Urban Transport Research

Issue
44
1988

Communication on research aimed at improving transport conditions in cities, towns and other built-up areas

3110

Published by the Federal Minister of Transport,
Transport Policy Department, Bonn-Bad Godesberg

Hoermann-Verlag, 8670 Hof/Saale

Following the appropriation of additional Federal funds for the development of transport in the communities, the Federal Ministry of Transport has commissioned research and study assignments since 1967 the results of which are intended to contribute to the improvement of their transport conditions. The annual research programme ist established with the participation of those Federal Ministries which have a special interest in this field of research, of the Länder and local authorities as well as of experts engaged in scientific and practical work.

The series entitled "Urban Transport Research – Communications on research aimed at improving transport conditions in cities, towns and other built-up-areas" ("Blue Series") is intended to present to the public a summary of the results of the Ministry's Urban Transport Research programmes.

Part I contains the abstracts which the research institutes have annexed to their final reports. The abstracts are intended to provide information on the field of research under study and on the most important results of the research work, and to stimulate and encourage practical applications. Conversely, the Federal Ministry of Transport is hoping for suggestions and impulses for research from those who are engaged in practical work.

Part II contains a survey of all research and study assignments on urban transport commissioned so far by the Federal Ministry of Transport the abstracts of which are published in this series. This survey is kept up to date.

The abstracts supplied by the research institutes are published unchanged and without comment. Extended abstracts or the full texts of the results of research projects which are deemed to be of special or current importance are published as special issues. See cover inside.

The issues of the series are distributed according to a mailing list of the Federal Ministry of Transport. Additional copies may be ordered from Hoermann-Verlag, POB 1560, D-8670 Hof/Saale.

A limited number of the full reports has been handed over by the research institutes to the Federal Ministry of Transport. Research reports which are not published are kept available for those who are directly interested by Section A 24 of the Federal Ministry of Transport, POB 20 01 00, D-5300 Bonn 2. **The reply to inquiries is only possible if the full project no. (e.g. 28/73 or 70 016/78 – see "Part B Survey . . .") ist stated.**

Part I: Abstracts of Research Reports

Project 77025/81

Quantification of the separating effects of traffic construction measures in urban areas on social relations and urban structures

Prof. Dr.-Ing. Harder, Hemmingen

Completed April 1985

Problem definition

People have generally become sensitive to ecologically harmful effects of the construction of traffic facilities. This attitude has resulted in the demand for methods which can be used for estimating the separating effects of road spaces, particularly in urban areas.

The construction of traffic facilities may produce positive or negative effects on social relations and urban structures if existing separating effects can be reduced by redirecting traffic (avoidance of "back-street routes", etc.) or by structural facilities, or, conversely, if such segregation effects arise.

It is the aim of this research project to ascertain the above mentioned effects, particularly those occurring in road spaces which are not part of the network of highways and major roads. For this purpose, criteria are to be developed which make it possible to ascertain and assess the following effects:

— visual separation effects (eye contacts, experiencing space, etc.)

— functional separation effects (accessiblitiy, interconnected areas, etc.)

— separation effects on social relations (neighbourhoods, communication structure, etc.)

In addition, the present research assignment is designed to develop methods which allow for the extant socio-empirical studies in the realm of urban sociology as well as for the present status of the debate on economic evaluation methods.

Comprehensive studies on urban sociology are available which were the result of representative surveys, observations, functional and structural stock-taking and other study methods. To begin with, these studies will be used for selecting and defining controlling factors (indicators), which are relevant for evaluation purposes, and will serve as a basis for developing evaluation approaches.

The envisaged work programme is mainly concentrated on the development of a self-contained procedure for quantifying the separating effects of traffic construction measures in urban areas on social relations and urban structures. Existing approaches to ascertaining functional separation effects will, in modified form, be integrated into the procedure.

Method

The construction of a traffic facility may entail development benefits provided the accessibility of certain destinations is improved. At the same time, deterioration of the O-D relationships of non-motorised road users may occur, which result in time losses. The definition of destinations comprises installations and facilities for the provision of goods and services of the public and of the private sector, which can be reached on foot. The time losses which are encountered on the way to these destinations and which are caused by a traffic facility are established in the form of separation values. The impairment of accessibility is called functional separation effect.

At the same time, heavy traffic volumes may impair, or in extreme cases even prevent, the social functions of street spaces (play, outdoor recreation, social contacts, communication, etc.). This impairment of the outdoor recreation and social contacts function of road spaces and the impairment of non-motorised road uses caused by heavy traffic volumes are called social separation effect. Social separation effects are simultaneously caused by an insufficient integration of road spaces into the urban environment owing to inadequate design. They are identified via indicators such as the space provided for play, outdoor recreation and social contacts, equipment, outdoor furniture and greenery, spatial qualities, etc..

Impairments of urban skylines, townscapes, striking prospects, etc., by traffic facilities are called visual separation effects. No special procedure for recording and quantifying these visual separating effects was developed in the context of this research project. However, numerous indicators serving to ascertain the social separation effect are simultaneously suitable for ascertaining visual impairments of townscapes.

In the context of the procedure developed here, assessments and feelings of the non-motorised users of road spaces constitute a necessary complement of the data base obtained from transport and town planning. A set of survey instruments, based on the results of a pretest and of a representative survey, was developed for interviewing the road space users.

Figure 1 shows those aspects of the separation effect of traffic facilities which have been taken into consideration in the course of the present study.

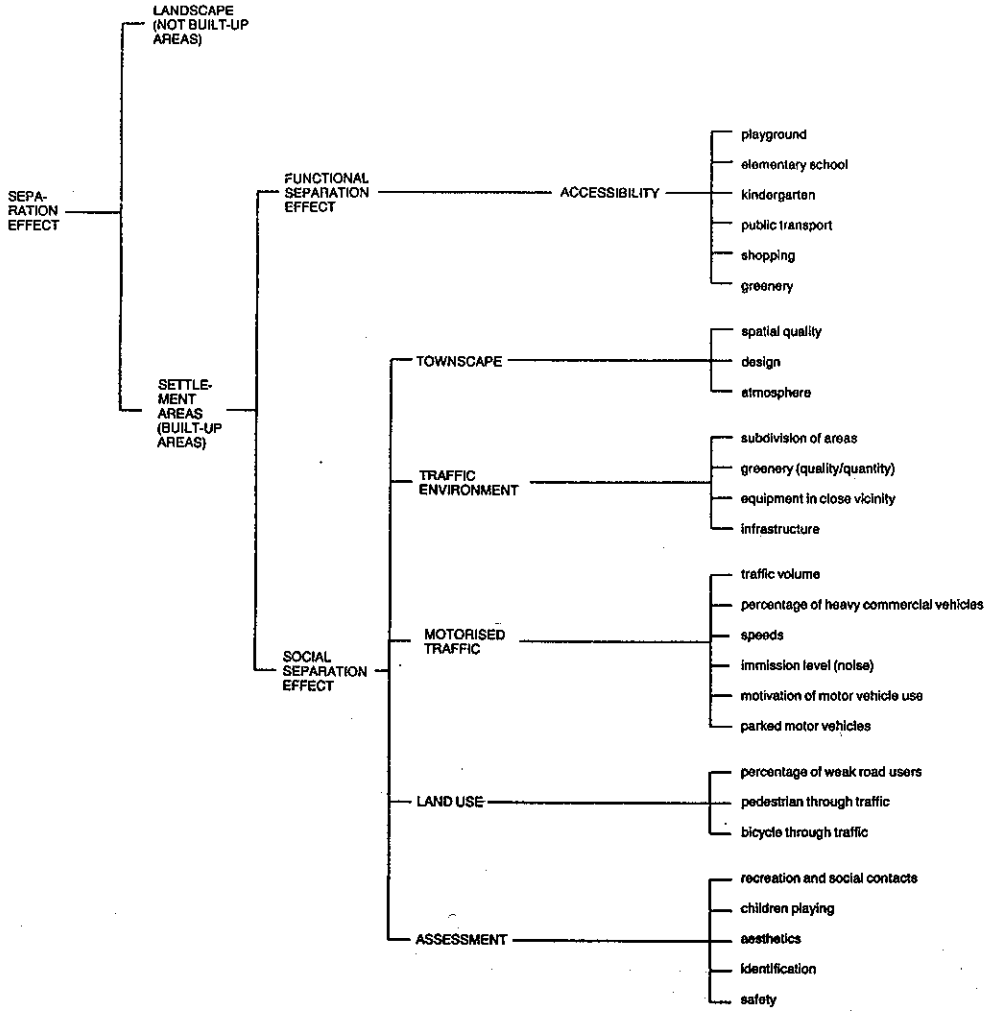

Figure 1: Aspects of the separation effect

An additive process is used to aggregate the individual separation values in such a way that they form a separation factor. This separation factor, ascertained by means of the method developed here, constitutes a measuring unit defining the separating effects of traffic facilities. Figure 2 shows the basic structure of this method.

Project 77039/85

Pilot study for the purpose of establishing extrapolation factors for short-term traffic counts in urban road networks

Institut für Verkehrswesen, Prof. Dr.-Ing. Brilon,
Ruhr-Universität Bochum

Completed October 1987

Problem definition

Ever since traffic surveys have been carried out, efforts have been made time and again to ascertain the percentage of peak hour traffic in the daily traffic volume in a representative manner or, conversely, to gross up to the daily traffic volume from short-term traffic counts. Numerous studies have been devoted to roads which the Federal Government has the obligation to construct and maintain. These studies have established regularities in the patterns of daily traffic flow and subsequently developed extrapolation models. However, these results cannot be used directly for characterising traffic flow on urban roads where greatly divergent trip purpose groups coincide. Each of these groups exhibits different patterns of daily traffic flow. For this reason, the daily flow lines counted may differ widely depending on the location of the census point in the street network. In the present study, which covers urban roads, an approach to ascertaining conversion factors for traffic volumes of different reference intervals is developed.

This being a pilot study, it ist not intended to present comprehensively corroborated calculation data. The aim of the study is rather to explore the available data base, to develop and test evaluation procedures, and to evaluate a limited set of data as far as possible on a trial basis. These evaluation results will be used to estimate the reliability with which extrapolation factors for urban roads can basically be indicated.

Study method

In accordance with the objective of the study, data recorded by permanent counters in several cities were to be used. Technically speaking, measurements can be taken on a permanent basis as part of vehicle-actuated traffic signal control. In view of these considerations, numerous cities which have powerful traffic computers were approached in writing with the request to cooperate on the project, whereupon six cities made data available. Thus it was possible to consider altogether 183 patterns of daily traf sections during the evaluation made for the study.

