					
road accidents		5.564	7.302	7.829	8.471
injured persons		1.807	2.102	1.809	1.545
killed persons		32	41	23	9
Module 3. Vehicle Ownership					
number of passenger cars and van	(`000)	46,2	93,4	115,1	126,9
motorcycle	(`000)	1,1	2,8	4,4	9,4
truck, bus, others	(`000)	3,5	5,6	5,9	7,6
all motor vehicles	(`000)	50,9	101,8	125,5	143,9
bicycles	(`000)	-	-	-	-
Module 4. Urban Transport Pricing					
average prices					
economy car	DM	-	-	-	-
standard bus	DM	-	-	-	-
minibus	DM	-	-	-	-
bicycle	DM	-	-	-	-
price of gasoline	DM/l	0,56	1,17	1,140	1,55
price of diesel	DM/l	0,57	1,12	1,020	1,29
bus fare for a 5 km trip	DM	-	-	-	-
metro fare for a 5 km trip	DM	-	-	-	-
taxi fare for a 5 km trip	DM	-	-	-	-
one hour parking fee in CBD	DM	-	-	-	-
toll for CBD entrance	DM	-	-	-	-
Module 5. Public Financing for Urban Transport					
annual capital outlays	Mio. DM/a	-	-	-	-
of which for urban road	Mio. DM/a	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)			*1982*	*1990*	*1994*
average trips per person per day		-	3,47	3,61	3,53
modal split for all person trips					
walk	%	-	25,0%	21,2%	21,5%
bicycle	%	-	29,2%	33,9%	31,7%
public transport	%	-	6,6%	6,6%	9,5%
private motorized transport	%	-	39,2%	38,3%	37,3%
taxi	%	-	-	-	-
modal split for peak-hour trips					
walk	%	-	-	-	-
bicycle	%	-	-	-	-
public transport	%	-	-	-	-
private motorized transport	%	-	-	-	-
taxi	%	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	-	-	-	-
mean travel time to work	km	-	-	-	-
mean travel distance to work	min	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-

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MUENSTER

		City of Muenster			
		1970	1980	1990	1998
Module 7. Traffic Performace Indicators					
average paek hour auto speed	km/h	-	-	-	-
av. off peak hour auto speed	km/h	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	-
av. off peak hour bus speed	km/h	-	-	-	-
av. metro speed	km/h	-	-	-	-
Module 8. Public Transport Operations					
Bus operation					
number of operators		1	1	1	1
number of vehicles		107	130	129	152
maximum capacity (seated and standing (4p/m2))		10.158	13.178	15.028	14.760
total fixed route-kilometres	km	188,6	292,8	457,1	433,5
total vehicle-kilometres travelled	Mio. km/a	4,7	6,1	6,1	8,2
total passenger kilometres travelled	Mio. km/a	82,0	80,0	126,0	209,0
total seat kilometres travelled	Mio. km/a	455,0	607,0	600,0	827,0
passengers per year	(`000)	21837	19371	18939	33344
Rail operation (Light Rail, Tram)					
number of operators		-	-	-	-
number of vehicles		-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-
total fixed route-kilometres	km	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-
passengers per year		-	-	-	-
Rail operation (subway)					
number of operators		-	-	-	-
number of vehicles		-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-
total fixed route-kilometres	km	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-
passengers per year		-	-	-	-
Suburban rail operation					
number of operators		-	-	-	-
number of vehicles		-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-
total fixed route-kilometres	km	-	-	-	-
total train-kilometres travelled	Mio. km/a	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-
passengers per year		-	-	-	-
all public transport					
inhabitants in traffic region	('000)	233,0	267,4	275,1	279,2
total vehicle-kilometres travelled	Mio. km/a	4,7	6,1	6,1	8,2
total passenger kilometres travelled	Mio. km/a	82,0	80,0	126,0	209,0
total seat kilometres travelled	Mio. km/a	455,0	607,0	600,0	827,0
average utilisation rate (occupancy)	%	18%	13%	21%	25%
total ridership (number of passengers)	(`000)	21.837	19.371	18.939	33.344
total fixed route-kilometres	km	189	293	457	434
total fare revenues	1000 DM/a	9.397	19.967	22.306	38.454
public transport stops (total of all operating modes)		-	-	-	-
operating costs	1000 DM/a	-	-	-	-
revenues per passenger	DM	0,43	1,03	1,18	1,15
revenues per passenger kilometre	DM/Pkm	0,11	0,25	0,18	0,18
Taxi					
number of taxis		-	-	-	-
total taxi-kilometres	km/a	-	-	-	-
total ridership		-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capaci

