Economy and Ecology are no Contradictions

Three messages from Zürich concerning the new transport policy

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The increasing significance of private motorised transport has kept our cities locked in a vicious circle for years. The blocking of roads and the lack of car parks are being counteracted by the construction of new roads and car parks and the extension of existing ones. The result is that even the new roads are blocked and the lack of car parks becomes even greater. A city becomes more unattractive, and this evil is once again dealt with by the most obvious means: with the construction of new roads and car parks! The transport policy of the City of Zürich has broken this vicious circle and transformed it into a "rainbow", a symbol of environmental protection and economic strength (Figure 1). The overflow of private motor traffic was answered not by increasing but by redistributing the existing road area in favour of local public transport and pedestrians. The result is greater urbanity, better environmental conditions, increased economic strength (!) and stabilised private transport.

The transport policy of the Council of the City of Zürich has 4 objectives:

- Promoting a change from the car to public, environment-friendly transport.
- Channelling motor traffic - creating quieter conditions in residential areas.
- Limiting the parking places for commuters.
- Reducing motor traffic in the city. This objective of generally reducing the motor traffic was first formulated with this stringency in 1987 - under the impression that atmospheric pollution was increasing.

This transport policy is based on a recognition of the fact that, for physical reasons alone, it is not possible to make a city of half a million people accessible with the car. Car traffic takes up too much space, so that there is a danger that there will no longer be any city left after it has been adapted to meet the traffic needs. We are aware of similar examples from the USA.

In the interests of the economy, the quality of the environment and living and leisure standards, an above-average proportion of passenger journeys was assigned to public transport. An essential requirement for this is the provision of an attractive local public transport system and good conditions for pedestrians. Furthermore, because the individual citizen is not willing voluntarily to dispense with the use of his car despite a clear knowledge of the relationships, at the same time neither additional streets nor car parks were constructed. The objectives have been substantially achieved. A comparison of the distribution of journeys made over the various forms of transport shows that about twice as many journeys are made by public transport in Zürich than in comparative German cities; the proportion of journeys made by car is correspondingly smaller (Figure 2). The number of journeys per inhabitant per year still shows marked differences compared with other European cities (Figure 3).

First message from Zürich

If you ask the inhabitants of a town which transport policy should be followed, the citizens will not choose the car. They are much more intelligent than politicians and other opinion leaders believe and have higher values than merely standing still in a traffic jam.

The answer to the question as to how it was possible in Zürich to convince the citizens of the advantages of a transport policy which gives preference to public transport in the existing road system over private motor transport is as follows: Politicians and experts did not have to persuade the citizens. On the contrary, the citizens themselves initiated this transport policy through several referendums and a public campaign, in opposition to the will of politicians and experts. In Zürich, every public construction project which costs more than SFr. 10 million must be voted on by the public. As long as 20 years ago a phenomenon emerged which has been very clearly developed by Brög Sozialdata München, in the publication "Estimates of mobility in Europe" for the countries of the European Community:

- The citizens are very well aware of what has to be done in terms of transport policy: 84% would like to promote local public transport at the expense of private motor transport, 85% want preferential treatment for pedestrians and 73% want this for cyclists at the expense of private motor transport (Figure 4).
- The decision-makers (politicians, experts, etc.) do not believe the citizens to be capable of this insight. They believe that only 49% are in favour of promoting local public transport at the expense of private motor transport, only 43% want to give preference to pedestrians and only 30% favour cyclists.
- The citizens are also prepared to accept restrictions in the use of a car: 75% favour enlarging the pedestrian zones, 71% would like to see restrictions on car traffic and 53% are in agreement with parking restrictions (Figure 5).
- The decision-makers very considerably underestimate this willingness. They believe that only 51% are prepared to agree to enlarging the pedestrian zones, only 48% are prepared to accept restrictions on car traffic and only 36% are willing to see parking restrictions.

The question of course does arise as to why the citizens of these countries do not behave in a corresponding manner. The difference between collective reason and individual reason is evident here: in a group, at a strategic level, the citizens are quite able to recognise the superior interest as their own interest and to decide accordingly - in questionnaires or in referendums. As an individual, when leaving the house early in the morning, only individual reason applies: a saving of 10 minutes or the greater convenience of using the car results in a decision in favour of this form of transport. Only when this has no immediate advantages (no available parking spaces, travelling time longer than with local public transport, more stress, etc.) owing to superior (individual decisions) does the attitude change, giving way to greater insight. No one would then seriously suggest replacing taxes with voluntary donations. We know very well that the fundamental (collective) view that taxes must be paid is not sufficient to overcome the short-term individual advantage of using the money for something "more intelligent".

The misjudgement of the citizens' opinion and the underestimation of the citizens' collective reason by politicians and experts was corrected in Zürich by the necessary referendum: the citizens rejected projects for new roads and multistorey car parks and they refused investment credit for underground local public transport systems (underground tram, metro). On the other hand - contrary to the recommendation of the town council - they agreed with the public campaign which demanded giving priority to trams and buses in the existing road system and, by constructional and operational measures, ensuring that they are able to travel from stop to stop without delays, without interference from the car traffic and at the technically feasible speed (Figure 6).

The instrument of the referendum is very clearly responsible for the fact that transport policy in Zürich differs from that in towns where elected representatives of the public determine what happens. Brög (kleine Fibel) has an explanation for this phenomenon too: representatives of the citizens, politicians, are generally men aged between 20 and 60 and hence belong to that quarter of the population which uses the car to an above-average extent of 66% (average for all citizens 40%) and makes only 30% of journeys by public transport or bicycle or on foot (average for all citizens 49%) (Figure 7). Expressed more simply, the quarter of citizens who travel by car at above-average frequency also make the decisions and, because they use their own needs as a measure of the needs of all citizens, they decide in favour of car traffic.

Second message from Zürich

The future of urban transport policy lies not in expansion but in the intelligent use of the existing traffic areas. The objective of ensuring mobility for people when travelling to work and shopping and during leisure time requires imaginative urban traffic management based on modern information technology.