Statistical methods were used to analyse the ing to the following criteria:

- typification of the various flow lines for roac work functions
- analysis of the percentage of the maximun as a function of Average Daily Traffic (ADT)
- possibilities of extrapolation making allow ences between the two directions
- monitoring of the weekly and monthly flu ume
- analysis of the typical pattern of traffic flo indication of extrapolation factors.

Study results

The survey among the cities showed that alr the technical capability of using permanent of traffic signal control. However, little use is On the other hand, the cities are ready to capabilities for the benefit of scientific studies cal agencies are very much interested in a extrapolation factors. Only the city of Hambur hensive network of constantly operated perr important major roads between intersections.

It is even possible to indicate extrapolation fa Preliminary data pertaining to radial roads ma Owing to the substantial variance of the data, indispensable for roads which have other net equivocal delimitation of different groups o lation of flow line and network function of a roa made on the basis of a more comprehensive the main study. However, it is reasonable lutions to result from the use of mulitivariate in this case.

The following detailed results are worth menti

- The counting interval which ist particula polation base is the four-hour interval fro corresponding interval during the morni from 7 a.m. to 11 a.m.
- The percentage of peak hour traffic in the is particularly constant on radial roads, an
- The percentage of the actual peak hour dependent of the ADT. On urban roads erally expected to fall between 4 p.m. an case of the inbound traffic on radial roac between 8 a.m. and 9 a.m.
- Basic differences in the extrapolation fac workdays of the week were not observed. the four-hour group in the ADT depend or

Practical conclusions

Where urban roads are concerned, the con ADT and peak hour traffic volume depend ve

Project 77043/85

Possibilities of improving a regional railway line of Deutsche Bundesbahn (DB) with special consideration of providing attractive park and ride facilities, as exemplified by the Limburg — Frankfurt/Wiesbaden DB line

SNV Studiengesellschaft Nahverkehr mbH, Hamburg

Completed July 1988

Problem definition

Regional passenger transport by rail is generally in a difficult situation today. In many cases, the number of passengers is declining. Cost increases also worsen the economic efficiency of these lines. Owing to a highly uneven distribution of the demand for travel throughout the day, the vehicle fleets are filled to capacity for very short periods only.

In rural areas, feeder transport to the railway stations is of special importance because a great many passengers live in towns or villages which are not endowed with a station. Compared with urban areas, the network of bus lines is wide-meshed and the number of trips offered is small. On the other hand, the availability of cars is very high. If the level of service by rail does not adequately meet the passengers' expectations, there ist the risk that the private car is not only used as a feeder for obtaining access to the station, but rather for the entire journey. The Limburg—Frankfurt/Wiesbaden railway line is used as an example to show how, on the outskirts of an agglomeration, an attractive supply of transport services with special consideration of park and ride (P + R) feeder traffic is able to counteract this trend and to attract additional passengers to the railway.

Study method

After taking stock of the settlement structure and the supply of transport, traffic surveys were conducted to ascertain detailed data on the demand for short-distance public transport, particularly P + R travel, and on the attainable potential demand. An overall concept, including proposed improvements, was prepared, which covers the supply of trips by rail, P + R facilities, bus feeder lines and marketing. The expected future demand for travel was forecast.

Study results

At Niedernhausen, after a distance of 38 km, the Limburg — Frankfurt/Wiesbaden railway bifurcates into the Niedernhausen — Frankfurt (32 km) and Niedernhausen — Wiesbaden (20 km) branches.

The Limburg — Niedernhausen section was electri ning of the 1986/87 winter timeable. Thus a double is electrified throughout ist available between Limbu (70 km). The Niedernhausen—Frankfurt section i the area served by the Frankfurt integrated trans (FVV); line S 2 of the rail rapid transit operates there

Trains run at irregular intervals. During the early a hours, mostly through trains operate from Limburg vice versa. Only a few through trains operate betwe Wiesbaden. During normal traffic hours, however, from Limburg to Wiesbaden or operate betwee Niedernhausen only, whereas only a small number semi-fast through trains serve the Limburg — Fran rolling stock used are suburban coaches, so-called S of which operate as push-pull trains.

According to a traffic survey carried out on 14th M proximately 6.550 passengers per day and direction between Limburg and Niedernhausen; 61% of th 4.000 passengers per day, travelled during the morn in the direction of Frankfurt/Wiesbaden.

Limburg, which is the administrative seat of a ru counted for about 2.900 passengers per day travell tion of Frankfurt/Wiesbaden, and was thus preemi stations used for boarding. The Eschhofen, N Niederselters, Bad Camberg and Idstein stations e 800 boarding passengers per day and direction, w three stations accounted for 175 to 390 boarding pas

Frankfurt main station and Frankfurt Höchst attra 17%, respectively, of all alighting passengers and w outstanding among all stations used for alighting. Al passengers used Wiesbaden main station for aligi one in four passengers alight at stations along t Niedernhausen section.

The catchment areas of the stations extend up to 20 flies towards the West, North and East of the railwa even into the Federal Land of Rheinland-Pfalz (Rl nate). Catchment areas become smaller with decre from Frankfurt and Wiesbaden.

The majority of all passengers (almost 60%) walked Among the other means of feeder transport, the c more than 30% of the public transport passengers a supraregional importance. Car drivers accounted passengers for 4%, and 7% were dropped off at th and ride traffic). Less than 10% used a scheduled 3% came by bicycle.

The overall concept aimed at improving the supp constitutes the desired final stage of an attractive sup and comprises the following components:

- supply of trips by rail
- level of comfort of rail transport
- park and ride facilities
- feeder bus lines
- marketing concept.

It is based on the following conditions:

- Improvement in the supply of trips from Limburg t vice versa, as well as from Limburg to Wiesbaden a
- adjustment to the S-Bahn (RRT) between Niede Frankfurt (40-minute headways during the day), able connections from/to Frankfurt are available throughout trains are running,

Project 70219/87

The development and provision of transport for large settlements

Ingenieurgruppe IVV, Aachen

Completed November 1987

About 200 — 250 large settlements were built in the Federal Republic of Germany during the sixties and seventies. They comprise approximately 500.000 — 600.000 housing units for about 1.5 million people. A large settlement may be roughly described by the following charcteristics:

- > 1.000 housing units
- self-contained with high building density
- mostly flats
- uniformly planned and built accordingly
- owned by one or few major sponsoring companies
- mostly to be classified as social welfare housing
- isolated location and in most cases suburban.

The sizes of large settlements range from 1.000 to more than 20.000 housing units.

While the large settlements of the sixties and seventies originally met with general public approval, pronounced criticism has been voiced in the meantime. This criticism has been mainly directed at the nature, appointment and concentration of the flats, at the housing environment and the prevailing social problems. However, there is no overlooking the fact that this critical basic attitude has also been caused by the urban transport planning concepts, which are now perceived as unsatisfactory. The question arises whether urban transport planning is able to make a contribution towards remedying the functional deficiencies of large settlements.

Special analyses, investigations, calculations and classifications were carried out for the purpose of answering this question. They were concerned with the following issues:

— volume and nature of the demand for travel,
— required development capacity,
— target concepts of urban transport planning,
— shortcomings of development,
— concepts for measures to be taken.

Naturally, the studies were unable to cover the entire range of possibilities. Rather, they were aimed at producing generalised findings concerning present conditions which are typical of many large settlements. Exemplary practical cases were also examined.

The results obtained in the course of this study are summarised below.

1. The inhabitants of large settlements clearly travel le parable population groups who live in integrated urba neighbourhoods. This is mainly attributable to the leisu ties of the various age groups. While in the group of you — 17 years old) there are hardly any mobility differenc with equal groups in other areas, it is obviously less attr group of the 18 to 65 year-olds to pursue additional ou tivities after having completed their compulsory ac related to employment and business). This is all the mc major distances have to be covered in order to reach at nations. This is the reason why mobility deficits of ab found in this group as against the findings normally en the trip purpose "leisure time and recreation".

In the age group of the over 65 year-olds conditions a reversed. In this group, without exception, travel serve activities and shopping purposes, with the latter also be tributable to leisure-time activities. Isolation and loneli settlements presumably are the reasons why the h settlement are left, in search of communication and di sequently, the overall mobility of this group is about than that of comparable groups living in urban residenti hoods.

The disproportionately represented group of the 18 t with about 15% "mobility deficits" on the one hand, a represented population group of the over 65 year-olds surpluses" of around 25% on the other hand, give ris mobility level which is 10% below the comparative va town dwellers.

Moreover, when considering non-motorised mobility (bicycle) the values found in large settlements fall cl those applying to integrated urban residential neighbo again, when comparing inhabitants of large settlemen grated urban residential neighbourhoods, we find three ent groups which display different patterns of behaviou

Non-motorised mobility is almost the same for the ag 0 to 17 years.

However, as far as the 18 to 65 year-olds are concern of non-motorised mobility are about 30% below those ing inhabitants of integrated urban residential neighbc is probably due to lacking attractiveness of the near hood.

In the group of older people (> 65 years), the mobility c probably no travel by bicycle) of people living in large 40% higher than that of comparable groups elsewher that the needs for communication often cannot be m way owing to the unattractiveness of travel by pu hence higher mobility on foot.

2. It is quite possible to influence the travel behaviou ing in large settlements; this can be achieved both by mix of land uses and by measures concerning infrastructure. Thus it can be assumed that savings travel of 20% to 30% can be obtained by a favourat uses in hitherto monostructural large settlements. The accompanied by a simultaneous increase in pedestr traffic in the large settlements.

However, there are certain limitations to the possibilit the travel behaviour of people living in large settlem ures affecting the transport infrastructure. Only 35% users are free with regard to their choice of mode of t dition, overall conditions cannot be shaped in such a nections by public transport can always be provided

Project 77028/85

The safety effects of measures taken to control road traffic by traffic signals

Dr.-Ing. Heusch, Dipl.-Ing. Boesefeldt, Aachen

Completed July 1987

It was the aim of the research presented here to ascertain and assess changes in the accident pattern which were consequent on the setting up of new traffic signal installations or on a change in signal control. A survey of the literature already available on these issues revealed that a good many research results, mainly concerning accidents involving pedestrians and accidents involving vehicles turning left, are extant. Therefore this study focussed on two other key issues, namely the changes in the accident pattern before and after the setting up of a signal installation and the effects of different coordination schemes for traffic lights on road safety.

Originally the examination of accidents happening at junctions where traffic lights had been newly installed was intended to cover junctions within and outside built-up areas. The accident data concerning junctions outside built-up areas were to be gleaned from the data tapes of the Federal Laender. However, assigning these data to the junctions was only possible to such a limited extent that subsequent evaluations were restricted to accidents occurring within built-up areas. In order to find intersections suitable for study, building construction and civil engineering agencies throughout the Federal Republic of Germany were asked to report junctions which had been newly equipped with traffic signals during the past few years without a simultaneous major change in the traffic pattern observed there.

