PUBLIC TRANSPORT IN BUDAPEST – SOME OBSERVATIONS ABOUT FUTURE DEVELOPMENTS

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Summary

The paper examines the actual problems and deals with the possible development strategies for public transport of Budapest. The presented versions of developments and the recommendations of improvements for public transport system can be used in the decision making process of the Urban Transport-Planning of the city.

1. Introduction

Budapest is a large city of over two million inhabitants, the capital of Hungary, and contains a concentration of industry, representing 37% of national production. After the physical linking by a bridge across the River Danube of Buda and Pest in 1849, and their political union with Óbuda in 1872, the new city grew rapidly and by 1900 was a major European city.

The population of Budapest has risen gradually since 1950 to a present total of 2,064,000. This increase is anticipated to continue for some more years, after which there will be a stabilization and then a slow decline to about 1.9 million by the turn of the millennium.

However with the rise in the standard of living and the decrease in family size, two problems are important; firstly a shortage of suitable accommodation, with 1.45 persons per room in 1980 and 1.14 families per dwelling, and secondly the rise in car ownership from 160,000 in 1975 (or 7.7 per 100 persons) to 321,800 in 1983 (15.6 per 100 compared to only 12 per 100 nationally) and an anticipated 485,000 by 2000 (22.5 per 100) has brought with it a severe lack of parking space and congestion on the main urban road network.

The function of Budapest as a capital city is distorted both by the proportion of industry in the city and also by the proportion of the national population living there (19%). This strains the transport system in the capital, which includes a well developed public transport network, with three Metro lines, four suburban (HÉV) railway lines and a dense network of tram, trolleybus and bus services.

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2. Present proposals

The development of the land area of Budapest and its transport system is governed by Five Year Plans produced by the City Council and approved by the Government. The main objectives of the Five Year land development Plans are firstly to meet the need for housing in the capital and secondly to provide decentralized service centres. The first objective is being met by the construction of a large number of flats on virgin land around the existing built up area.

2.1. *Housing provision*

In 1980 there were 728,000 dwellings and this is planned to rise to 910,000 units by 2000, when there will be on average of 1.02 persons per room and 0.92 families per dwelling. Some 600,000 people already live in the first phase of this new construction, which began in 1970, and forms a distinctive "white wall" around the nineteenth century city.

It consists of 10 and 11 storey prefabricated flats built on market gardens which were cultivated around the city. In total 300,000 new dwellings will be needed in the 30year period until 2000, since 120,000 dwellings will be demolished as unfit or to make way for other developments including transport. The construction of 10,000 dwellings per year is a target which should be met, since 17,000 dwellings per year were built between 1976 and 1982 and 16,000 in 1983.

2.2 *District centres*

The second part of this policy is the development of district service centres at South Buda by Móricz Zsigmond Körtér and Örs Vezér Tér which are nearly completed, and at Újpest, Kőbánya, Kispest, Pesterzsébet and Óbuda (Fig. 1). Another centre is planned for North Buda. These district centres provide a range of shopping, medical and other services, and transport facilities. As the centres are being constructed, the public transport system is being modified, especially by the construction of further Metro lines, to provide a focus at these centres. These district centres will reduce the pressures on the city centre and so the demand for radial travel.

2.3 *Transport proposals*

At the time of writing the 1985 Five Year Plan was not available, so the proposals of the 1980 Plan have been examined. The main objective of that plan is "to satisfy every need that arises from regional development, population growth and industrial development". The Plan sees public transport facilities being developed only on sound economic grounds. In order to cope with the