In a city, there will always be a shortage of space for traffic owing to the apparently unstoppable growth of private motor traffic with its enormous need for space. The expansion of these traffic areas through the extension of roads and car parks or the construction of new ones is extremely expensive and takes place at the expense of economically useful areas or of open spaces and is therefore in competition with other basic values of the citizen. If the traffic areas cannot be expanded, the popular request is not fully met. Coming to terms with this problem without economic and ecological losses means urban traffic management. Figure 8 impressively shows the different space requirements of 240 people who travel to work or to the shops by various means of transport. A tram transports about 8000 people per hour on one track, and a bus about 4000. Ten and five tracks, respectively, are required for transporting the same number of people in cars. Trams or buses do not occupy parking spaces in the inner city. An employee who travels to work by car occupies twice the useful area there compared with someone who uses public transport: like himself, his car requires about 25 m².

These physical facts explain why the growth in road systems and the construction of car parks cannot solve the traffic problem in the city. Accessibility for employees and visitors can be ensured only when a decisive proportion uses space-saving public transport. If, as decided by referendum in Zürich, the citizens as taxpayers do not find it reasonable to replace the trams with expensive underground railways or find it more attractive if trams and buses travel through the urban streets in daylight in the interests of short walking distances, the high density of stops and high frequency in the timetables, the first requirement in the management of the valuable traffic area is the priority for public transport in the existing road network.

Numerous analyses of the hindrance of trams and buses indicate three technical/operational instruments of urban traffic management which permit this priority:

- Free travel, unhindered by private traffic, between the junctions with the creation of individual routes and separate bus lanes.
- Maximum preference for public transport at the junctions controlled by traffic lights through real-time detection of trams and buses with the aim of ensuring "Waiting Time Zero" for public transport.
- Introduction of the tram- and bus-operation control system so that, on the one hand, the drivers are continuously informed about their timetable situation and can therefore adhere exactly to the timetable, and so that, on the other hand, the operations control centre is always informed about deviations from the timetable and faults and can intervene in a corrective and helpful manner with prepared measures.

Travel unhindered by private traffic between junctions

The measures under this heading must ensure that trams and buses can overtake slow-moving or stationary lines of cars and quickly reach the next junction, so that the priorities provided there are effective (Figure 9). Furthermore, it is necessary to avoid the situation where cars turning left in the free sections or cars pulling out to avoid parked vehicles force trams and buses to brake or to stop. In Zürich, these measures have to be realised without extending the road area, either by converting an entire road section into a pedestrian public transport only area, or by eliminating the parking spaces along the edge of the road or by structural redesign of the road cross section with a separate track, etc. With this objective in mind, the following measures are among those implemented over the past twenty years: parking and stopping prohibited in 17 road sections. 41 bans on left turns in roads with tram routes. 72 "Give way" signs at intersections in roads carrying bus and tram traffic. 21 km of bus lanes. About 40 building projects, such as islands for bus and tram stops, separate tracks, pedestrian zones with trams and buses, multi-track systems, bus lanes, etc. 2 newly constructed sections for extending a tram line by 2 and 6.4 km, respectively, with a separate track throughout.

Maximum preference for public transport at traffic lights

Modern urban traffic management requires not only clear priorities in the allocation of the available traffic areas but also modern operating systems which manage these areas and always maintain them in a state which permits maximum movement. A novel traffic light operating system is of key importance (Figure 10).

A very special traffic light operating system designed for active management of the limited traffic area was developed and set up in Zürich over the past twenty years. Typically, the work is carried out not by transport engineers but by electrical engineers who work according to the principles of operations research. The Zürich traffic light operating system requires about five times more hardware and five times more software than systems usually installed in comparable European cities. 14 process computers, 2 central coordination computers and over 3000 SESAM detectors (Figure 11) in the road surfacing permit completely dynamic signal program switching. The controllers do not contain any fixed signal plans but merely conditions relating to safety and priority. The signal sequence will be calculated at each point in time - on-line - on the basis of the many pieces of information from the detectors. All traffic lights are controlled centrally: the computers control 7 areas, each in a duplex system and with about 60 traffic lights (Figure 12). The traffic lights are combined in small groups of varying size and shape, depending on the traffic situation and are internally coordinated in terms of time (Figure 13). Between these intersection groups are back-up spaces (intermediate storage areas) which make the groups independent of one another with regard to time. Coordination in terms of quantity is always guaranteed, to such an extent that the flow towards an overloaded group is restricted whereas the flow towards a poorly used intersection group is promoted. A central master computer coordinates the 14 area computers and serves in particular for storage of operational data, detection of system faults and continuous counting of the traffic volumes. Furthermore, the master computer serves to revise continuously the control programs, which can then be loaded into the traffic computers via the cable network connecting all traffic lights.

Conventional traffic light controllers serve two purposes: traffic safety and optimisation of the efficiency of an individual junction or of a group of junctions combined to form a green zone. If the traffic light operating system is to fulfil the objectives of urban traffic management, the following requirements also apply:

- Prevention of "overcrowding" of the road network by continuous counting of traffic area by area and metering of access to maintain the mobility of cars at a stabilised level. Every housewife knows that a washing machine must not be completely filled if a good result is to be achieved. The same applies to the urban road network.
- Preferential treatment of trams and buses through constant readiness to give them priority without delay when they arrive.
- Taking into account the importance of pedestrians by keeping pedestrian waiting times short.
- Continuous possibility of observing program sequences centrally and making program changes centrally and without great effort, so that it is possible to react rapidly and expediently to roadworks, diversions or traffic conditions altered in some other way.

Unfortunately, such an operating system cannot be simply bought, set up and left to function by itself. Industry offers no such controls at this time. They have to be developed afresh for every city, set up step-by-step and then operated. A very decisive factor is that one body in the city should be responsible for the entire operating system, including the fixed road signals and signs: planning, design, construction and operation are so closely intertwined that a permanent group - in Zürich there are 22 people, including 6 programmers - must be employed. The traffic light operating system set up in Zürich meets the requirements described to a high degree. It is very clearly superior to traffic light operating systems conventionally installed. Although the same traffic lights are present in the roads, they switch on the basis of more wide-ranging objectives and more complex, refined technology and with a result which is evidently different.