Ultimately it was possible to cover 50 junctions from 9 towns in this study. Characteristic data, concerning these junctions' construction, operation and traffic, and data from the accident reporting forms covering one year before and one year after the commissioning of the traffic lights, were collected, processed and entered into a computer. Numerous logic operations were used to integrate the data from the various universes and finally to evaluate them statistically. The first item under study were the effects which the installation of traffic lights has on safety in general, i.e. independently of certain junction characteristics. For this purpose the accident numbers and accident rates of accidents entailing consequences of varying severity were established. Subsequently the question was examined whether there are relationships between Annual Average Daily Flow (AADF), certain junction and control characteristics, and the accident pattern.

In the 173 approaches, 305 accidents had happened during the "before" period and 179 during the "after" period on workdays between 6 a.m. and 10 p.m. The provision of traffic signals primarily helped to avoid accidents involving vehicles turning in or
The number of accidents involving personal injury was redu
of all; it was down 61 % "after" as against the level "befo
accidents involving minor material damage only decreasec
Average accident costs per year and junction amount
151.000 "before" and DM 65.000 "after" at intersectior
DM 114.000 "before" and DM 47.000 "after" at T-junct
amounts to an average annual saving in accident costs tot
22.000 per approach. Accident costs both "before" and '
up with increasing traffic volumes, but so do simultaneous
ings. Road type and type of land use in the surrounding are
other main factors influencing deviations from average ac
ures.

These results were compiled in such a manner that a user
estimate the safety effects of traffic signals while making a
for important junction features. Thus he is given a signific
for deciding on a new signal installation.

In Hannover (Hanover), Düsseldorf, Köln (Cologne) and
(Aix-la-Chapelle), 246 approaches at 141 junctions alo
roads were selected for studying the influence of different
ordination schemes on the accidents happening there. In
1983 to 1985, a total of 2370 accidents occurred at those
on workdays between 6.00 a.m. and 10.00 p.m.. The numb
dents involving only minor material damage was twice a
Aachen as it was in Köln and Hannover, while it was sut
lower in Düsseldorf. In addtion, the number of accident
severe material damage in Hannover was almost three tim
ure recorded in the other towns. For these reasons, all ev
were carried out both cumulatively and separately for all fc
All accident factors (accident numbers, rates, costs and c
are clearly higher at intersections than at T-junctions. Mor
cident numbers and costs clearly go up with increasin
whereas accident rates and cost rates tend to fall. Of all
junction features recorded, it is only approach lengths, tota
of lanes and number of left-turning lanes which are obvic
related to the accidents happening at the respective junctic
dition, all four accident factors are lower at junctions with tra
ated signal control than at those with fixed time operation.

Only a sub-universe of 1672 accidents was used for exam
influence of signal coordination. This sub-universe compr
dents caused by drivers going straight ahead, becau
assumed that they were more strongly affected by sign
nation than accidents involving turning manoeuvres for
ditional factors are relevant, such as the volume of oncomi
the volume of pedestrian traffic and the kind of safeguar
protecting turning vehicles. A difference was made betwe
called basic coordination cases which denote the kind of in
of the platoon arriving from the nearest upstream junction a
line, such as "head of platoon arrives on red". The lowes
cost rates were ascertained for the case of the entire vehic
arriving on red, which is followed by the case where all vel
pass without obstruction during the green period. Both situ
clear-cut. The most unfavourable result was obtained f
nation cases where the green period at the respective junc
short that both the head and tail of the platoon arrive on red

In addition, when considering staggering times and ac
gression speeds v_{pa} for the beginning of the green period,
emerges that accident cost rates are above average for v_p
40 and 60 kph, and below average for higher or lower v
Hence, coordination schemes under which the progressio
the beginning of the green period is equal to the permiss
mum speed, and is thus often desirable from the traffic en
point of view, do not at the same time provide maximum s
available data do not suggest any correlation between acci
phase staggering or the progression speed at the end of
period.

Traffic safety

Accidents are rare events on the roads through small towns and villages, which are the subject of this study and which carry relatively small volumes of traffic. Consequently, information concerning the details of accidents, which can be derived form accident reports, cannot be fully satisfactory for the purpose of research into causes of accidents. It does not permit reliable findings to be established with regard to the link between planning and design elements on the one hand and traffic safety on the other. Generally, however, clear and/or prominent road narrowings and carriageways or sections of carriageway on which compulsory mixed use is perceptibly bound to occur presumably do not tend to present an increased accident hazard, at least not on roads through built-up areas carrying low volumes of traffic. On the other hand, road sections which are complex or which are difficult to assess with regard to their cross-sections and their routeing appear to be prone to accidents resulting from excessive speed and/or mistaken spatial appraisal.

Observations obtained by means of the traffic conflict technique have shown that

- conflicts arising at narrowings are at a controllable level and that they are unlikely to escalate into conflicts, let alone accidents, and
- sections of the road space on which carriageway surfaces are used jointly by some non-motorised road-space users on a voluntary or more or less compulsory basis should not be characterised as being dangerous, provided that it is possible to lower the hazards by reducing the speed of motor vehicle traffic.

Behaviour of non-motorised road-space users

Voluntary joint use of the carriageway approximately as it would develop on mixed-use areas is obviously more generally practised when

- the volume of motor vehicle traffic is small (up to about 250 motor vehicles/hour),
- there are few commercial vehicles (up to about 20 lorries/hour),
- motorists drive considerately at low speeds (up to about 25 kph),
- the percentage of non-motorised road space users is high and
- the road space is properly designed so that it can also satisfy use requirements other than those of traffic.

The last two criteria are, as a rule, not met on the fringes of towns but rather in attractive town centres (e.g. market place, shops).

While narrow sections of road space with compulsory joint use of the carriageway by pedestrians meet their traffic function, they do not also fulfil other requirements, namely those of non-motorised road-space users. Separate footpaths and cycle paths to carry longitudinal traffic therefore become desirable at road narrowings with growing motor vehicle volumes.

Survey among the road-space users

Joint use of carriageway areas, which is dictated by the situation of the road space, reduces the subjective sense of security on the part of non-motorised road space users. Most pedestrians would rather have a lane assigned specifically to them which should not be jointly used by motorised traffic.

Traffic safety is considered to be adversely affected speeding motor vehicles, absent or unusable footpaths plexity of road space.

Roads through towns and villages where segregation is a means of raised kerbs are given better ratings than oth soft segregation is attempted. Urban standards are often be good and progressive and are therefore applied to roa villages without their necessity or usefulness having been

Traffic patterns at narrow sections of road or carriagev narrowings

At carriageway narrowings that exist for a short time caused by vehicles stopping on the carriageway), a tend served to avoid encounters with other vehicles within the n tion even when the available carriageway width would permit vehicles to pass each other safely.

The willingness to pass other vehicles within narrow roa and permanent carriageway narrowings is obviously grea ation effect on the part of drivers who are familiar with t than within temporarily narrowed carriageway sections. this willingness will presumably go up generally as the tra and the length of the narrow section/carriageway na crease, in order to avoid longer waiting periods (the readi risks grows). There is also a dependence on the kind of c delimitation and on the visual impression of the change in tion. Elastic carriageway delimitations (e.g. dropped kerl are conducive to vehicles passing each other, since, if ne can be run over to make way, without the risk of damage case of rigid margins (raised kerbs, walls and the like). A duction of carriageway width also furthers the inclination coming vehicles. In such configurations, the motorist's and ability to make the right judgement are clearly overta other hand, a distinct reduction of carriageway width cautions, wait-and-see behaviour.

Stopping at fairly short narrow sections and carriageway is often avoided by appropriate driving (mostly by decel sometimes by accelerating).

Two-lane narrow sections where motor-assisted bicycles cycles are used and where the oncoming lane is not suffic are not suitable for overtaking bicycles.

In contrast to narrow sections and carriageway narrow traffic moving in either direction enjoys equal rights, there where traffic moving in one direction is granted priority. loads are symmetrical and up to a load ratio of 1:2, this duces longer waiting times and longer waiting queues ov the overall stopping rates remain approximately constant.

Where the load situation is asymmetrical, priority for vehicle stream results in more stopping processes but s ing times overall.

When traffic volumes are low or medium, the use of tra results in higher stopping rates and longer waiting times.

The interdependences between the length of the narrow the traffic volume, the percentage of commercial vehicles tial case of meeting an oncoming vehicle, stopping rate waiting times and lengths of queues are documented by graph in Annex II.

single-lane sections (up to about 50 metres) do not produce major impairments of traffic. Wherever possible, no special traffic control measures (signs 208/308 of the StVO) should be resorted to. If one direction of traffic must nevertheless be granted priority, the direction carrying the smaller traffic volume should be selected for this purpose.

When the traffic volumes carried by through roads are small or medium-sized, traffic signals should only be used at narrow street sections/carriageway narrowings where it is not possible to see the entire length clearly.

Part 2: Design recomendations applicable to roads through village-type and urban-type built-up areas

Problem definition

Many roads through small towns and villages which coincide with primary routes do not meet the requirement that the street space in built-up areas should be fully multifunctional. For a long time, local concerns such as the building structure or the land use requirements of local residents, were only taken into account insufficiently or not at all when designing through roads. Only in recent years has a change in the relevant design principles evolved. It is, however, as yet unclear how far the design recommendations applicable to roads through villages, which are hardly disputed any longer, can also be applied to places of a more urban nature, i.e. those located near towns and cities or serving a central function in rural areas.

The mostly generalising assessment of settlement types and building structures as being either "village-like" or "urban" does not make allowance for rural areas in the vicinity of big cities. Such places have become increasingly urbanised in terms of their population, building structures and urban development concepts. In addition, the growing traffic volume, caused particularly by an increasing number of journey-to-work commuters, has influenced the design of the street space for through roads. These through roads are thus no longer comparable to those leading through genuine villages in rural areas. It is therefore logical and reasonable to show up the differences in the planning and design of through roads through village-type and urban-type built-up areas which result from the different requirements of all road users and to develop a differentiated design repertory for small towns and other built-up areas which does justice even to places that cannot be completely attributed to either category.

Comparison of use requirements and the situation in the street space of through roads in places with a village or urban character

The planning and design of the street space of through roads in villages and towns is determined by topography and building structure, as well as to a substantial extent by the requirements of all relevant user groups. Owing to the relatively low level of use requirements in places which have retained the character of villages, the space alongside the street can normally be put to mixed use. In this way, sufficient accommodation can be provided for overlapping use requirements made on the same areas. In places which are urban in nature, however, an optimum allocation of areas for all kinds of uses, which satisfies any demand arising there, is not usually possible.

The use requirements made by moving motor vehicle traffic ensue largely from the network function of the through road and the location of the town or village concerned. The influence of those features which are related to urban planning and desi
the volume of trips generated or ending there and o

Speeding motor vehicles are observed on most of t
under study. This is particularly true for short route
and similar built-up areas.