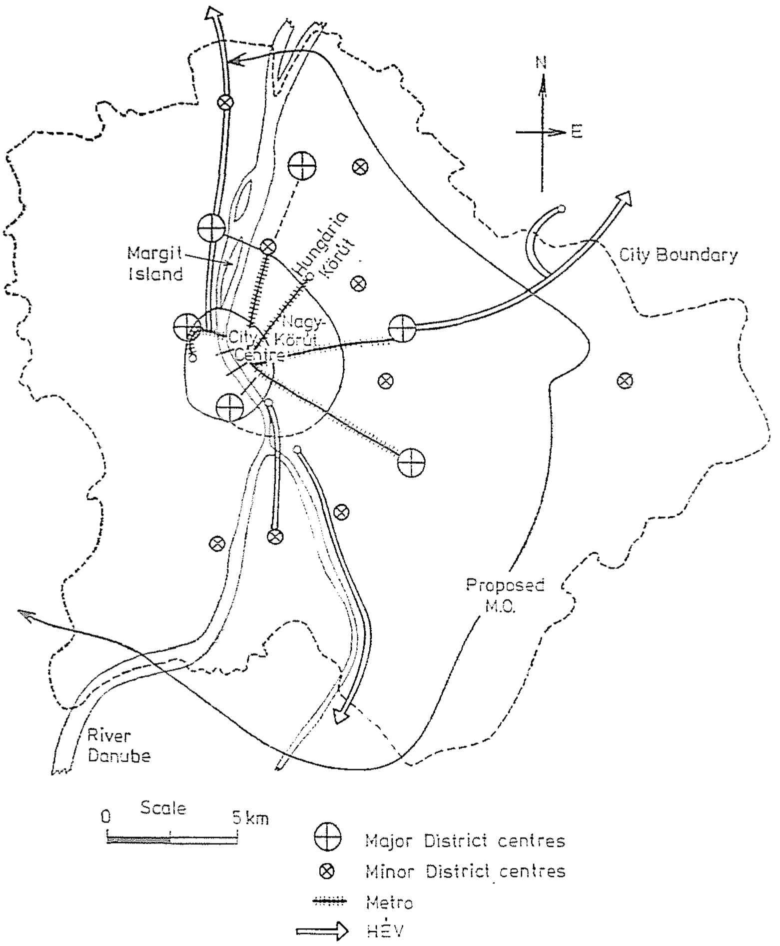

Fig. 1. Development of Budapest to 2000

increasing demands for car use, the plan sees public transport being improved in terms of capacity, higher speeds, higher standards of comfort and reliability, "to keep private passengers car traffic within limits of reason." This is particularly true for the journey to work which represents the most important economic reason for travel and the largest part of peak travel demand.

The road network will be developed at the same time as suburban construction proceeds to reduce the traffic demands in the city centre by providing alternative routes through the suburbs. This is particularly true on the Pest side with the improvement of the outer ring road (the Hungária Körút) and the construction of a new outer motorway M—0 (Fig. 1). The Plan also sees a substantial construction of new or improved Metropolitan railways; extending the present Metro by the addition of lines 4 (Dél Buda—Újpalota) and 5 (Óbuda—Kelenföld) and the reconstruction of three out of four HÉV lines to form a network 146 km long.[1] The important nodes in this extended railway system will co-incide with the nine district centres outlined in 2.2.

Perhaps the most crucial and expensive part of the Plan is the proposed increase in the number of Danube road crossings, and their links to the road network. This will increase capacity across the Danube and relieve the most heavily congested parts of the road network. These are needed because of a continuing concentration of industry in Budapest, and because many of the existing bridges are not able to take the weight of modern heavy goods vehicle traffic. New crossings are proposed north to south, for the motorway M—0, between Újpest and Római Part, a tunnel between Széna Tér and the Kis Körút (parallel to Metro line 2), at Lágymányos, between Csepel and Albertfalva, and for the southern arm of the M—0. The available lanes on Szabadság Bridge will also be increased. By these means the present number of 10 traffic lanes in each direction across the Danube will be increased to 28 by the next millenium. The junctions and approach road to existing bridges will also be improved.