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MUNICH

		City of Munich				MVV-area (MVV: Munich integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1996
Module 1. Area, Population, Employment and Income									
Area	km^2	310,5	310,4	310,5	310,5	4.750,0	5.270,0	5.500,0	5.500,0
settled area	km^2	192,2	225,1	237,9	239,4	-	-	-	-
devoted for transport	km^2	41,8	42,6	48,1	51,1	-	-	-	-
total population	(`000)	1.359,4	1.298,7	1.270,6	1.206,0	2.180,0	2.200,0	2.300,0	2.424,0
employed population	(`000)	-	-	-	-	-	-	-	-
jobs	(`000)	-	-	-	-	-	-	-	-
per capita income	DM/a	-	-	-	23.000,0	-	-	-	-
social welfare recipients	(`000)	-	-	-	44,0	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	-	-	59,7	65,0	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	-	-	158,1	159,0	-	-	-	-
other roads	km	-	-	2.049,8	2.059,8	-	-	-	-
length of total road network	km	-	2.167	2.267,6	2.283,8	-	-	-	-
number of tolled bridges		-	-	-	-	-	-	-	-
juctions with signaling		-	-	-	-	-	-	-	-
Parking in the city center									
off street parking spaces		-	-	-	-	-	-	-	-
on street parking spaces		-	-	-	-	-	-	-	-
commercial parking spaces		-	-	-	-	-	-	-	-
Fixed track system									
metro rail tracks	km	0	16	57	78	-	-	-	-
of which, underground	km	-	-	-	-	-	-	-	-
light rail tracks/tram	km	119	105	85	71	-	-	-	-
suburban passenger rail	km	-	-	-	-	-	-	-	443
segregated busways	km	-	-	-	-	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	-	-	-	-	-	-
carbon monoxide	t/a	-	-	-	-	-	-	-	-
sulphur dioxide	t/a	-	-	-	-	-	-	-	-
hydroccarbons	t/a	-	-	-	-	-	-	-	-
nirtogen oxides	t/a	-	-	-	-	-	-	-	-
Modul 2b: Road accidents									
road accidents		45.946	43.924	51.454	40.666	-	-	-	-
injured persons		12.118	10.143	8.302	7.125	-	-	-	-
killed persons		246	117	56	31	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	327,3	468,6	594,6	685,5	680,0	1012,0	1183,0	1368,2
motorcycle	(`000)	-	13,7	27,0	41,0	-	-	-	-
truck, bus, others	(`000)	-	54,7	67,4	53,5	-	-	-	-
all motor vehicles	(`000)	375,1	537,0	689,0	780,0	-	-	-	-
bicycles	(`000)	-	-	-	-	-	-	-	-
Module 4. Urban Transport Pricing									
average prices		-	-	-	-	-	-	-	-
economy car	DM	-	-	-	-	-	-	-	-
standard bus	DM	-	-	-	-	-	-	-	-
minibus	DM	-	-	-	-	-	-	-	-
bicycle	DM	-	-	-	-	-	-	-	-
price of gasoline	DM/l	-	-	-	-	-	-	-	-
price of diesel	DM/l	-	-	-	-	-	-	-	-
bus fare for a 5 km trip	DM	-	2,00	2,40	3,60	-	-	-	-
metro fare for a 5 km trip	DM	-	2,00	2,40	3,60	-	-	-	-
taxi fare for a 5 km trip	DM	-	-	-	-	-	-	-	-
one hour parking fee in CBD	DM	-	-	-	5,00	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	-	-	-	-	-	-
of which for urban road	Mio. DM/a	-	-	-	-	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	-	-	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	-	-	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)		*1976*	*1982*	*1989*	*1997*				
average trips per person per day		-	-	-	-	-	-	-	-
modal split for all person trips									
walk	%	31%	29%	24%	22%	-	-	-	-
bicycle	%	6%	10%	12%	13%	-	-	-	-
public transport	%	19%	22%	24%	24%	-	-	-	-
private motorized transport	%	44%	39%	40%	41%	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	-	-	-	-	-	-	-	-
bicycle	%	-	-	-	-	-	-	-	-
public transport	%	-	-	-	-	-	-	-	-
private motorized transport	%	-	-	-	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	19	-	57 4)	-	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	153	-	290 4)	-	-	-	-	-
mean travel time to work	km	-	-	-	-	-	-	-	-
mean travel distance to work	min	-	-	47	-	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-	-	-	-	-