The tram- and bus-operation control system

The second modern operating system is a high-quality management instrument with which the Traffic Manager can talk to every driver and to the passengers in every tram and every bus (Figure 14). The master computer of this system knows where these are located to an accuracy of 10 m. However, all the timetables are stored in the system, so that it is always clear whether a vehicle is travelling according to the timetable or, if not, how great the difference in the timetable is. The comparison of the actual and ideal situations is communicated continuously to every driver in his vehicle. He is therefore able to monitor himself. Conformity to the timetable and hence regularity can thus be considerably improved (Figure 15).

The tram- and bus-operation control system permits efficient fault management. The control centre has two manned, central positioned trams and five buses distributed over the network and can use these to replace a late or missing vehicle in the correct position in the timetable. Where sections are blocked by accidents, processions, demonstrations, etc., the control centre orders diversions and - if required - organises operation with extra buses as a replacement. In addition, the police, ambulances and technical assistants can be summoned very quickly when required. The aim of all measures is to eliminate faults rapidly and to limit their effects so that as few uninvolved people as possible have to suffer from them. The information provided for the passengers in the vehicles and at the most important stops of the Züri-Linie over loudspeakers connected to the control centre should not be forgotten.

In order to be able to maintain continuous operation of the tram network when sections are blocked or during authorised processions in the inner cities, some additional service tracks, i.e. branching facilities, diversion sections and turning loops, were constructed. Thus, operations control is flexible and can also order diversions for the tram network.

With the tram- and bus-operation control system, the journeys by the vehicles can be stored and can be described in terms of certain evaluation criteria. These serve, for example, as a basis for the timetable or for evaluating trouble spots. Investigations of the situations before and afterwards show the effectiveness of improvement measures of a constructional or organisational type. The line and travel time files are also used for the timetable generation program, the results of which in turn form the basis of the service plan generation program and the service plan disposition and salary bonus program.

Third message from Zürich

With regard to urban transport policy, economy and ecology are by no means contradictory. Zürich is living proof of the fact that a transport policy which promotes public transport at the expense of private motor transport results in considerable economic development of the city.

The urban transport policy must provide optimal conditions for the development of the economy. It is vital to ensure accessibility for employees and visitors in sufficient numbers and under attractive conditions and to enable freight transport to be conducted economically. Whether the visitors come by car or by public transport is unimportant for the economic development of the city; a decisive factor is that they come and are restricted as little as possible in their freedom of movement. Unfortunately, it has been found again and again that private motor traffic has a tendency to stifle itself. If its volume is not stabilised at a level which corresponds to the efficiency of the urban road network (cf. washing machine), the result is congestion, and accessibility is no longer guaranteed.

The transport policy must also ensure that, when providing mobility, the negative effects on the environment do not exceed a tolerance level. Ecology in its widest sense means an environment worth living in, an environment that brings joy to the majority of those affected and in particular does not make them ill. Unfortunately, private motor transport is rapidly reaching the limit of tolerability from this point of view too. Although certain adverse side effects can be suppressed by technical measures, for example NOX emission by means of catalysts, however atmospheric pollution, noise, the danger of accidents, etc. are unacceptable for the environment in the case of a major proportion of private motor traffic. The transport policy chosen in Zürich by the citizens themselves is clearly more advantageous from the points of view of ecology, quality of life and leisure time value. The greater the number of passenger journeys combined into large vehicles of the local public transport system the lower the risk of accidents, the less space required and the lower the level of immissions, and the higher the quality of the environment and the quality of life and of leisure time in the city. Less private motor traffic with the same or better accessibility means:

- Greater safety in traffic, less danger for children and the elderly,
- less noise in residential areas and along important street sections,
- roads and squares are used to a greater extent for social activity and play and are not so cluttered with cars from other districts,
- better air quality and less danger to the health.

From economic points of view, it is first necessary to consider the benefit of mobility. There is no doubt that benefits can be obtained from an increase in mobility. It is just as clear that this increase gives rise to costs. Figure 16 shows how benefits and expenditure change with an increase in mobility: the benefits initially increase sharply and subsequently level off. The expenditure shows the opposite behaviour: the initial increase in mobility costs little whereas further increases require higher and higher expenditure. If the two curves are superposed, it is evident that there is a region in which the cost/benefit ratio is optimal. To illustrate the cost/benefit ratio, three different approaches are shown in which initially the benefits in terms of the number of people transported are compared with the costs in money. Figure 17 shows that the cost/benefit ratio - expressed in francs per person per hour - is about six times more advantageous for an underground railway and almost ten times more favourable for a tram system on a separate route than the corresponding ratio for an urban motorway.

Figure 18 shows that the cost/benefit ratio for the development measures is eight times more advantageous for trams and buses and four to five times more favourable for the suburban railway than for the urban motorway network. In Figure 19, it is assumed that all eight cities compared had the same conditions about 20 years ago: historic city centre, increasing concentration of jobs in the city centre and private traffic reaching the limits. All eight cities had a well developed tram network and had the same aim, which they have since achieved: the creation of an attractive reliable local public transport system. The three largest cities, Munich, Stockholm and Vienna, constructed underground railways, which was unavoidable in view of the large numbers of passengers to be transported. Four cities constructed light rail systems, which are comparable to tram systems in their transportation capacity but travel in tunnels in the city centres and leave the traffic space in the inner city road free for private motor traffic. The existing tram networks were removed. Zürich remained loyal to the tram and gave it priority in the allocation of the road area and in the operation of the traffic lights (and did the same for buses).

Even with all the problems of this comparison, it is quite clear that the investments in local public transport in Zürich have resulted in an excellent cost/benefit ratio with comparable quality of service: 4 - 11 times better, based on the passengers, and 2 - 6 times better, based on the residents, than in the case of the cities compared.

Economic data provide a valid answer to the question as to whether the transport policy is successful. And - surprisingly? - this answer is extremely positive for the City of Zürich. The economic strength of this city is unaffected.

- The Zürich land prices - which are a reliable yardstick for the profitability per unit area - are among the highest in the world.
- Switzerland has one of the highest gross national products; Zürich can be shown to be responsible for a significant part of this.
- The people of Zürich pay the state 30% of the gross national product in taxes and social security contributions. The inhabitants in neighbouring states on the other hand pay over 40%. Note: Transport policy is paid for from taxes.