2.4. *Discussion*

Budapest is located in the centre of Europe and is on several important international routes, including the River Danube. With the growth of international trade, transit traffic through Hungary and Budapest will grow. In 1975 transit traffic represented 0.3% of car traffic and 0.5% of goods vehicle movements, at 2,000 per day each. International freight traffic produces 130,000 movements annually to carry nearly 2 million tonnes. Even when the Rhein-Main-Danube canal is completed it will not immediately reduce this heavy traffic. The most pressing aspect will be the growth of heavy goods vehicles whose weight and size demand the most expensive road construction and maintenance techniques. The anticipated growth in the 25 years from 1975 is 75% and because transit traffic represents an important source of foreign earnings, Budapest will be required to accommodate it. For this traffic the crossing of the Danube is crucial, since the next bridging point south of Budapest is 80 km distant at Dunaföldvár and north at Komárom 80 km away. At present the majority of this international traffic uses Petőfi Bridge, 2.6 km south of the city centre, which causes considerable congestion problems in the environs of the inner city.

The second area for concern must be the anticipated growth in car ownership. Firstly the parking required and secondly the traffic caused by car use. Private motor cars confer many benefits on their users: speed, comfort, privacy, flexibility and the ability to carry heavy loads. Motorists are willing to pay many times the equivalent public transport fares to gain these benefits

[1] Within the borders of Budapest.

when using their cars. Without the development of parking places in line with increasing car ownership, a significant proportion of city centre traffic will be circulating to find a parking place. Without strict controls and enforcement there will be illegal parking eg. on footways and traffic islands. A deliberate policy of traffic restraint may be necessary certainly in the inner area, to keep traffic demands the capacity of the road network and parking places. In the short term this may be most easily achieved by strict parking controls and an extension of pedestrianized zones, which until now have not been needed because car traffic is a relatively new phenomenon.

The third area for concern is the ability of public transport to improve its services at least as fast as the rise in car ownership (66% by the turn of the millenium) so that car traffic does not grow by the same rate. Even though the present public transport system is integrated, there can still be improvements so that some car owners will choose to use public transport instead of their car, especially at peak times. This principle will be discussed in more detail later.

2.5. *Conclusions*

The current Five Year Plan envisages ameliorating the growth in car traffic, generated by increasing car ownership, by attracting potential car users to an improved public transport system. It would seem problematic that this can be achieved by purely voluntary means, especially as Budapest also has a role as a transit route, which will put increasing strains of the Danube river crossings. Another important point is whether the resources will be available to construct both a metropolitan railway network aproximately, 146 km long,[1] 80 km more than presently exists, and nearly 150 km of new main roads including over 70 km of motorway which will be a significant part of the existing national motorway network.

3. The present public transport system

3.1. *Characteristics of the system*

The present public transport system is integrated and consists of Metro, HÉV, tramway, trolleybus and bus services. The characteristics of these are listed in Table 1.

On average each resident in Budapest makes 2.9 journeys per day of which 1.9 are made by public transport, 0.3 by car and 0.7 on foot or by bicycle. Public transport is therefore an essential part of the transport system for passenger movements in Budapest. However this must be tempered by the fact that less than 20% of the people in Budapest have a car and so have a choice of how to travel. For those with a car the comparison between public

[1] After 2000, within the borders of Budapest.

Table 1

	Metro	HÉV	Tram	Trolley bus	Bus
No. of lines;	3	5	38	13	206
length	27 km	109 km	175 km	63 km	660 km
no. vehicles;	280	390	936	249	1797
pass. km pa.	1676 M	924 M	1606 M	278 M	4303 M
no. pass. pa.	327 M	100 M	446 M	77 M	634 M
av. journ. lnth.	5.1 km	9.2 km	3.6 km	3.6 km	6.8 km
service speed km/h	32	26–34	15–18	16–18	20–22
% of traffic by pass. km	19	11	18	3	49
by pass.	21	6	28	5	40

Source: Budapest Statisztikai Zsebkönyve 1983.

transport and car travel is wider than the mere monetary costs, since these are very much higher by car, but includes comparisons of comfort, speed, reliability, regularity and the need to interchange. The way in which passengers perceive these aspects together, was discussed in an earlier paper (Lesley and Várlaki 1985), which showed that these aspects can be weighted and unified, and then used to determine the probability that one mode of transport will be chosen from those available for a particular journey. This enables an analysis to be made of the shift that may occur, when more people have the use of a private car, from public transport to private car. Alternately the technique can be used to determine by how much and in what characteristics public transport must be improved if it is to maintain its present share of the travel market in Budapest. This is important because there has also been a shift in income distribution with an increasing gap between those on low incomes and those with high incomes, which will encourage a further switch from public transport.