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MUNICH

		City of Munich				MVV-area (MVV: Munich integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1996
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour auto speed	km/h	-	-	-	-	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. metro speed	km/h	-	-	-	-	-	-	-	-
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1	-	-	-	50
number of vehicles		474	784	822	523	-	-	-	-
maximum capacity (seated and standing (4p/m2))		55.303 6)	65.487	51.174	42.314	36.090	51.929	-	-
total fixed route-kilometres	km	819,4	530,7	613,7	687,2	1.173,4	2.424,6	4.228,0	4.287,2
total vehicle-kilometres travelled	Mio. km/a	25,6	34,2	35,6	30,7	32,6	35,7	42,6	48,2
total passenger kilometres travelled	Mio. km/a	-	-	-	210,0	404,0	560,0	702,0	614,1
total seat kilometres travelled	Mio. km/a	2.504,0 6)	2.805,0	2.309,0	2.334,0	2.251,0	2.584,0	3.117,0	3.572,0
passengers per year	Mio.	-	-	-	-	-	-	-	-
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1	1	1	1	1
number of vehicles		861	513	287	131	574	513	287	131
maximum capacity (seated and standing (4p/m2))		61.200 6)	35.638	24.978	17.800	37.854	35.638	24.978	17.800
total fixed route-kilometres	km	214,7	163,7	114,0	94,2	187,6	163,7	114	94,2
total vehicle-kilometres travelled	Mio. km/a	42,5	27,4	16,8	8,8	17,296	27,39	16,803	8,778
total passenger kilometres travelled	Mio. km/a	-	-	-	453,507	623	570	270	210
total seat kilometres travelled	Mio. km/a	3.400 6)	2.285	1.432	1.233	2.865	2.285	1.432	1.233
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		-	1	1	1	-	1	1	1
number of vehicles		-	250	466	508	-	250	466	508
maximum capacity (seated and standing (4p/m2))		-	36.250	67.570	73.660	-	36.250	67.570	73.660
total fixed route-kilometres	km	-	23,0	83,6	98,9	-	23,0	83,6	98,9
total vehicle-kilometres travelled	Mio. km/a	-	14,7	40,1	50,6	-	14,7	40,1	50,6
total passenger kilometres travelled	Mio. km/a	-	-	-	1.272,6	-	-	-	1.272,6
total seat kilometres travelled	Mio. km/a	-	3.056,0	5.749,0	7.331,0	-	3.056,0	5.749,0	7.331,0
passengers per year		-	-	-	-	-	-	-	-
Suburban rail operation									
number of operators		-	-	-	-	1	1	1	1
number of vehicles		-	-	-	-	140	162	189	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	53.312	64.064	-	-
total fixed route-kilometres	km	-	-	-	-	507,5	507,5	488,8	518,5
total train-kilometres travelled	Mio. km/a	-	-	-	-	12,074	12,203	14,303	18,318
total passenger kilometres travelled	Mio. km/a	-	-	-	-	1.915	2.041	2.863	2.944
total seat kilometres travelled	Mio. km/a	-	-	-	-	8.320	9.053	9.006	-
passengers per year		-	-	-	-	-	-	-	-
all public transport									
inhabitants in traffic region	('000)	1.442,7	1.378,7	1.350,6	1.274,9				
total vehicle-kilometres travelled	Mio. km/a	68,1	76,3	92,6	90,1	29,4	54,3	71,2	77,7
total passenger kilometres travelled	Mio. km/a	1.544,0	1.417,0	1.809,0	1.946,0	3.231,0	3.534,0	4.845,9	5.039,0
total seat kilometres travelled	Mio. km/a	3.400,0	5.341,0	7.181,0	8.564,0	14.691,0	14.394,0	16.187,0	-
average utilisation rate (occupancy)	%	45%	27%	25%	23%	22%	25%	30%	-
total ridership (number of passengers)	(`000)	271.192	340.657	401.316	427.735	404.960	451.291	507.213	593.697
total fixed route-kilometres	km	1.034	717	811	880	1.869	3.119	4.914	4.999
total fare revenues	1000 DM/a	139.360	236.306	389.717	516.454	259.785	420.294	572.848	808.267
public transport stops (total of all operating modes)		-	-	-	-	-	-	-	-
operating costs	1000 DM/a	-	-	-	-	-	-	-	-
revenues per passenger	DM	0,51	0,69	0,97	1,21	0,64	0,93	1,13	1,36
revenues per passenger kilometre	DM/Pkm	0,09	0,17	0,22	0,27	0,08	0,12	0,12	0,16
Taxi									
number of taxis		-	-	-	-	-	-	-	-
total taxi-kilometres	km/a	-	-	-	-	-	-	-	-
total ridership		-	-	-	-	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