Final considerations

The transport policy of the City of Zürich may be regarded as a model of an economic, environment friendly transport policy for a city with a population of half a million. The requirements of the Environment Protection Law and clean air regulations need no revision but consistent further development. The policy is based on management of the existing road system with clear preference for trams and buses, for which "unhindered travel without delays between the stops" is ensured, and preferential treatment of pedestrians. It is the result of a long political process and is based on a freely chosen restriction of the requirements of private motor traffic in the interests of superior political objectives.

The fact that it is necessary to set limits to the free market economy in urban traffic and that the "free" car traffic destroys not only one's own freedom but also the quality of the environment and the economy are not new discoveries. Not so well known was the fact that, when backed up by the necessary political will and modern technology, the good old tram is a very up-to-date means of public transport which is very particularly valued by the passengers.

The Zürich model of an economic, environment-friendly transport policy proves that the redistribution of road areas and of green time at traffic lights in favour of trams, buses and pedestrians is not only an aesthetic idealistic aim but also a well-founded materialistic objective of a modern urban transport policy.

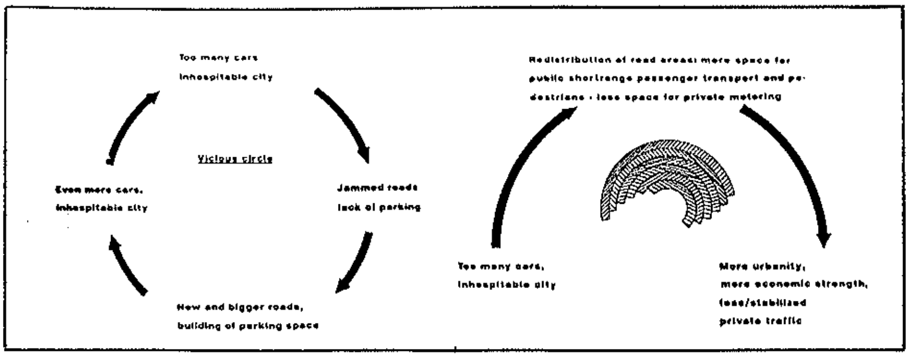

Figure 1. The City of Zürich has broken the vicious circle and turned into a rainbow, a symbol of environmental protection and economic strength.

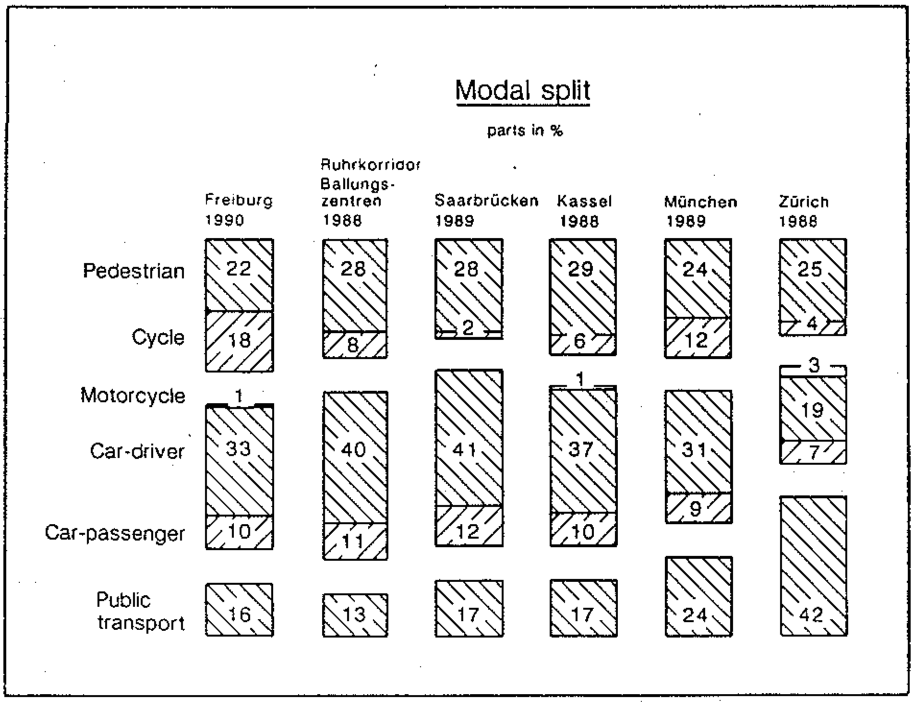

Figure 2. In Zürich, local public transport covers about twice as many trips as in comparable cities. Source: Verkehrsgemeinschaft Freiburg/Sozialdata München.

	Population in transport aera	Trips per annum	Trips per person per annum in transport aera
London	6,7 mio	1'941 mio	290
Wien	1,52 mio	612 mio	403
Amsterdam	680'000	220 mio	320
Stockholm	1,5 mio	432 mio	288
Düsseldorf	1,1, mio	170 mio	160
Hannover	540'000	127 mio	235
Köln	1,1 mio	179 mio	162
Stuttgart	570'000	147 mio	258
Greater Manchester	2,6 mio	375 mio	147
Tyne and Wear	1,1 mio	374 mio	340
West Midlands	2,6 mio	343 mio	170
Zürich	550'000	310 mio	560