3.2. *Planned changes*

The 1980 Five Year Plan acknowledges the need to improve public transport, so that many car owners will choose to travel by public transport instead of using their cars. The central part of this policy is the construction and extension of new Metro lines across the city. This will involve a northward and southward extension of Metro line 3, and the construction of Metro lines 4 and 5. In total this will be 63 km of new line, excluding the reconstruction of the HÉV and the construction of 16 km of HÉV extensions and connections.

The northward extension of Metro line 3 is presently being built at the rate of about 1 km per year. At this rate of new construction the final Metro and HÉV network will not be realised (excluding the reconstruction of existing HÉV lines) until 2065, long after most forecasts predict the exhaustion of oil supplies and so the use of internal combustion engined motor cars (Michelberger et al 1985). However like all forecasts there is an element of uncertainty which could mean that exhaustion may be sooner or later than the prediction. However almost independent of that date there will be a rise in prices to reflect the very high costs of oil extraction from marginal fields.

By 2000 there are expected to be 485,000 motor cars in Budapest, or about 26 per 100 people. This last figure is that which Britain presently enjoys, and there public transport carries only 15% of the total passenger kms. Therefore the critical period for public transport will be the next fifteen years as car ownership rises to the level where nearly every family will have a car. During this period up to about 15 km of new Metro line might be built, only 19% of the planned network. By 2000 about 34% of individuals will have an actual choice over the use of a private car. The pressures on public transport are likely to be severe, especially for bus and trolleybus services which must share the same highways as private cars. Therefore at the turn of the millennium only a relatively small part of the public transport network (about 1.5%) will have been improved further. However the construction of these new Metro lines will represent a 55% expansion of the present Metro system.

3.3. *Landuse changes*

The construction of 300,000 new dwellings during the period until 2000 will be concentrated in the outer areas of Budapest, just inside the city boundary. Accompanying this will be a decline in the total of population and so a very large reduction of the population living in the inner parts of the city. From the 1970 figure there will be an 11% reduction by 2000 of the population of the inner districts Nos I, V, VI, VII, VIII and IX, and an increase of 26% in the population of outer districts. This is a large change in the "centre of gravity" of the city from a dense inner population to geographically dispersed outer areas. This change in population distribution will be accompanied by the development of about eight new district centres, which will act as a counter balance to the city centre.

For the new outer suburban population the local district centre will become the most important focus for journeys, except the journey to work in the morning and afternoon peaks. Unless there is a further concentration of work places in the city centre, most of these work journeys will be from suburb to suburb, and will not need to cross the city centre unless that is the only route. The planned improvements to the public transport system are essentially between the city centre and suburbs, except for Metro line 5, which will traverse the Nagy Körút around the city centre. Therefore in the future the enlarged outer population, making their journeys to work will have the use of a car or may use a public transport system which is dependent upon buses for suburb to suburb movements. Unless there is a significant improvement in these bus services the majority are likely to use their cars. For other journey purposes, public transport on suburb to city centre routes may also be less important as people use their local district centre for everyday needs, and use the city centre less frequently for entertainment and comparison shopping.

Either way the relative importance of radial journeys will decline compared to suburb to suburb movements. However public transport is planned to be improved by the construction of new Metro lines between the city centre and outer suburbs. The main strain on the public transport system will be felt in suburban movements, which at presently are mostly provided by buses.

Given that the proposed expansion of the Metro system is unlikely to be completed before the middle of the next century, when excluding an unforeseen technical advance, private cars will be obsolete through a lack of fuel, and that the most severe competition between private and public transport will take place during the next 15 years, then the present policy for improving public transport may need to be reconsidered. Firstly there needs to be an assessment of the financial resources and their adequacy, and secondly there will be a qualitative change in the movement patterns in the city, from being radial and based on public transport to circumferential car movements.