In view of the cases of vehicles meeting/passing
must be allowed for when dimensioning, and w
desired quality of traffic flow, the required carri
through routes are 5.50 to 6.50 metres.

The different demands which the other user groups
roads in villages and in towns may be summarise
erally speaking, these findings are true for roads
and other places of a similar character:

— On the whole, less demand for kerbside parkin
kind, if any, exists for agricultural vehicles and
than for passenger cars.

— Public transport has a low trip frequency and c
gers.

— The volumes of bicycle and pedestrian traffic a
crossing frequencies low.

— People are found in isolated places only, o
transition between public and private spaces.

— Children play throughout the entire street space

On the other hand, the following must be conside
with roads through towns and other places of an url

— Heavy demand for kerbside parking, particularl

— Public transport has higher trip frequencies
passengers, particularly school children.

— The volumes of bicycle and pedestrian traffic
frequencies are higher.

— People are found throughout the entire spa
street, particularly in central areas and in the vi
cilities.

— Playing children are rarely found, and if so,
alongside the street.

Apart from regional differences in topography and
ture, the differences in the street spaces of road
and towns may be summarised as follows:

In the street spaces of roads through villages and
similar nature, there are usually

— fairly large distances between buildings and
individual buildings,

— as a result of this: changing street space wi
sequence of spatial sections,

— no areas of transition between open route and b
and

— a great many green areas in public and priva
contribute to spatial guidance and environment

The street spaces of roads through towns and o
urban nature are usually characterised by

— high-density building with structures of a simila

— as a result of this: linear, uniform course of the

— areas of transition on the approach to more
parts,

Project 77036/83

The possibilities of including the cost of accidents in urban areas in the RAS-W Guidelines with special consideration to quantitative data and relationships

Prof. Dr.-Ing. Harder, Hemmingen

Completed March 1985

In the context of a preceding research assignment bearing the same title as the present assignment (Project 77066/79), comprehensive data concerning the accidents occurring in the city of Hannover (Hanover) were acquired. The present research project has been designed to examine those data with a view to establishing the extent to which network elements (route sections or intersections) can be combined in groups exhibiting the greatest possible homogeneity in terms of accident patterns. It is necessary that these groups be easily and unequivocally definable by means of traffic facilities or traffic environment characteristics.

The study is based on altogether more than 44,000 accidents recorded in the years 1976 to 1978 on 1,033 route sections and 559 intersections. This covers slightly more than 76% of the accidents which happend in the city of Hannover during that period; the total network under examination comprises more than 400 kilometres.

Detailed knowledge of local conditions made it possible to subject the data to thorough plausibility checks. Atypical network elements were excluded from the universe under study.

Subsequently the influence of all ascertained characteristics of the traffic facilities and the traffic environment on the accident pattern, specifically on the accident rate, of the route sections and intersections was systematically examined. Characteristics which exert a clear and plausible influence on the accident rate were used for breaking down the universe under study.

Following several grouping stages it was possible to break down the universe of route sections into ten subgroups and the universe of intersections into six subgroups which can easily be defined by means of traffic facility or traffic environment characteristics. The groups are defined by combinations of the following characteristics:

- network function (urban motorway, major road [f travel], residential or local road)
- type of abutting buildings
- number of lanes (for routes only)
- dual carriageway (for routes only)
- number of legs (for intersections only).

As a rule, all these characteristics can either be easily as were already known in the preliminary planning stage.

As a further working stage, the structure of the accide and consequences) within the individual groups was became apparent that taking accident severity (in terms cost rate) into account, as opposed to the sole conside accident rate, results in only minor changes in the safety individual groups. However, the use of different cost much more pronounced influence on accident costs an ranking of the various route and intersection types wi their safety levels. An updating over time, and forecast cost rates is urgently necessary whenever it is a matter accident consequences which are not unequivocally "accident involving casualties" or "accident involving ualties").

A further breakdown of the route and intersection types traffic volumes, which was carried out whith the aim of still relatively major spread of accident rates within th groups, did not produce the desired result. The links be volume and accident rate, as well as those between tr and average accident cost, are too weak.

The economic cost of an accident is decisively detern consequences of accidents involving casualties. Theref data from several big cities in the Federal Republic of Ge compared. This comparison revealed, on the one hand ferences in the consequences of accidents reported fr cities and, on the other hand, in all areas a clear anc trend over time to accidents entailing less serious co These facts underline the need to check whether the a model can be applied at different times and to differe mainly by studies in towns of different sizes (small, n and big towns).

In the last chapter of the present research assignment cost model is developed which is in accordance with th and which is to be integrated into the Guidelines Co Construction of Roads, Part "Studies of Economics" the purpose of estimating the cost of accidents in built-u

For the purpose of a rough estimate of benefits in th large-scale considerations or in the course of approxim nary studies, a supplementary working stage was a served to ascertain the accidents occurring on route those happening at intersections. The accidents occ tersections account for a sizeable proportion of all ac given route. For this reason, the data specified here c rough indication. Ultimately, they are only valid for a lengths and distances between intersections in the city The extent to which the findings can be applied to route should likewise be checked by means of comparab towns of different sizes.

Projekt 70138/85

Review of public transport's standards of transport, operation and technology with the aim of reducing cost

Hamburg-Consult GmbH, Hamburg

Completed November 1987

1. Problem definition and study approach

The well-known poor conditions under which public transport has to operate will not improve in future. For this reason, local and regional authorities, as well as transport undertakings, are called upon to look for potential savings in the public transport sector in order to reduce the need for subsidies or, at least, not to let them increase any further. The idea has been propounded to lower the standards of public transport service to an economically justifiable level. To prevent passengers from switching to other modes and the staff from being placed in a worse position, it is intended to lower standards primarily where passengers and operating staff feel least affected by such a deterioration.

In terms of methodology, the study approach proce areas of work which, successively building upon ea tute the course of the study.

1. Differentiation of the main components of the pu system and description of standards in close coc the components.
2. Analysis of the cost structure of the operating bran transport with the aim of assigning shares in the c vidual components.
3. Analysis of the cost-relevant standards and apprai savings.
4. Assessment of the savings effects of selected set and of their impact on passengers and staff.
5. Adoption of proposals regarding more in-depth stuc the information base existing in the field of cost-ef ards.

2. Components of public transport and standards them

The tried and tested breakdown of the overall pu systems according to system components is used as a ing stock of the prevailing standards (Fig. 1). The star to individual components or sub-components are of h quality and topicality. To some extent, standards have laws, regulations and directives, whereas they c founded on the value concepts of the planner or decisi cerned. The evaluation of the relevant sources of tra tion and technology standards results in a combined a current standards relating to the system componen This stock-taking serves as a basis from which develo and approaches for changing standards with a view tions can be set forth.

The standards concerning the "level of service" contain some potentia. for cost-effective reductions, both when defining the minimum supply during late and normal operating hours, and when fixing transport capacity during peak hours. When the task of "providing public transport as a public service" is taken into account, it appears to be unjustified to consider any further reduction in the standard of minimum service. It is possible, however, to replace minimum service by minimum demand-orientated level of service which can be realised by demand-orientated forms of supply (such as dial-a-taxi paratransit). Only that part of the supply is accountable which is actually used.

Lowerec standards for dimensioning the transport capacity provided during peak hours hold out the greatest chances for success with a view to the desired cost savings, owing to their direct impact on the peak capacities which must be provided. The possible spectrum of using existing standing room capacities extends from downgrading the level of service (LS) to a very low level, e.g. LS = 45% (which means that more than every second passenger must stand during travel), to a complete utilisation of the vehicles' static carrying capacity and accommodation which would amount to about 6 persons per sqm standing room.

3.3 "Operation"

More than any other sector of public transport, the scheduling and operating of operation have been regimented by laws and regulations. For this reason, the scope for decisions by the individual enterprise is also restricted with regard to cost-effective action.

As far as safety-relevant provisions and laws are concerned, this is even intentional and necessary. In addition to the more technically and organisationally orientated laws and regulations, several regulations and agreements from the sectors of labour law and collective bargaining law must be allowed for, with a view to the effect of standards on the staff, because they incorporate, to some extent, vested social rights of the people concerned, which will not be globally called into question here. An approach to amended standards in this area is rather seen in a further development of the definition of the operating staff's occupational activities who can, with increasing use of technical aids, assume extended and more responible functions aimed at improving passenger service.

As a result of the analysis of the standards generally prevailing in the "operation" sector, cost-effective changes can be derived which concern the following areas:

- acceleration of vehicle turn-around;
- more emphasis on the employees' and passengers' own responsibility within the issue "safety system";
- capacity-orientated flexible working hours and further development of the definition of the operating staff's occupational activities;
- flexible manpower deployment and increasing recourse to the services of third parties for meeting peak demand.

3.4 "Stop/station" and "route"

Reduced standards applying to the components "stop/station" and "route" are of special importance for the transport undertakings if they serve to cut expenditure for operating and maintaining facilities.

A potential for reducing standards is mainly seen in limiting the equipment and installations at the stops and stations to those parts which are indispensable for smooth operation.

The general aim is to reduce the depths at which are constructed, predominantly for the purpose costs, but with the attendant possibility of rec standards. This means that escalators and expen ties are largely dispensed with and that simplified i bute to minimising the cubical content of the stop.

A potential for reducing the standards applying t port system's rail tracks arises mainly in the sec the track proper and to some extent also the track

When the supervisory authorities determine the inspections, they should increasingly make allowa the art which is, in many fields, reflected by the p self-monitoring facilities. In addition, the wear of ponents has been substantially reduced by improv materials. Instead of carrying out inspections at fi possible, for instance, to use exact stock-takin documenting of measured data for assessing the track and the clearance gauge, and thus to rest work to those areas where the limits of tolerance reached in the foreseeable future.

3.5 "Vehicles"

A survey of the relevant sources concerning "vehicles" component revealed very little potentia changes in standards, both for rail vehicles ar coaches. Obviously the particularly well-develop type recommendations of the VÖV (Association o Undertakings) concerning vehicle technology hav effect on the economic dimensioning of public t The cost-effective change in standards applying t demonstrated in an exemplary manner by refer "ratio of seats to standing room", "maintenanc "vehicle size in line with demand".