Figure 3

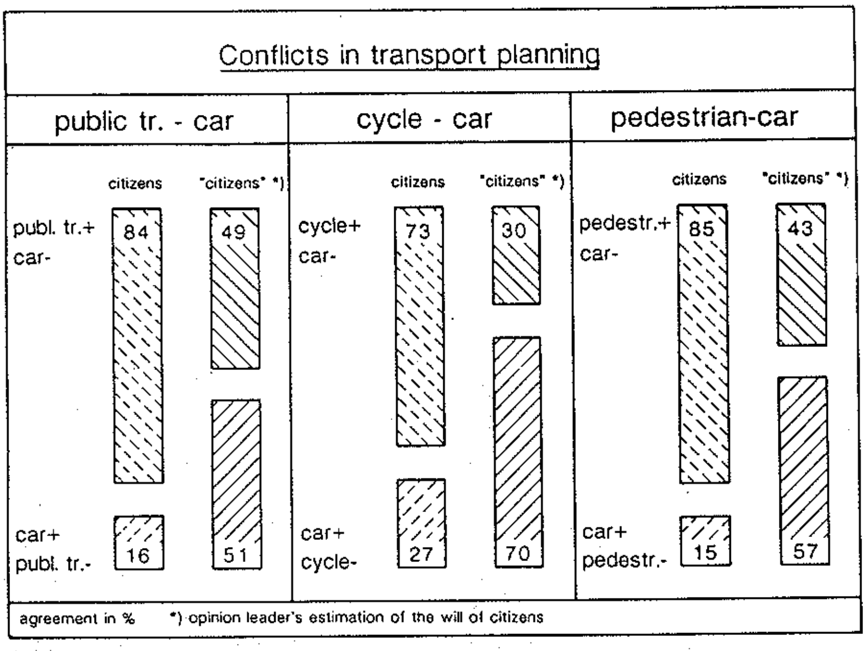

Figure 4. Although the citizens and decision-makers have virtually the same priorities, the decision-makers believe that the majority of the population would (still) want a traffic plan and traffic policy which are favourable to the car. Source: UITP/Eurobarometer.

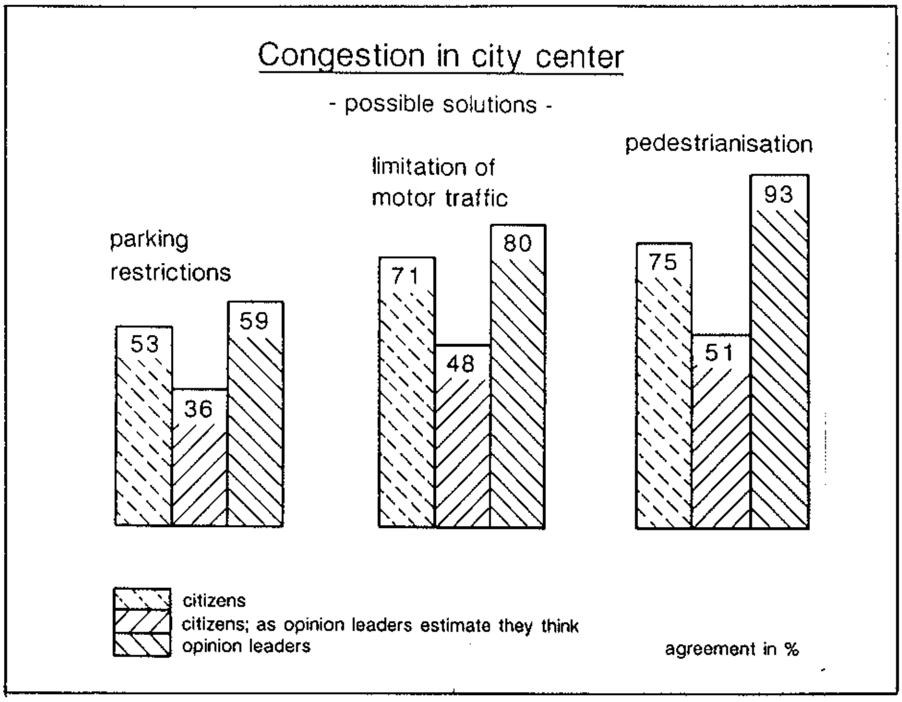

Figure 5. Political decision-makers in the communities of the European countries would welcome the three restrictive measures against cars in the centre to an even greater extent than the citizens. While the decision-makers' and the citizens estimates are of a similar order of magnitude, the decision-makers believe that there is much greater reservation among the citizens. Source: UITP/Eurobarometer.

Wording of the puplic campaign of 18 June 1973 for the promotion of public transport

At the expense of the investments fund, a credit of 200 million francs will be approved to permit, in the course of the ten years following the referendum, at a rate of 15 to at most 25 million francs per year, the financing of structural additions and improvements to the network of the transport company of the City of Zürich, which will serve exclusively and substantially to eliminate all interference by private traffic and internal problems within the companies, so that the vehicles of the VBZ (Zürich transport company) can travel along their lanes or tracks virtually as fast as is technically possible. The credit will be reduced by an amount corresponding to any contributions by the Canton which the latter makes on the basis of the regional transport law for the same purpose during the ten-year period. Where they are beyond the competence of the City Council, regulations for implementing this resolution are the responsibility of the municipal parliament and are subject only to the optional referendum in the meaning of Clause 11, letter c, of the Municipal Regulation. Such directives cover the provision of separate tram and bus lanes, the construction and conversion of traffic light operating systems remote controlled by the public transport, the conversion of the important traffic junctions entirely to meet the requirements of the VBZ and the pedestrians.

The municipal parliament advises the voters to reject the proposal (resolution of the municipal parliament of 24 November 1976).