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ZURICH

		City of Zurich				ZVV-area (ZVV: Zurich integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 1. Area, Population, Employment and Income									
Area	km^2	91,7	92,1	91,6	91,9	-	-	1.728,6	1.728,9
settled area	km^2	43,2	47,2	48,5	49,5	-	-	-	-
devoted for transport	km^2	10,3	12,0	12,6	12,5	-	-	-	-
total population	(`000)	423,0	369,5	365,0	359,1	-	-	1.179,0	1.178,4
employed population	(`000)	228,0	195,0	201,0	-	-	-	687,8	700,3
jobs	(`000)	-	239,0	314,0	317,0	-	-	61,5	67,2
per capita income	DM/a	-	-	-	-	-	-	-	-
social welfare recipients	(`000)	3,0	3,0	7,0	10,0	-	-	-	-
Module 2. Urban Transport Infrastructure									
Road Network									
length of expressways	km	-	-	-	13,8	-	-	-	-
of wich, tolled	km	-	-	-	-	-	-	-	-
length of arterial roads	km	-	-	-	167,1	-	-	-	-
other roads	km	-	-	-	554,1	-	-	-	-
length of total road network	km	-	-	-	-	-	-	-	-
number of tolled bridges		-	-	-	-	-	-	-	-
juctions with signaling		385	385	385	385	-	-	-	-
Parking in the city center									
off street parking spaces		-	147.340	198.187	218.871	-	-	-	-
on street parking spaces		-	56.898	60.095	59.387	-	-	-	-
commercial parking spaces		-	15.645	22.599	54.884	-	-	-	-
Fixed track system									
metro rail tracks	km	-	-	-	-	-	-	-	-
of which, underground	km	-	-	-	-	-	-	-	-
light rail tracks/tram	km	59,5	-	68,5	-	-	-	-	-
suburban passenger rail	km	-	-	-	-	-	-	-	660
segregated busways	km	-	-	-	21,5	-	-	-	-
Module 2a. Air Quality Module									
particulates	t/a	-	-	-	-	-	-	-	-
carbon monoxide	t/a	-	-	19.000	8.800	-	-	-	-
sulphur dioxide	t/a	-	-	110	53	-	-	-	-
hydroccarbons	t/a	-	-	4.000	1.600	-	-	-	-
nirtogen oxides	t/a	-	-	2.950	1.850	-	-	-	-
Modul 2b: Road accidents									
road accidents		-	7.990	6.280	5.568	-	-	-	-
injured persons		-	1.710	1.327	1.320	-	-	-	-
killed persons		-	43	19	9	-	-	-	-
Module 3. Vehicle Ownership									
number of passenger cars and van	(`000)	109,6	127,5	136,9	136,3	-	-	512,4	564,5