Potential savings by means of reduced standards widths are realised in the new DT4 metropolitan Hamburg. The vehicle width is 2.60 metres and th ment is 2+2, although this means that the seat a short of the type recommendation issued by the V dimensioning rules which are customary in Hamb of a standard 2+1 seating arrangement would ha increase in vehicle deployment during peak ho adopted instead means that seated passenger somewhat cramped conditions during the peak ho

Owing to the developments in vehicle technology years, the reliability of parts and assemblies has protection against corrosion has been improved. further reducing workshop repair capacities emerg perspective of the transport undertakings, the co ments in maintenance strategies over the past fe themselves felt because, the more effectively pr ance and inspection are carried out, the less the burdened with repair jobs. The comparison of th for the "care", "inspection and maintenance" a tions, as recommended by a vehicle manufactu sponding data in the support and promotion guid the Federal Ministry of Transport, reveals a sa maintenance sector (inspection, preventive ma which, depending on the distance travelled an vehicle fleet, amounts to 2 to 5 work stations in th depot size of 50 to 200 vehicles, which is usual today. It is in this area that an adjustment to the a pears to make sense with a view to the planning pots. This is all the more true since, in addition

COST CENTRE GROUPS			SALES SERVICE	OPERATING	DEPOT OPERATION	STOP/STATION OPERATION	FUEL/POWER SUPPLY	MAINT. STRUCTURES AND TRACKS	MAINT. STOPS/STATIONS	MAINT. VEHICLES	MAINT. OTHER TECHNICAL EQUIPMENT	DEPRECIATION	INTEREST	GENERAL ADMINISTRATION	MISCELLANEOUS	SUM TOTAL [%]
METROPOLITAN RAILWAY	SHARE IN [%] OF TOTAL COST		5.2	8.8	2.1	13.7	7.5	5.0	9.6	8.2	6.3	12.4	2.4	13.2	5.7	100
	DEPENDENT TO THE LEVEL OF n [%] on:	ADMINISTRATION	85								13	19		61	60	19
		ROUTE NETWORK		10		100	8	96	100		84	48	67			42.5
		VEHICLE FLEET		10	14					73	3	33	33	16	17	15.1
		DISTANCE TRAVELLED	15	80	86		92	4		27				23	23	23.4
LRRT/TRAM	SHARE IN [%] OF TOTAL COST		4.4	27.4	2.2	0.3	5.8	11.4	1.8	17.5	2.7	10.4	3.9	8.7	3.5	100
	DEPENDENT TO THE LEVEL OF n [%] on:	ADMINISTRATION	30								20	10		42	40	10.2
		ROUTE NETWORK		5		100	10	90	100		70	30	55			21.5
		VEHICLE FLEET	10	10	40					65	10	40	45	30	30	25.2
		DISTANCE TRAVELLED	10	85	60		90	10		35		20		28	30	43.1
BUS	SHARE IN [%] OF TOTAL COST		2.0	51.1	2.0		6.8			8.7	2.9	5.1	0.5	14.5	6.4	100
	DEPENDENT TO THE LEVEL OF n [%] on:	ADMINISTRATION	80								35	5		8	8	4.7
		ROUTE NETWORK		1							55	3	20			1.9
		VEHICLE FLEET	10	9	95					39	10	53	40	53	53	24.1
		DISTANCE TRAVELLED	10	90	5		100			61		39	40	39	39	69.3

Table 1: Cost breakdown according to cost centre groups and spheres of influence

The savings potential which can be developed by combining cost percentages on the one hand, and possible changes in standards on the other, is qualitatively classified into four levels related to the total expenditure of the operation:

— no cost effects,
• minor cost effects (savings of up to 1%)
● medium cost effects (savings of up to 3%), and
● major cost effects (savings of up to 6%)

The classification shown in **Table 2** is a kind of estimate prepared by experts.

5 The effects of reduced standards as exemplified by selected sets of measures

The analysis of the cost structures of the operating branches "metropolitan railway", "light rail rapid transit/tram" and "bus", as well as a preliminary appraisal of the achieveable savings potential concerning the system components, have shown that reliable data concerning the effet of reduced standards on costs which are restricted to individual system components can only rarely be obtained. When the appraisal of the savings potential is subdivided according to the individual components, it cannot be ruled out that the full utilisation of this potential, by means of reduced standards concerning individual components, results in additional expenditure in the case of other sub-components. For this reason, the final economic assessment of reduced standards can ultimately only be carried out with regard to the specific cost situation of the enterprise concerned. As explained above, adequate cost accounting methods are not yet available for such decision-orientated cost accounting operations.

The cost effects of selected sets of measures involv standards, however, can also be appraised without ta count in detail all that is involved in the costs of the enti For this purpose, strategies for change are formulate based on the experience of the enterprises participatin and which, as a rule, comprise sets of measures aime form objective. While pursuing maximum cost effecti negative repercussions on passengers and staff are to b far as possible. These are conflicting objectives in the c all measures because it is only in exceptional cases t ings without any disadvantages to passengers and/or achieved. Anything close to a compromise between the requirements "maximun cost savings" and "minimu tage" to passengers can most probably not be formula erally valid manner and will rather vary from place to pl enterprise to enterprise. An assessment will certa achieved by the implementation of measures which is a by monitoring efficiency. Nevertheless, a qualitative st cerning the effects of reduced standards is assigned he of measures under study. **Table 3** shows a compilation pertaining to the sets of measures under study.

bundle of measures	cost effects in terms of their share in the overall operating cost of the various branches of operation: metropolitan railway	LRRT/Tram	bus	effect on: passengers	staff
— relocation of ticket sales	●	●	●	+	+
— restructuring of customer service and information	●	●	●	+	+
— reducing the level of service during peak hours	●	⬤	⬤	-	-
— speeding up vehicles turn-arounds	o	●	●	-	+
— increasing the responsibility of staff and passengers	●	⬤	⬤	+	+
— flexible working hours (capacity orientated flexitime)	●	●	⬤		-
— flexible deployment of staff, resorting to third party services	o	●	⬤		-
— limited provision of lifts and escalators	● [1]	● [1]	o	-	
— lowering of maintenance standard	●	●	o		
— replacing regular service by demand-orientated service — flexible operating modes			[2]	+	+

COST EFFECT
- o none
- ● minor (up to 1%)
- ⬤ medium (up to 3%)
- ⬤ major (up to 6%)

EFFECT ON PASSENGERS/STAFF
- - negative
- + positive

[1] heavily dependent on local situation, therefore difficult to compare
[2] no direct cost saving as against the current situation, but essential for maintaining public transport in rural are

Table 3: Survey of the results of the sets of measures under study

Project 70137/85

Cashless money transfer in the public transport sector with the help of novel means of payment

Hamburg-Consult GmbH, Hamburg

Completed August 1987

The transport enterprises are forced to rationalise and automate. For this reason, the users of short-distance public transport are increasingly obliged to acquire tickets from vending machines. This entails problems involving coins which are all the more serious when higher amounts have to be paid (e.g. for multi-ride tickets and day tickets).

Handling cash payments aboard the vehicle results in long waiting times at the stops, and thus substantial delays requiring longer vehicle turn-arounds. The effort on the part of the driver who has to do the accounting goes up with increasing amounts of cash. Transporting, counting and accounting for the coins collected by the vending machines involve considerable expenditure on the part of the transport enterprises. With fares increasing with time and the amounts to be paid going up, the problems are bound to worsen.

Vending machines which accept notes do not constitute a satisfactory solution. Apart from the fact that some passengers take a critical view of them, the risk of robbery becomes more serious when the amount of money handled grows. In addition, problems concerning the balances of the amounts due arise when notes over DM 20 and even DM 50 are accepted.

These problems can be overcome by using cashless payment methods by means of so-called "value cards" (credit cards and debit cards). The development of such means of payment as an alternative to paying by means of coins and notes has made rapid progress over the last few years. Debit and credit cards are more easily handled than cash and checks, and as a result their importance will grow. Public transport authorities cannot afford to ignore this topic without accepting a loss in attractiveness of public transport.

It is the aim of this study to use model cases involving different sales methods, branches of operation and spatial structures for examining the transport, operations and economic aspects of the potential success of using debit and credit cards instead of cash to buy public transport tickets. This is to make certain that the technological and organisational foundations for the use of cashless payments in the public transport sector are laid at an early stage.

Based on the requirements of public transport users and enterprises for the use of cashless payments in the public sector, the conditions created by the organisation and sal res of the transport enterprises, and the card systems cor available, four models have been developed:

— Model A (POS)

POS (Point of Sale) is a system which makes it possible f ders of electronically scannable cards to pay "electronica cash registers (POS terminals) of suppliers of goods and without handing over cash, checks or any other means of For this purpose, the customer must identify himself by e "Personal Identity Number" (PIN). Processing is entirely c cards are the medium used at the present time"). M intended for the cashless sale of higher-priced tickets (e. tickets) at vending machines or in the sales agencies of the enterprises.

— Model B "POS / Off-line credit card"

This model comprises a combination of model A with credit procedure operating within certain accounting li characterised by the additional use of the EC cards as credit card for rather small amounts. For the purpose c ditional function, the card is used as an identity card only. code, account number and card number are read into the F nal, the authorisation is checked and stored together amount of the transaction. In order to be admitted to this customer has to grant direct debit authorisation to be trar terprise and have an appropriate entitlement mark recorc credit card. Subsequently all transactions are collectec cumulated per customer on the transport enterprise's cer puter. Once a previously fixed credit line or time limit is rea customer's bank account is debited. The off-line credit ca to purchase single, multi-ride and day tickets, while the PC the model is used for buying higher-priced tickets.

— Model C "POS / Monofunctional wallet"

This model is based an a combination ot the POS method and a debit function (monofunctional wallet). It involves an of a POS-usable EC card by an additional memory, whic the holder to buy tickets from a transport enterprise. The dates the debit portion at the terminal of a bank or of a tra terprise. Crediting to the transport enterprise is effected tely. The debit portion of the card is intended for the acq single, multi-ride and day tickets, the POS part for higher-p ets.

— Model D "Debit card"

The concept of the transport enterprise-related debit ca basically from the models described above in that there i nection with the EC card issued by banks. The cards offer this model are issued by the transport enterprise concer passenger buys the debit card at any sales outlet and uses cash.

A short evaluation of these four models comparing their e customer and transport enterprise, as well as the possibili implementation, produces the following findings:

— The Model A "POS" has the advantage that customer holding an EC card can participate in the cashless transa tem without any further formalities. However, owing to the high cost per transaction, it is only suitable for selling high tickets. Its implementation is possible at short notice pro Gesellschaft für Zahlungssysteme (GZS, Payments Syste pany) makes the necessary infrastructure available.

Project 77052/86

Optimising the operational planning of winter road maintenance in towns and villages

Institut für Verkehr, Prof. Dr.-Ing. Durth, TH Darmstadt

Completed July 1987

In the course of conducting the present research project, entitled "Optimising the operational planning of winter road maintenance in towns and villages", the winter road maintenance by local authorities, including its constraints and operational planning, was analysed, and a method for optimising operational planning was developed. The winter maintenance was analysed by means of a wide-ranging survey among municipal street-cleaning services, in which 156 towns and villages participated. The survey covered the route network, spreading materials, winter maintenance equipment, operational planning and practical application. On the basis of the survey results, detailed indications and recommendations concerning optimised operational planning of municipal winter road maintenance were developed and described in the form of recipes.