Figure 6

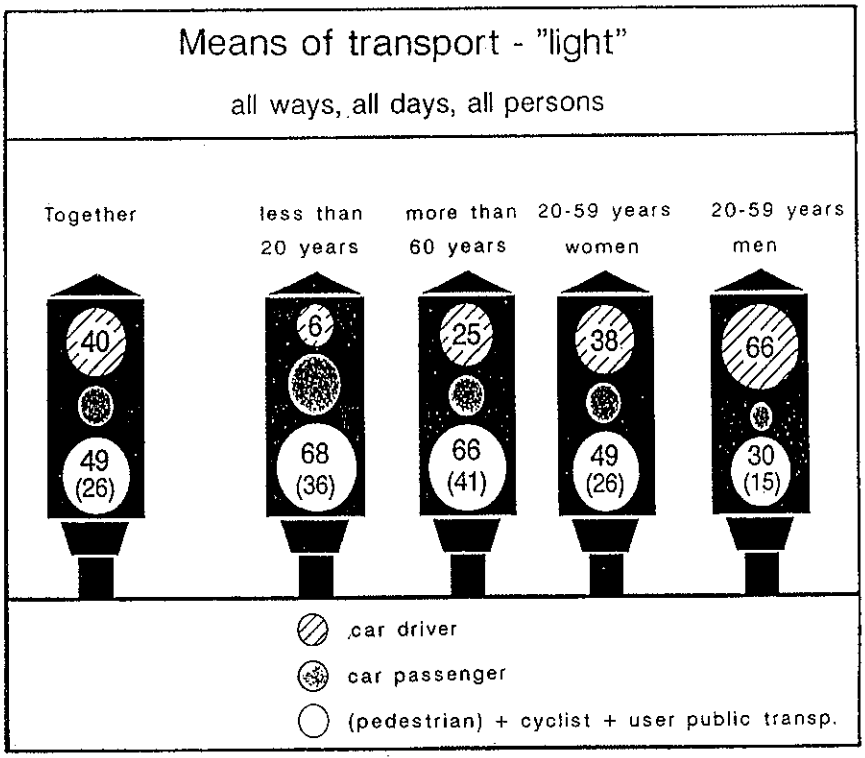

Figure 7. Politicians are generally men aged between 20 and 50. They therefore belong to that quarter of the population which uses the car to an above-average extent (66%) and makes only 30% of journeys by public transport or bicycle or on foot. Source: Kleine Fibel, Sozialdata München.

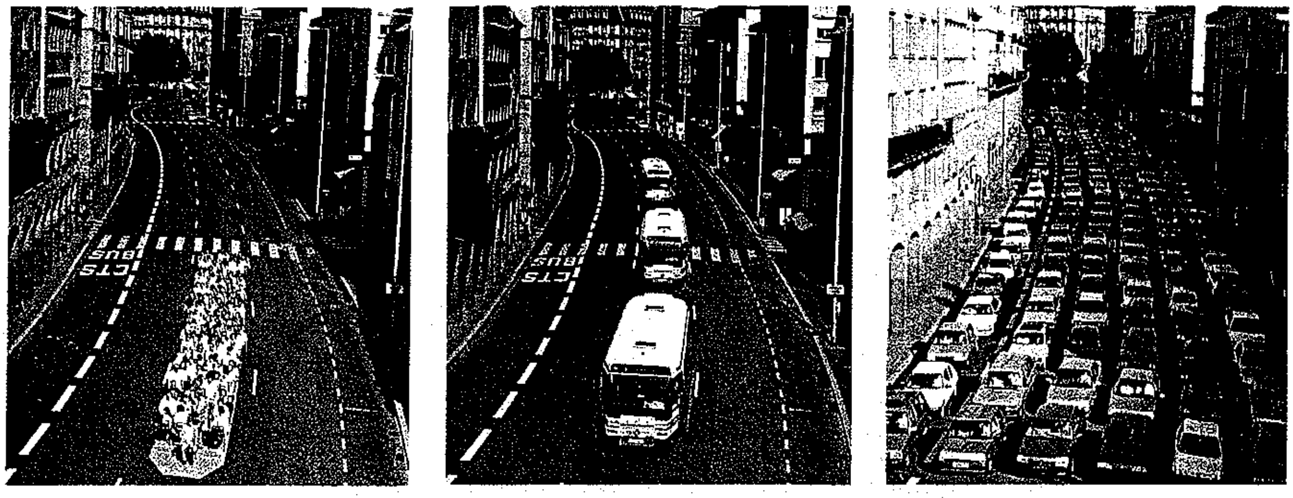

Figure 8. 240 people travel to work: in 1 tram, in 3 buses or in 180 cars. Source: City of Strasbourg.

Figure 9. Trams and buses must be able quickly to overtake slow-moving or stationary lines of cars. Five to ten times more people can be transported on a reserved tram or bus lane than on a car lane.

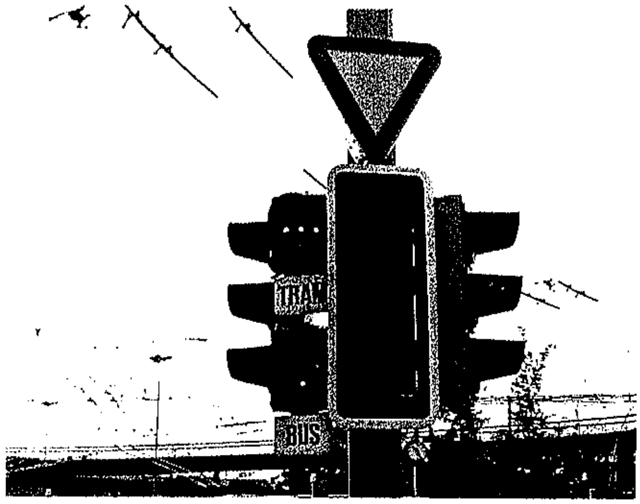

Figure 10. Trams and buses do not require the traffic signals to remain green for a long time but they need the green light exactly when they arrive: "Waiting Time Zero" for trams and buses.

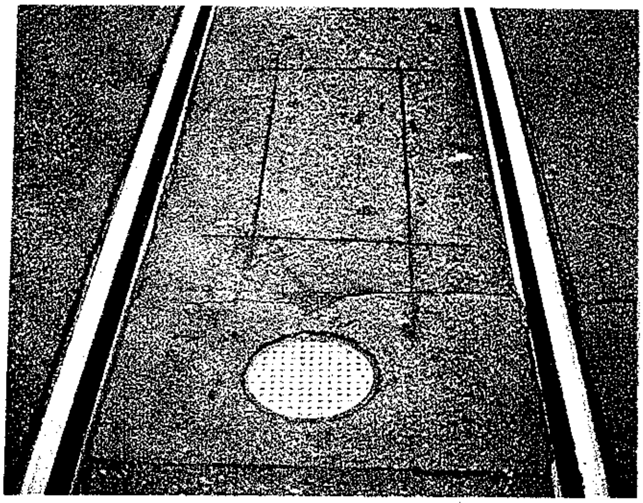

Figure 11. More than 2500 detectors record trams, buses, private traffic and pedestrians. 16 computers control about 400 traffic lights, not according to rigid programmes but completely dynamically in accordance with the current traffic situation and predetermined priorities.