motorcycle	(`000)	4,8	6,1	11,1	13,6	-	-	48,8	66,5
truck, bus, others	(`000)	9,5	10,6	12,6	12,5	-	-	64,3	69,4
all motor vehicles	(`000)	123,9	144,2	160,6	162,3	-	-	625,5	700,3
bicycles	(`000)	49.952	68.857	120.000	-	-	-	-	-
Module 4. Urban Transport Pricing									
average prices									
economy car	DM	6.752	15.204	26.016	34.636	-	-	-	-
standard bus	DM	-	-	-	-	-	-	-	-
minibus	DM	-	-	-	-	-	-	-	-
bicycle	DM	422	760	976	1.361	-	-	-	-
price of gasoline	DM/l	0,52	1,30	1,27	1,51	-	-	-	-
price of diesel	DM/l	-	1,28	1,27	1,51	-	-	-	-
bus fare for a 5 km trip	DM	-	-	2,17	4,45	-	-	-	-
metro fare for a 5 km trip	DM	-	-	-	-	-	-	-	-
taxi fare for a 5 km trip	DM	5,06	14,12	19,51	27,21	-	-	-	-
one hour parking fee in CBD	DM	-	0,54	1,08	2,47	-	-	-	-
toll for CBD entrance	DM	-	-	-	-	-	-	-	-
Module 5. Public Financing for Urban Transport									
annual capital outlays	Mio. DM/a	-	-	202,708	61,1078	-	-	-	-
of which for urban road	Mio. DM/a	-	-	136,584	45,769	-	-	-	-
annual O&M expenditures	Mio. DM/a	-	-	48,5632	42,5528	-	-	-	-
of which, for mass transit	Mio. DM/a	-	-	83,7932	118,2572	-	-	-	-
Module 6. Person Trips (mainly from O-D survey)			*1984*	*1989*	*1992*				
average trips per person per day		-	-	-	-	-	-	-	-
modal split for all person trips									
walk	%	-	29,0%	25,0%	28,0%	-	-	-	-
bicycle	%	-	5,0%	7,0%	7,0%	-	-	-	-
public transport	%	-	32,0%	32,0%	37,0%	-	-	-	-
private motorised transport	%	-	34,0%	36,0%	28,0%	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
modal split for peak-hour trips									
walk	%	-	-	-	-	-	-	-	-
bicycle	%	-	-	-	-	-	-	-	-
public transport	%	-	-	-	-	-	-	-	-
private motorised transport	%	-	-	-	-	-	-	-	-
taxi	%	-	-	-	-	-	-	-	-
commuting trips (outgoing) per 1000 inhabitants	(`000)	17,23	17,85	28,44	-	-	-	-	-
commuting trips (incoming) per 1000 inhabitants	(`000)	92,32	129,85	160,28	-	-	-	-	-
mean travel time to work	km	-	-	-	9,18	-	-	-	-
mean travel distance to work	min	-	-	-	24,54	-	-	-	-
vehicle kilometres travelled	km/a	-	-	-	-	-	-	-	-