3.4. *Conclusions*

During the next fifteen years the structure of Budapest will change significantly. Coupled with this will be a rapid increase in car ownership, concentrated for practical and economic reasons among the increasing suburban population. For the many people who will have to make suburb to suburb journeys, their car will be a very attractive option compared to the choice of public transport which will either be a direct bus jorney or an indirect journey via the city centre.

The present plans to improve public transport are based almost wholly on the construction and extension of new Metro lines to link the city centre with the expanding suburbs. Because of the construction of new district centres the role of public transport for both work and non work journeys may decline. In these circumstances the construction of further Metro lines may not be the best use of the available resources, and there may be alternative ways of improving public transport so that it can meet the inreasing competition of private cars.

4. Competition between private and public transport

4.1. *Car ownership and usage*

In 1980 there were about 260,000 private cars in Budapest, or about 12.7 per 100 inhabitants. In that year journeys by car represented 14% of the mechanized travel in the city. In 1983 there were 321,800 cars (15.6 per 100) about 17% of wehicular travel was made by car.

If we consider future levels of car ownership, anticipated to be 485,000 in the year 2000 (26 per 100 people), then the impact of that level on public transport could be large. One study by K.T.I. (1980) anticipated an increase in the per capita number of journeys made of 44% with an optimistic view of economic growth, or 25% with a pessimistic view.

4.2. *Changes in public transport use*

In a report by Budapest City Council (1981) a more modest increase of 18% in personal mobility was forecast for 2000 to 2.75 journeys per capita per day. That would increase the annual number of journeys by 196 million. The total journeys by car then would be 534 M per year. However the question must be raised as to whether such an increase in mobility can be expected. By contrast a study by Lesley (1981) showed an average daily level of mobility of 3.01 per head for residents over the age of 12 in a British new town with 19.7 cars per 100 people. The range was from 2.88 to 3.67 journeys per day. That level of car ownership will not be reached in Hungary until 1995 (KTI 1980).

An increase in the level of mobility must be questioned for another reason which relates to the structural changes in Budapest arising from the increase in the suburban population. This means that for the journey to work, at least, residents face a longer distance to travel. Unless there is a compensatory increase in travel speed, residents will on average travel further and take a longer time for each journey than at present. Without a decrease in working hours people will have no time to make many extra journeys.

4.3. *Alternatives*

What would be the result if there was only a modest increase in the per capita journey making, say to the British figure (3.01) by 2000? With the uncertainty of all projections especially car ownership and mobility levels, it would be wise to examine the consequences of a more conservative forecast.

The volume of public transport after 2000 could well stagnate while the role of individual transport will increase i. e. the proportion of the public transport (within the total amount) will decrease. Would a continued investment in Metro construction then be "on sound economic grounds"?

4.4. *Public transport service quality*

4.4.1. *Introduction*

This section examines the present quality of public transport from the passengers' point of view. Public transport operations judge the quality of their services in global terms, and use aggregate measures, eg. percentage of journeys on time, bus kms run against scheduled kms etc. Such statistics are of little interest to the passenger who is concerned about each particular journey made, and the extreme conditions that may be met.

4.4.2. *A survey of public transport*

Over a period of nearly four months a record was kept of every public transport journey made in Budapest by the author. Recorded in this survey were: the time of arriving at the origin bus, tram or trolleybus stop or station, the time spent waiting for the service to arrive and the time of arrival at the the destination stop/station. For journeys needing interchange, the extra time spent walking between stops and waiting were also recorded. For Metro journeys additionally the time spent reaching the platform at the origin station and the time to reach the street at the destination station were recorded.

These times were determined with an electronic digital time piece accurate to better than one minute per month. In total 408 journeys were recorded, with 108 during the peak periods and 300 in off peak times. During

Table 2

Recorded use of public transport

	Number of trips		
Mode of transport	Peak	Off peak	Total
Bus	86	252	338
Tram	55	188	243
Metro	24	62	86
Trolleybus	1	14	15
Other	0	2	2
Total	166	518	684

The totals do not match because of incomplete data these journeys a total of 701 individual trips were made on public transport modes, 178 in the peaks and 532 off peak. These trips can be subdivided by mode of transport used and are set out below.