Figure 14. The tram- andbus-operation control system detects every tram and every bus with an accuracy of 10 metres. The computer continuously compares the actual position with the theoretical position and indicates deviations, which can be re-acted to with suitable measures - extra vehicles, detours, etc.

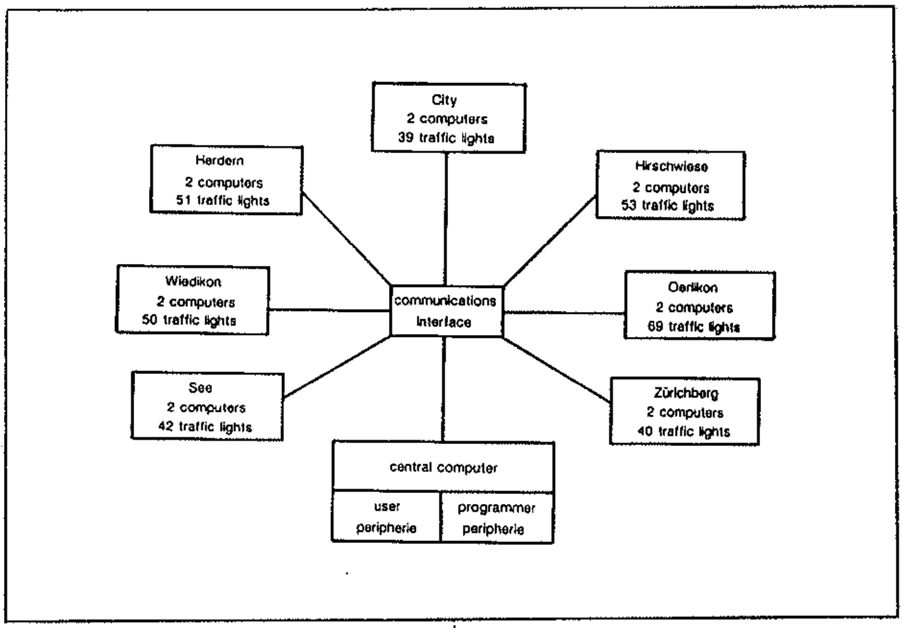

Figure 12. The centralised traffic light operating system consists of 7 duplex control stations, each of which controls 40-70 traffic lights in the particular control areas. The main control centre serves for monitoring and coordinating the entire system and allows program-proceedings to be observed centrally at any time and program changes to be made without great effort. Source: Oehrli, Zürich City Police.

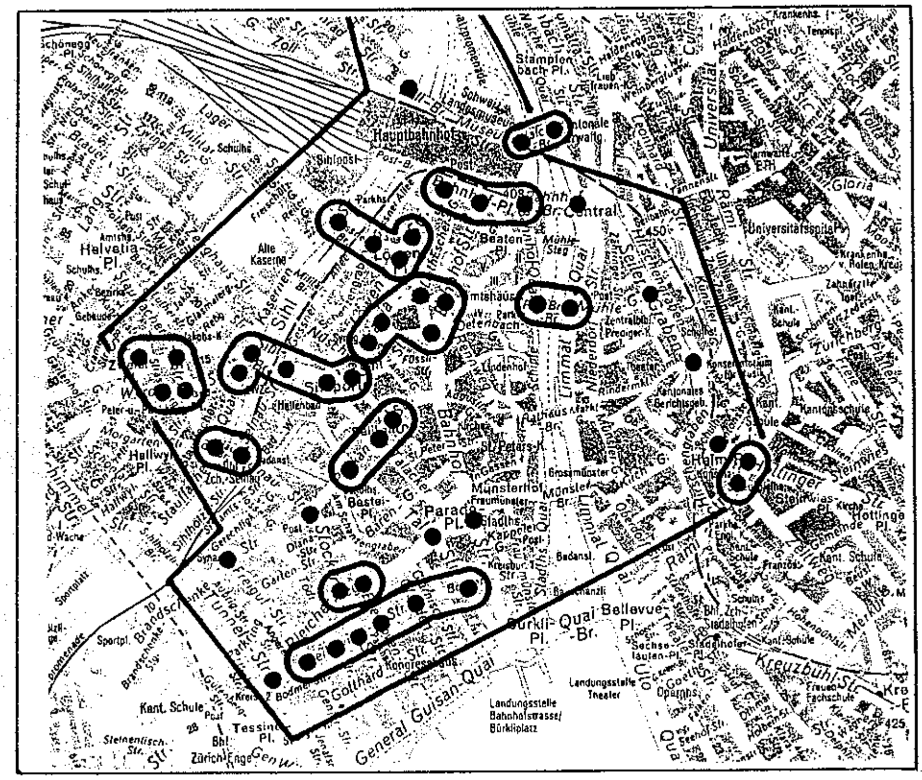

Figure 13. Cells in the City control area. Coordination of the volume of motorised private traffic between the cells makes it possible to avoid overcrowding and blockage of the road network and thus always to ensure mobility at a limited level. The back-up areas between the cells make them independent of one another in terms of time and permit intervention in favour of public transport at any time.