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ZURICH

		City of Zurich				ZVV-area (ZVV: Zurich integrated tranport system)			
		1970	1980	1990	1998	1970	1980	1990	1998
Module 7. Traffic Performace Indicators									
average paek hour auto speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour auto speed	km/h	-	-	16	-	-	-	-	-
av. peak hour bus speed	km/h	-	-	-	-	-	-	-	-
av. off peak hour bus speed	km/h	-	-	13	-	-	-	-	-
av. metro speed	km/h	-	-	-	-	-	-	-	-
Module 8. Public Transport Operations									
Bus operation									
number of operators		1	1	1	1	-	-	-	40
number of vehicles		196	261	278	263	-	-	-	652
maximum capacity (seated and standing (4p/m2))		22.366	31.447	35.003	30.894	-	-	-	-
total fixed route-kilometres	km	133,9	127,3	126,0	139,0	-	-	-	1.600,0
total vehicle-kilometres travelled	Mio. km/a	8,0	8,6	11,5	11,7	-	-	36,5	37,5
total passenger kilometres travelled	Mio. km/a	-	-	-	162,0	-	-	-	390,0
total seat kilometres travelled	Mio. km/a	-	-	-	1.388,9	-	-	-	-
passengers per year	Mio.	-	-	-	-	-	-	-	-
Rail operation (Light Rail, Tram)									
number of operators		1	1	1	1	-	-	1	1
number of vehicles		417	380	386	355	-	-	-	381
maximum capacity (seated and standing (4p/m2))		49.221	51.328	55.161	53.002	-	-	-	-
total fixed route-kilometres	km	119,9	110,7	117,3	109,3	-	-	-	109,3
total vehicle-kilometres travelled	Mio. km/a	19,6	18,1	20,4	18,2	-	-	11,82	18,228
total passenger kilometres travelled	Mio. km/a	-	-	-	331,0	-	-	-	331,0
total seat kilometres travelled	Mio. km/a	-	-	-	2755,8	-	-	-	2755,8
passengers per year		-	-	-	-	-	-	-	-
Rail operation (subway)									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	-
total vehicle-kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
Suburban rail operation									
number of operators		-	-	-	-	-	-	-	-
number of vehicles		-	-	-	-	-	-	-	-
maximum capacity (seated and standing (4p/m2))		-	-	-	-	-	-	-	-
total fixed route-kilometres	km	-	-	-	-	-	-	-	900
total train-kilometres travelled	Mio. km/a	-	-	-	-	-	-	14,6	13,6
total passenger kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	1.285,0
total seat kilometres travelled	Mio. km/a	-	-	-	-	-	-	-	-
passengers per year		-	-	-	-	-	-	-	-
all public transport									
inhabitants in traffic region	('000)	613,0	557,7	556,2	529,0				
total vehicle-kilometres travelled	Mio. km/a	28,6	30,2	34,3	32,3	-	-	-	-
total passenger kilometres travelled	Mio. km/a	384,4	412,6	581,4	532,0	-	-	-	-
total seat kilometres travelled	Mio. km/a	3.429,0	3.871,0	4.580,0	4.613,0	-	-	-	-
average utilisation rate (occupancy)	%	-	-	-	-	-	-	-	-
total ridership (number of passengers)	(`000)	202.295	217.183	306.000	280.900	-	-	-	-
total fixed route-kilometres	km	254	238	243	248	-	-	-	-
total fare revenues	1000 DM/a	60.441	117.159	152.552	393.720	-	211.000	230.000	238.000
public transport stops (total of all operating modes)		-	-	-	-	-	-	-	-
operating costs	1000 DM/a	-	239.632	386.016	450.240	-	514.800	592.400	562.100
revenues per passenger	DM	0,30	0,52	0,50	1,40	-	-	-	-
revenues per passenger kilometre	DM/Pkm	0,50	0,65	0,65	0,74	-	-	-	-
Taxi									
number of taxis		1.195	1.196	1.139	1.265	-	-	-	-
total taxi-kilometres	km/a	-	-	-	-	-	-	-	-
total ridership		-	-	-	-	-	-	-	-

1) 1997 2) 1996 4) 1987 3) 1995 5) 1995 6) calculated by using average vehicle fleet seat capacity

Appendix C:

Vehicle tax system in Germany

Emission Group	Tax – 2001 per 100 ccm in DM for Gasoline Cars	Tax – 2001 per 100 ccm in DM for Diesel Cars	Tax – 2004 per 100 ccm in DM for Gasoline Cars	Tax – 2004 per 100 ccm in DM for Diesel Cars	Tax – 2005 per 100 ccm in DM for Gasoline Cars	Tax – 2005 per 100 ccm in DM for Diesel Cars
EURO 3, EURO 4 and similar vehicles	**10.00**	**27.00**	**13.20**	**30.20**	**13.20**	**30.20**
EURO 2	**12.00**	**29.00**	**14.40**	**31.40**	**14.40**	**31.40**
EURO 1	**21.20**	**45.10**	**21.20**	**45.10**	**29.60**	**53.50**
Other Passenger Cars	**49.60**	**73.50**	**49.60**	**73.50**	**49.60**	**73.50**

as at December 1, 2000