The survey results show that the increasing awareness of ecological problems has brought about a major change in municipal winter road maintenance over the past few years. More and more towns are introducing a differentiated form of winter maintenance, comprising the graduated spreading of de-icing substances and abrasive materials, and a growing percentage of "white streets", where no spreading whatsoever is applied. This differentiated winter maintenance, however, is substantially more expensive and makes much higher demands on the organisation of practical operations than the winter maintenance of earlier years did. It is precisely in this area that developments in recent years have not kept abreast of the increasing requirements.

It is true that the vehicles available to winter maintenance operators today are of a better quality (route dependence, spreading of pre-wetted salt, dual-compartment spreaders). In terms of quantity, however, they are still what they used to be 10 years ago. This means that a more demanding winter maintenance must be carried out with the same number of vehicles. Thus it is imperative to make optimum use of the existing vehicle fleet through appropriate operational planning.

It is precisely in the field of operational planning that a major deficit can be identified. Owing to closely meshed networks and numerous constraints (vehicles, predetermined directions of driving), the preparation of snow-removal and spreading schedules in towns is very difficult in its own right, but it becomes even more complicated because of the differentiation into two superimposed s| reading activity (de-icing substances and abrasive m.

Besides, route planning is still carried out without the s methods (EDP) or new scientific findings (optimisati even though such aids are available today. Snow- spreading schedules are drawn up manually in a very la ner and are changed as little as possible over the yea avoid additional effort and expenditure. In many town ing route lengths are ascertained, but not the distanc vehicles cover when empty and when going to reload. are available on real distances covered and the resultir ti nes, which are often distributed in a highly varied wa existing operational plans are frequently not the opti could be developed for the case in question by using r ods.

The present research project is designed to close this tional planning for the municipal winter road maintenan the survey results, which reveal the present divergen conditions existing in the various towns, a method was preparing optimised snow-removal and spreading sc the aim of optimisation to implement the best possible tenance with the means available.

The method, the working of which is described in the cipe, and which is broken down into individual steps, is timisation methods used in business management and It proceeds from a clear presentation of the winter route network in abstract terms by means of edges ("graphs"). All the standards and constraints necess maintenance are systematically recorded and present of graphs and/or tables.

If the route network is to be broken down anew accord levels and/or spreading materials, indications are list proceed and which appraisal criteria to use for such gra

Route planning proper starts with the formation of su the town area, from which individual vehicle precincts a in accordance with the details of the existing vehicle fl this first step, a subsequent essential measure is the a vehicles to the individual precincts, which should b possible. It has a substantial influence on the quality plans (minimising the distances travelled for reloading)

Within the precincts, optimised operating routes shou tablised for the individual vehicles. They should mee straints and contain as little dead mileage as possib graph theory methods are used for finding minimum de

The precise ascertainment and supervision not only of covered when spreading, but also of the necessary se and from the vehicle's precinct), of dead mileage precinct) and of reloading trips are essential for opti tional planning. Correspondingly, it is necessary to e cisely the vehicle route in the operation schedule, so th routes are in fact implemented.

In addition to the drawing up of standard operating description is given of how and when special plans c lished for extraordinary cases, such as snow-removal weather conditions, restricted operations or a reduce vehicles.

Optimising winter maintenance, however, does not route optimisation; over and above this, it may result i ation of the entire winter maintenance organisation. course of the optimisation process, it is possible to ana

Part II: Urban Transport Research Programme

A. Classification of research and study assignments

1. Planning methods and planning

1.1 Town, country and regional planning
1.2 General transport plans
1.3 Individual transport plans
1.4 Legal questions
1.5 Miscellaneous

2. Technical studies

2.1 Civil engineering
2.2 Vehicle technology
2.3 Technology of transport
2.4 Operating technology
2.5 Construction and operating expenditure
2.6 Urban planning and construction
2.7 Miscellaneous

3. Economic studies

3.1 Demand
3.2 Supply (economics and technology)
3.3 Investments and financing
3.4 Miscellaneous

4. Sociological, medical and other studies

4.1 Sociology, psychology
4.2 Medicine and related fields
4.3 Miscellaneous

5. Specialized studies

5.1 Electronic data processing (EDP)
5.2 New transport systems
5.3 Miscellaneous

Project		Commissioned to	Abstr publi in Iss
77 025/61	Quantification of the separating effects of traffic construction measures in urban areas on social relations and urban structures	Prof. Dr.-Ing. Harder, Hemmingen	
77110/82	Capital investment in transport for a recreation-oriented environment — An empirical stock-taking of traffic control and traffic restraint measures in communities for recreational use	Institut für Verkehrsplanung, und Verkehrswegebau TU Berlin, Prof. Dr. Heinze	
70111/83	Allowing for the needs of public transport when planning and redesigning traffic-restraint zones — The treatment of scheduled buses in the planning process	Institut für Stadtbauwesen, RWTH Aachen, Prof. Dr.-Ing. Mäcke	
70124/83	Traffic Restraint Precincts in small towns and rural communities — Documentation and discussion of practical experience concerning the use of signs 325/326 of the German Highway Code (StVO)	Prof. Dr. Heinze, Berlin	Spec

1.2 General transport plans

1/67	Which principles should be heeded in the general transport plans of towns, cities, regions, Länder (states), and the Federal Republic in order to maintain and develop a uniform and co-ordinated transport system?	Prof. Dr. Voigt, Bonn	
16/67	Investigations of the possibility of replacing traffic volume surveys by traffic density surveys for urban and regional traffic planning (extension cf. project 18/69)	Prof. Dr. Leutzbach, Karlsruhe	
10/68	Theoretical studies on the planning of transport networks with special consideration of public short-distance passenger transport	Prof. Dr. Grabe, Hannover	
11/68	The desirable connexion of urban road networks with motorways	Prof. Dr. Mecke, Braunschweig	
12/68	Parking space requirements for passenger cars within office buildings for service enterprises	Prof. Sill, Hamburg	
18/69	Investigations of the possibility of replacing traffic volume surveys by traffic density surveys for urban and regional traffic planning (extension of project 16/67)	Prof. Dr. Leutzbach, Karlsruhe	
19/69	Methodological foundations of accounting for the cost of congestions in urban traffic	Prof. Dr. Mäcke, Aachen, Prof. Dr. Voigt, Bonn	
3/70	Development of standard transport plans including their elements, and proposed solutions for traffic and transport analyses and forecasts for different town size classes	Ing.-Büro Dr. Riemer, Düsseldorf	
4/70	Developing and programming a technique for the search of alternative routes in public and private short-distance transport (extension cf. projects 2/71 and 20/75)	Dornier System GmbH, Friedrichshafen	
5/70	Investigation of the distribution in space and time of recreational traffic during weekends in the fringe areas of urban agglomerations; determination of relevant parameters	Prof. Baron, Dortmund	
6/70	Investigation of the financial effects on the budgets of the territorial authorities involved and on the commercial result of Deutsche Bundesbahn (DB, German Federal Railways) which are the result of DB's participation in operating and fare communities as illustrated by the example of Münchener Verkehrs- und Tarifverbund (operating and fare co-ordination scheme for transport in the greater München region)	Deutsche Revisions- und Treuhand AG München	
7/70	Investigation of the determination of travel time savings and their economic evaluation	Prof. Dr. Oettle, München	
8/70	Determination of optimum criteria for the purpose of delimitating regions from the point of view of travvid and transport	Prof. Dr. Retzko, Darmstadt	
16/70	Operational, legal, and economic prerequisites for the creation of traffic pool systems	Direktor Dr. Gutknecht, Aachen	
1/71	Suitable survey methods for co-ordinating parking space and road space for moving traffic	Prof. Dr. Leutzbach, Karlsruhe	
2/71	Developing and programming an integrated traffic model for urban areas and conurbations (with special reference to assignment techniques) (extension of project 40/70, cf. also 20/75)	Dornier System GmbH, Friedrichshafen	

Project		Commissioned to	Abstr publi in Iss
5/76	Transport conditions of disadvantaged groups of the population as a guide for purposive town and transport planning	Institut für Zukunftsforschung, Berlin	
6/76	Space-time relationships of Sunday traffic volumes in urban and near-urban areas	Dr. Heusch, Dipl.-Ing. Boesefeldt, Aachen	
21/76	Possibilities of using the STREAK/UTPS program packages for the purposes of integrated traffic route planning	DATUM, Bonn-Bad Godesberg	
5/77	Study of measures designed for separating road-bound short-distance public transport and private transport in terms of space and time	Dr. Heusch, Dipl.-Ing. Boesefeldt, Aachen	
6/77	Possibilities of developing urban pedestrian precincts paying special consideration to a passenger-oriented inclusion of scheduled public transport	Prof. Dr. Fiedler, Wuppertal	
19/77	Possibilities of handling and transporting luggage when the passenger transport of DB is shifted from rail to road	Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	
22/77	Price elasticities in the demand for short-distance public transport	Socialdata GmbH, München	
70 025/79	Preparation of the Bus Transport System demonstration project	Hamburg-Consult GmbH, Hamburg	Ex At Spe
70 054/80	Consideration of environmental aspects when planning urban traffic networks	Prof. Dr. Ruske, Braunschweig	
70 058/81	The development of bicycle traffic and the probable amount of capital expenditure needed	Intraplan Consult GmbH, München	
70 060/80	Development of a concept for a future light rail rapid transit system	Rhein-Consult GmbH, Düsseldorf	
70 065/80	Inclusion of environmental aspects in the methodology of transportation planning	Ingenieurgruppe IVV, Aachen Institut für Stadtbauwesen, TU Braunschweig	Specia
70 085/81	Influencing modal choice in favour of public transport, bicycle traffic and pedestrian traffic in urban transport, in big towns at the centre of large sparsely populated areas	Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	
77 015/80	A study concerning the cross section design of oneway streets in built-up areas	Dr.-Ing. K.H. Trapp, Aachen	
77 022/81	The planning and design of streets in towns	Institut Wohnen und Umwelt, Karlsruhe	
77 037/84	Network simulation for homing systems in urban part areas	Prof. Dr. Hoffmann, Berlin	
77 039/85	Pilot study for the purpose of establishing extrapolation factors for short-term traffic counts in urban road networks	Institut für Verkehrswesen, Prof. Dr.-Ing. Brilon, Ruhr-Universität Bochum	
77 043/85	Possibilities of improving a regional railway line of Deutsche Bundesbahn (DB) with special consideration of providing attractive park and ride facilities, as exemplified by the Limburg—Frankfurt/Wiesbaden DB line	Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	
70 155/85	Determination of foreseeable effects of the Bus Transport System demonstration project and ascertainment of *status quo* for the purpose of carrying out a "before/after" comparison and obtaining proposals for improving the demonstration project — "before" study —	Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	