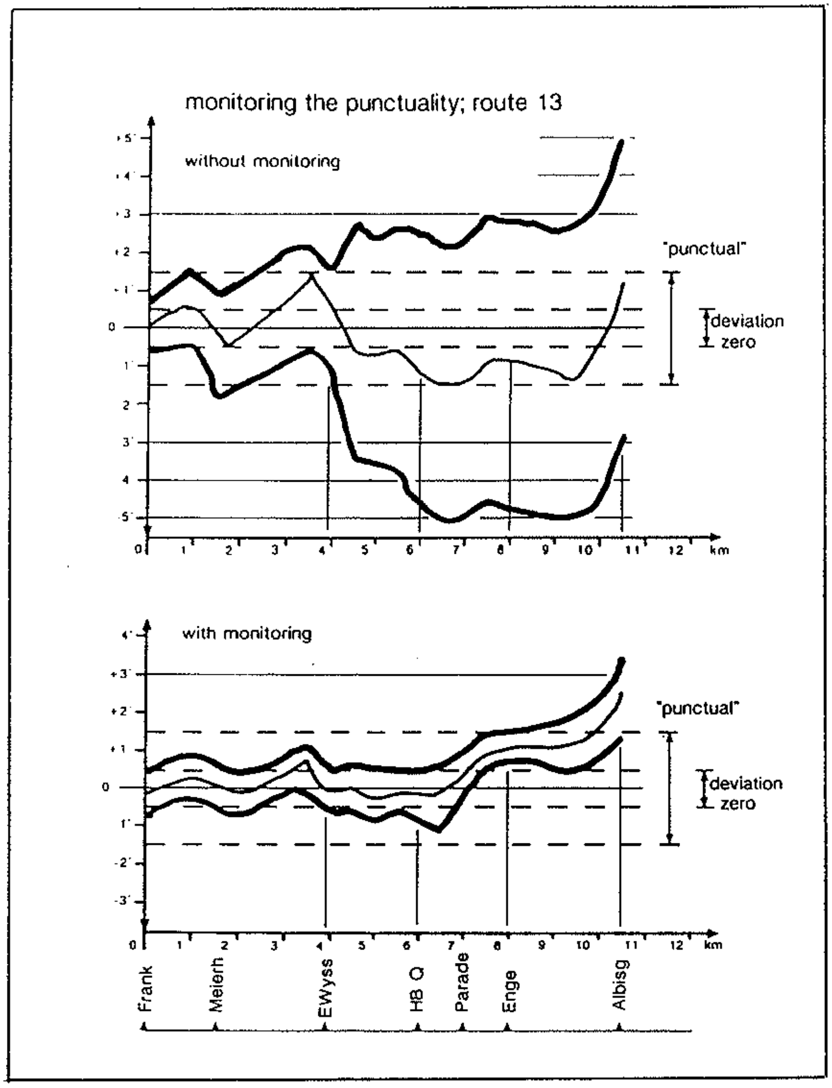

Figure 15. Feedback of deviations from the timetables to the driver enables the latter to adhere exactly to the timetable. Comparisons of the situation before and after show the high reliability.

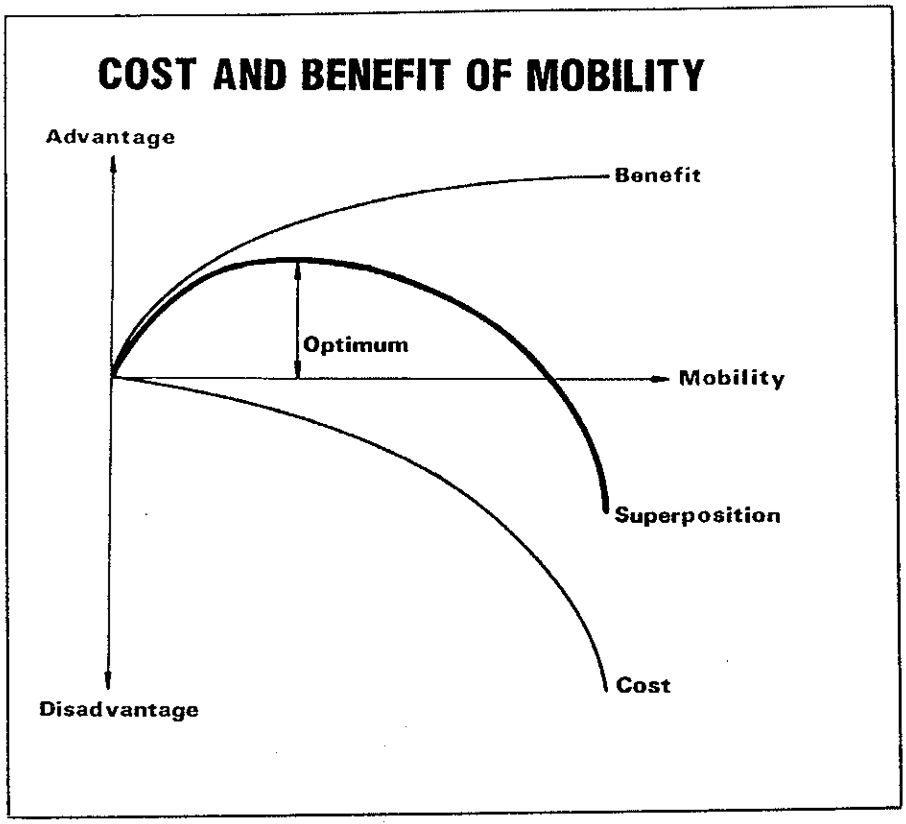

Figure 16. The increase in mobility initially gives rise to benefits at low costs. After an optimum has been passed, the costs - or damage - of the mobility increases more sharply than its benefits. Source: Prof. Rotach, ETH Zürich.

Cost: Transport corridor of 1 km length in mio £ Benefit: Capacity in persons per hour in one direction			
	Cost in mio £	Benefit in pers./h	Cost/Benefit
Expressway, 6-lanes	30	5'600	5'300
Metro (heavy rail)	28	30'000	900
Tramway, exclusive right of way	4,5	8'000	600

Figure 17

Cost: Expressway-network (not yet completed), S-Bahn (heavy-rail) system, and speed-up programmes for tram and bus, all realised in Zürich in mio £ Benefit: Capacity in persons per hour in one direction			
	Cost in mio £	Benefit in pers./h	Cost/Benefit
Expressway-network, without ring-expressway	750	15'000	50'000
S-Bahn Zürich	550	50'000	11'000
Speed-up programmes for tram and bus in Zürich	100	40'000	2'500

Figure 18

Cost: Investments in transit-systems since 1960 in mio £ Benefit: Fast, regular, reliable transit Cost/benefit: In £ per trip and £ per inhabitant					
	Investments in mio £	Trips per annum in million	Inhabitants in transport area in million	£/Trip	£/Inhabitants
Metro					
München	1'100	379	1,4	2,9	790
Stockholm	1'500	432	1,5	3,5	1'000
Wien	1'000	612	1,5	1,6	670
LR Rapid Transit					
Düsseldorf	700	170	1,1	4,1	640
Hannover	600	124	0,54	4,8	1'110
Köln	500	179	1,1	2,8	450
Stuttgart	500	139	0,56	3,6	890
Tram and Bus Zürich	100	306	0,55	0,3	180

Figure 19