1.3 Individual transport plans

14/67	State and improvement of transport conditions in the area surrounding München as exemplified by the München-Wolfratshausen-Beuerberg traffic link	Ifo, München	
22/68	Investigation of the lay-out of above-ground transfer facilities and interchange points to private transport (follow-up project cf. 39/70)	Prof. Dr. Kracke, Hannover	
23/68	Investigation of the connection of underground with above-ground transport systems and with private transport (follow-up project cf. 40/70)	STUVA e.V., Köln	

Project		Commissioned to	Abstract published in Issue
16/68	Determination of load on tunnel structures attributable to traffic loads, and determination of stress on the tunnel floor owing to the operational load	Prof. Dr. Kordina, Braunschweig	19
17/68	Examination of the guiding performance on the tracks when wheel sets of varying dimensions and contours are operated jointly on tracks with identical gauges	Prof. Dr. Kurek, Osnabrück	2
8/69	Investigation of the effects of sprayed-on concrete as tunnel lining as compared with the shield method of construction with thin covers of loose rock	Prof. Dr. Breth, Darmstadt	6
14/69	Suitability of direct fastening of rails of underground railways and/or tramways	Prof. Dr. Eisenmann, München	4
15/69	Investigation of the guiding properties of small wheels, in particular laterally elastic wheels, in single and double crossing frogs of tramways and urban railways	Prof. Dr. Kurek, Osnabrück	14
9/70	Slip resistance of bituminous multilayered waterproofing 1. Examination of the long-term behaviour of bituminous multilayered waterproofing in case of coplanar loads 2. Examination of the behaviour of bituminous multilayered waterproofing being secured against tangential stresses by disc-shaped anchors	STUVA e.V., Köln	10
10/70	The sealing of reinforced concrete tunnel liners in single-shell methods of construction	Materialprüfungsanstalt, Stuttgart	13
11/70	Investigation of the causes of periodical transverse wear manifestations on the tracks of short-distance transport and the consequences thereof for the construction of vehicles	Prof. Dr. Nöthen, Aachen	11
12/70	Investigation of the determinants of tunnel height in the construction of metropolitan railways	STUVA e.V., Köln	13
8/71	Deformation behaviour of low-cover tunnels in urban areas and the generation of zones of loosening in their neighbourhood with due regard to heavy foundation loads	Prof. Dr. Müller, Karlsruhe	10
9/71	Static investigations of tunnel structures used for traffic purposes	Prof. Dr. Duddeck, Braunschweig	8
10/71	Implementation of tests for measuring earth pressure on tied-back soldier pile walls	Prof. Dr. Breth, Darmstadt	10
11/71	Investigation of the dependence of current on earth resistances with special reference to conditions in conurbations	Forschungsgemeinschaft für Hochspannungs- und Hochstromtechnik e. V., Mannheim	15
12/71	Locating and correcting sealing defects on blankets of underground railway structures – parts I and II (extension cf. project 9/74)	STUVA e.V., Köln	18
13/71	Investigation of the appropriate design of underground railway stations with regard to acoustics	Müller-BBM GmbH, München	10
8/72	Comparative measurements of structure-borne sound on various novel, ballast-free types of permanent way	Müller-BBM GmbH, München	
10/72	The creep behaviour of grouted anchors	Prof. Dr. Jelinek, München	26
11/72	Economical dimensioning of high retaining walls in urban traffic construction	Prof. Dr. Smoltczyk, Stuttgart	15
4/73	see 1.2 General transport plans		
11/73	Investigation on the structure gauge and vehicle gauge of double rail public transit	Dipl.-Ing. Braitsch, Bergisch Gladbach	3
11/73	Studies on the dimensioning of the clearance and of the vehicles of double-rail systems used for short-distance public transport	Dipl.-Ing. Braitsch, Bensberg	
12/73	Study on methods of monitoring the loading of building structures particularly of tunnels	STUVA e.V., Köln	18
13/73	Ventilation and air-exhaust systems for short-distance transport tunnels	Deutsche Eisenbahn-Consulting, Frankfurt/M.	10
14/73	Investigation of the behaviour of waterproofing systems around flexible joints in underground railway structures	STUVA e.V., Köln	16
15/73	Technical investigations of acoustics on elevated railways of different design	Müller-BBM GmbH, München	1

Project		Commissioned to	Abstract published in Issue
70 080/81	Investigation with regard to the safe guiding of vehicles of surban railways on their tracks	Prof. Dr.-Ing. Kurek, Osnabrück	35
70 100/81	Experimental and mathematical investigation of frontal impacts which occur when rail rapid transit vehicles are shunted, and drafting of new dimensioning and construction criteria for the car bodies of such vehicles	Prof. Dr.-Ing. Bugarcic, Berlin	37
70 118/83	Study on reducing the spacing of the wheelsets on the bogies of light rail rapid transit vehicles	Prof. Dr. Bugarcic, Berlin	42

2.3 Technology of transport

3/67	Measures and effects of traffic diversions during the construction of transport facilities below ground level regarding various methods of construction	STUVA e.V., Köln	1
14/68	Measures of construction and traffic engineering for the reduction of traffic noise on highways	BAST, Köln	3
21/68	Studies into the advantages of applying the Aachen measuring techniques as compared to the other known methods for ascertaining the disturbing influence of traffic, and as a contribution to establishing guidelines for improving traffic conditions in cities, towns, and other built-up areas	Studiengesellschaft "Leichtbau der Verkehrsfahrzeuge", Frankfurt/M.	4
17/70	Investigations of the practical effects of alternating direction lanes on the safety and capacity of urban streets	Prof. Dr. Wehner, Berlin	11
19/70	Optimum travelling speeds on jointly operated routes (follow-up project cf. 14/72)	Prof. Dr. Kracke, Hannover	13
14/71	Investigations of traffic-actuated signal control. Part C: control models for partial networks	Dr. Heusch, Dipl.-Ing. Boesefeldt, Aachen	8
16/71	Effects of high-rise office buildings in town centres on traffic	Prof. Dr. Schlums, Stuttgart	8
9/72	Optimization of tramway and bus operation by way of time and traffic dependent signal control	Dr. v. Stein, Düsseldorf	14
13/72	Preliminary study for the determination of the accident probability arising in various conditions of pedestrian crossing movements on urban streets	Forschungsgemeinschaft "Der Mensch im Verkehr", Köln	10
14/72	Determination of blocking times and capacity of track junctions for local lines by means of digital computers (follow-up project for 19/70)	Prof. Dr. Kracke, Hannover	13
23/72	Reducing traffic peaks by co-ordinating traffic generator times	Prof. Habekost, Braunschweig	21
17/73	Study of the possibilities for an objective assessment of the quality of private transport in towns with special consideration of journey speed, standard deviation of acceleration and street characteristics	Prof. Dr. Grabe, Hannover	21
13/74	The effect of trains of certain suburban railway lines entering trunk lines at variable intervals on the potential degree of capacity utilization and punctuality of such suburban trunk lines	Prof. Dr. Pierick, Braunschweig	21
14/74	Practical efficiency of speed-dependent safety systems for rail-based transport systems	Prof. Dr. Pierick, Braunschweig	21
10/75	Determination of the qualitative performance of junctions on high-speed short-distance railways and study of its influence on the configuration of the junctions and the routes leading up to them	Prof. Dr. Kracke, Hannover	21
10/76	Traffic-actuated signal control including control of short-distance public transport – a study of the mutual relationships involved in the control of traffic flow as a whole	Dr. Heusch, Dipl.-Ing. Boesefeldt, Aachen	27
11/76	A generally valid procedure for calculating the capacity of platform tracks and the most suitable design of the railheads of passenger stations	Prof. Dr. Kracke, Hannover	29
77 001/78	The dimensioning of urban streets with regard to different qualities of traffic, taking into account the repercussions on the quality of the housing environment	Prof. Dr.-Ing. Mäcke, Aachen	35

Project		Commissioned to	Abstract published in Issue
2.6 Urban planning and construction			
11/69	Land use index – road index – parking index	Salzgitter-Industrie GmbH, Verkehrs- und Industrieplanung, Lenz Planen + Beraten	5
35/70	Visual marking of urban clearways and major roads in towns for the improvement of road safety and traffic flow	Prof. Spengelin, Dipl.-Ing. Dückert, Hannover	15
2.7 Miscellaneous			
2/67	Examination of the oscillation dynamics in the vicinity of tunnels of railways and discussion of measurements taken at certain points of the tunnel	Prof. Dr. Koch, Hannover	1
15/68	Statistical measurements of the sound level of railways	Physikalisch-technische Bundesanstalt, Braunschweig	4
18/68	Measurements of the admittance per unit length of various objects for determining the specifications for DC-railways in tunnels	Technische Akademie, Wuppertal	3
19/68	Study on accompanying luggage in local transport (in vehicle and at points of transfer or change)	Planungsgesellschaft Ruhr, Essen	2
24/68	Measurements of the sound conducted by solids during the passing of tramway vehicles as compared with underground railway vehicles	Prof. Dr. Koch, Hannover	4
17/71	Noise abatement on commercial motor vehicles as exemplified by the standard VÖV-bus for line operation	Gesellschaft für Verkehrsberatung und Verfahrenstechniken mbH, Hamburg	7
18/71	Effects of different vehicle types on the emission of structure-borne sound in underground railway or underground tramway tunnels with a permanent way with ballast as studied in different cities	Prof. Dr. Koch, Hannover	11
16/72	Examination of external and special influences on tunnel sections of DC operated railways with a view to corrosion hazards	Technische Akademie, Wuppertal	13
77 009/79	Assessment of road traffic exhaust gas immissions	Prof. Dr. Glück, München	29
3 Economic studies			
3.1 Demand			
8/67	The influence of the elasticity of demand for transport services as a function of transport rates and its effect on the transport volume in short-distance passenger transport	Prof. Dr. Diederich, Hamburg	1
9/67	Possible methods of cost comparison of private and public passenger transport from the point of view of road and rail users and of public authorities	Prof. Dr. Oettle, München	1
3/68	Problems, possibilities, and requirements of urban traffic forecasts from the economic point of view	Prof. Dr. Funck, Karlsruhe	7
6/68	Examination of the theoretical and practical possibilities of charging tolls for the solution of urban transport problems	Prof. Dr. Funck, Karlsruhe	5
8/68	Development of a method for ascertaining and analysing private car traffic in conurbations	INFAS, Bonn-Bad Godesberg	2
1/69	The future demand for passenger transport services as a function of the socio-economic structure of communities of various sizes and types (extension project cf. 24/70)	Prognos AG, Basel	3
2/69	The future load on the traffic networks of communities in the Federal Republic of Germany attributable to short-distance freight transport with special consideration of conurbations	DIW, Berlin	7
3/69	Distribution of passenger traffic volume on different modes of transport (modal split) as a function of income, social status, location within the community, journey time, journey cost, journey purpose, available transport services	INFAS, Bonn-Bad Godesberg	3

Project		Commissioned to	Abstract published in Issue
3.2 Supply (economics and technology)			
4/68	Are tax reductions and tax exemptions for public short-distance transport compatible with the principles of equality and justice of taxation, and how do they influence competition?	DIW, Berlin	2
5/68	Optimum fares in public short-distance passenger transport	Prof. Dr. Bellinger, Berlin	4
7/68	Problems and possible solutions of urban track cost calculation	Prof. Dr. Funck, Karlsruhe	7
9/68	Preliminary study preceding a study into passenger and goods transport in conurbations with a view to a technical optimum of transportation services taking into consideration utilization and properties of different means of transport a) inbound and outbound traffic b) internal traffic c) transition from private transport to public short-distance passenger transport	Prof. Dr. Nebelung, Aachen	2
20/68	The connection of the large commercial airports in the Federal Republic of Germany with the existing rapid transit systems as seen from the point of view of public short-distance passenger transport	Prof. Dr. Lambert, Stuttgart	2
4/69	The effects of operating communities in public short-distance passenger transport on the quality of service, the demand for transport, and the economic situation for the participating undertakings, as exemplified by the Verkehrsverbund Hamburg	Prof. Dr. Diederich, Hamburg	5
5/69	Effects of free public short-distance transport services in conurbations upon individual undertakings and upon the economy as a whole	Prof. Dr. Oettle, München	3
13/69	Ascertainment of the shortfall in receipts resulting from the rate for pupils, students, and apprentices on tramway, trolleybus, and scheduled motor vehicle services in the Federal Republic of Germany as measured against the comparable season ticket rate, and principles guiding the calculation of compensations	Wibera AG, Düsseldorf	3
27/70	Study on the determination of dimensioning loads Part I Part II	Prof. Dr. Retzko, Darmstadt	11 12
28/70	Productivity and possibility of utilization of various short-distance transport systems from the economic point of view with due consideration of the foreseeable technological progress	Battelle Institut e.V., Frankfurt/M.	5
29/70	The cost-benefit analysis as a criterion in assessing the feasibility of urban underground rapid transit systems	DIVO, Frankfurt/M.	4
30/70	Rates and fares in line with future requirements and modern services for passengers (passenger handling) with due consideration of the economic situation of the transport undertakings, the demand for transport, and the practical aspects involved	Dr. Neubert KG, Düsseldorf	6
31/70	Definition of a standard of service in public short-distance passenger transport	Gesellschaft für Verkehrsberatung und Verfahrenstechniken mbH, Hamburg	7
21/71	Cost-benefit analysis of a central goods distribution system for transport by lorries as exemplified by a conurbation	Dornier System GmbH, Friedrichshafen	7
30/72	Concessionary fares and their influence on demand	Wibera AG, Düsseldorf	14
31/72	The influence of transport infrastructure on the travel behaviour of the population, as exemplified by the Munich suburban railway system	Stadtentwicklungsreferat, München	14
20/73	Cost-benefit analysis of alternative measures for traffic connections and transport development of an urban development area by public local transport as exemplified by the town of Augsburg	Dornier System GmbH, Friedrichshafen	24
21/73	Making allowance for environmental pollution when planning urban transport investments by means of cost-benefit analyses and cost-effectiveness analyses	Prof. Dr. Willeke, Köln	13
24/74	Demands on and expectations of first-class travel on short-distance public transport as exemplified by the Deutsche Bundesbahn (German Federal Railways)	Infraplan, Köln, Dr. Ellinghaus	13

Project		Commissioned to	Abstract published in Issue
70130/84	The possibilities of using the Dutch Buurtbus System as a neighbourhood bus in the Federal Republic of Germany	SNV Studiengesellschaft Nahverkehr mbH, Hamburg	37
70 132/84	Study of the possibilites of improving short-distance public transport, including Deutsche Bundesbahn's rail transit, with special consideration of a branch terminal line in a medium-sized agglomeration and rural area, as exemplified by the rural district of Tübingen — Preparation of practical trial —	Study Group Kommunalentwicklung Baden-Württemberg GmbH, Stuttgart, Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	42
70 133/84	Study into the improvement of the economics of public transport with due consideration paid to the experience gained during the trial operation of the BFB Flexible Operating Modes Command and Control System as exemplified by the Bodenseekreis (Lake Constance District) — Phase II: Preparation of practical implementation —	Study Group Kommunalentwicklung Baden-Württemberg GmbH, Stuttgart, Studiengesellschaft Nahverkehr mbH (SNV), Hamburg	42
70 165/86	Study of the effect of changes in fares on the demand for public transport	Forschungsinstitut für Wirtschaftspolitik, Mainz, Prof. Dr. Diederich und Prof. Dr. Bartling	44

3.3 Investments and financing

12/67	Structure and development of transport investments of public authorities and enterprises in conurbations	Ifo, München	5
16/69	An economic comparison of alternative urban transport systems as exemplified by the city of Hannover	Prof. Dr. Hesse, Göttingen	4
32/70	The financing of public transport investments in conurbations	Prof. Dr. Willeke, Köln	6
23/71	The evaluation of new solutions in the short-distance public transport of a medium-sized city based on cost-benefit analyses taking into consideration foreseeable technological progress – as exemplified by the conurbation of Kiel	Deutsche Stadtentwicklungs- und Kreditgesellschaft mbH, Frankfurt/M.	19
22/73	Financing of public short-distance passenger transport	Wibera AG, Düsseldorf	9
29/74	Standardized assessment criteria for evaluating transport infrastructure investments for short-distance public passenger transport and road building projects of local authorities (extension cf. project 21/75)	Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn	15
14/75	Methodical ascertainment and quantification of the dividing effect of thoroughfares and of the preservation of valuable buildings, green spaces and recreation areas within towns as benefit components for benefit-cost analyses	Dr. Harder, Hannover	21
15/75	Ex-post benefit-cost analysis for metropolitan railway line 3 in München	Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn	19
16/75	Basic procedures for carrying out benefit-cost studies in the field of transport	Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn	26
17/75	Methods for determining costs resulting from short-distance public transport for the Federal Republic, the Länder and the local authorities	Wibera AG, Düsseldorf	15
19/75	Possibilities of reorganizing short-distance public transport in rural regions with a low traffic volume	Kommunalentwicklung Baden-Württemberg GmbH, Stuttgart	19
21/75	Standardized assessment criteria for evaluating transport infrastructure investments for short-distance public passenger transport and road building projects of local authorities – test runs (extension of project 29/74)	Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn	16
15/76	Criteria and procedures for quantifying social benefits derived from local public transport in order to establish standards to guide government decisions on assistance measures in the field of fare, tax and subsidy policies	Prof. Dr. Willeke, Köln	24
14/77	Cost-benefit analysis as exemplified by a metropolitan railway line in Frankfurt/Main	Battelle Institut e.V., Frankfurt/M.	26
17/77 A	Model study for determining the investment expenditure for noise control measures for existing railway routes	Dorsch Consult Ingenieurgesellschaft mbH, München	27
17/77 B	Model study for determining the investment expenditure for noise control measures for newly planned or substantially modified railway routes	Dorsch Consult Ingenieurgesellschaft mbH, München	27

Project		Commissioned to	Abstract published in Issue
24/76	Principles and basic fundamentals to be observed in selecting representative undertakings providing local and regional public transport and in ascertaining transport-specific cost figures to be used as a basis for compensation payments towards school-commuter traffic in accordance with Art. 45a para. 2 PBefG (Passenger Conveyance Act) and Art. 6a para. 2 AEG (General Railway Act)	Wibera AG, Düsseldorf	2(
70 077/80	Representative survey conducted to ascertain the mobility behaviour of (mobility-) handicapped persons and of the members of their households	Socialdata GmbH, München	Specia 3(
—	Study into the design of public rail transport in line with the needs of the handicapped	Gruppe Hardtberg, Bonn-Bad Godesberg	Special 3
70 099/82	Statistical assessment of rail transit lines in the Federal Republic of Germany	STUVA e.V., Köln	4
70 168/85	Transportsystems in line with needs of the handicapped Accessible bus services	Gruppe Hardtberg Bonn-Bad Godesberg	Special 43

4 Sociological, medical and other studies

4.1 Sociology, psychology

13/67	The competitive situation between private and public transport from the point of view of road and rail users	INFAS, Bonn-Bad Godesberg	1
34/70	A sociological typology of traffic (Problems and aspects involved in the development of an empirically based sociological typology of traffic as a medium-term forecasting instrument for private transport)	Prof. Dr. Klages, Berlin	13
27/74	Social assessment of novel short-distance transport systems (preliminary study)	SNV, Hamburg, Battelle, Frankfurt/M., Prognos, Basel	15
18/75	An inquiry into the provision of better services for the handicapped on local public transport	STUVA e.V., Köln	Exten Abstr Special 23
23/75	Social assessment of short-distance transport technologies (phase II)	SNV, Hamburg, Battelle, Frankfurt/M., Prognos, Basel	21

4.2 Medicine and related fields

21/72	Noise abatement for traffic facilities: the influence of fluctuating traffic noise levels on the disturbing effect. Suitability of the energy-equivalent continuous noise level for characterizing traffic noise	Dr. Buchta, Düsseldorf, Prof. Dr. Schlipköter, Düsseldorf	14
16/76	Traffic noise forecasts for urban streets	Dr. Schreiber, BBM GmbH, München	24
70 081/80	Inderdisciplinary field study an special features of rail-traffic noise as compared with road-traffic noise	Planungsbüro Obermeyer, München Project management Prof. Dr.-Ing. Heimerl, Stuttgart	35

4.3 Miscellaneous

36/70	Living conditions of plants at difficult urban habitats, in particular on tunnels, service ducts and underground garages	Prof. Dr. Schreiber, München	8
37/70	Ascertainment of occuring and reasonable walking distances within central urban areas	Prof. Dr. Retzko, Darmstadt	14
70 035/79	British and Scandinavian social science contributions to urban transport research	Battelle Institut e.V., Frankfurt/M.	33
70 047/79	Measures ans possibilities for integrating handicapped people into the overall transport structure	Studiengesellschaft Nahverkehr mbH (SNV), Berlin	Special I 30
70 045/80 and 70 090/82	Establishing fondations and recommendations for the introduction of car pools for journey-to-work commuting on the basis of model tests (70 045/80), and practical trial of a commuter information system (70 090/82)	SNV Studiengesellschaft Nahverkehr mbH, Hamburg	35