The survey tried to reproduce as closely as possible the behaviour of public transport passengers, in taking the quickest route, catching the first suitable service, and changing if necessary. A proportion of the journeys were made with two small children whose mobility and walking speed matches that of elderly people. Therefore overall the survey should reflect a cross section of journeys, and a cross section of passengers in Budapest, and so may be considered to be an average for the city as a whole. The survey did not record the actual geographical origins and destinations of journeys, only the original and destination public transport stops/stations, which for the purpose of this paper will be adequate.

4.4.3. *The results*

4.4.3.1. *Journeys by public transport*

The number of journeys made each day of the week was analysed. This gives an overall daily average of 4.1, with a standard deviation of 1.6. These are set out below on a daily basis.

Table 3

Daily journeys by public transport

	Day of week						
	Mon.	Tues.	Weds.	Thurs.	Fri.	Sat.	Sun.
Average	3.8	4.1	4.1	3.9	4.1	5.0	3.7
St. Dev.	0.7	1.7	1.5	1.9	2.3	1.2	1.3

A Ki-Square test was made of the frequency distribution. This showed no significant difference between the number of journeys made each day.

The average number of journeys per day is higher than that for the city as a whole (1.9) but lies within the range observed in different people due to their age and economic position.

4.4.3.2. *Bus waiting times*

The average waiting time on all bus trips was 3.6 mins, and this can be subdivided into peak and off peak times, and by route, since about 60% of all bus journeys were made on one service (Route 11). These are listed below.

As no detailed information on bus departure times was known, the arrival time recorded in the survey, can be assumed to be random. However if a bus service is operating reliably, and passengers arrive at random, the bus headway will be twice the average waiting time.

Table 4

Average bus waiting times

	Average (standard deviation) in mins	
	Peak	Off peak
All services	2.8 (3.1)	3.9 (3.3)
Route 11	2.3 (2.0)	3.6 (2.9)
Other services	3.6 (4.1)	4.4 (3.7)
Longest	19.0	17.0

A Student "T" test was conducted on both the average waiting times and their standard deviations. This showed that there was a significant difference between the averages of route 11 and the other routes surveyed, and also a significant difference in the standard deviations. Since the mean plus (or minus) one standard deviation represents 67% of observations, and two 95% of observations, this suggests that route 11 operates significantly more reliably than the other services surveyed in the city.

However of great importance to passengers is the longest wait, since this determines their worst expectations of service quality. For bus services the longest wait was about 6.8 times the average wait.

4.4.3.3 *Tram waiting times*

The same analysis as for bus was undertaken on the tram trip data, giving an average of 2.6 mins, subdivided as follows.

A Student "T" test was performed on these results. Services 4, 6, 47 and 49 and not significantly different in either the peak or off peak periods. However services 9 and 19 have significantly longer waiting times, in both the peak and off peak, being nearly double in both compared to services 4, 6, 47 and 49. The standard deviation of services 9 and 19 is also significantly worse, which suggests that the reliability is also worse. The longest wait was 5.8 times the average, less than for bus services.

Table 5

Average tram waiting times

	Peak	Off peak
All services	2.2 (2.4)	2.8 (2.7)
Routes 4 + 6	1.7 (2.3)	2.1 (1.9)
Routes 9 + 19	3.9 (4.0)	5.0 (3.8)
Routes 47 + 49	1.8 (1.6)	2.0 (1.9)
Longest	13.0	16.0

4.4.3.4 *Metro waiting times*

Trips on all three Metro lines were recorded, giving an average waiting time of only 1.8 minutes. The difference between the peak and off peak times are set out below:

Table 6

	Peak	Off peak
All lines	1.2 (0.9)	2.0 (1.2)
Longest	3.0	5.0

The Metro has waiting times which on average are less than for either bus or tram services. The standard deviations are also smaller implying a much higher level of reliability. However to be set against this is the extra time needed to reach the platform at Metro stations, which will be discussed later. The longest wait was only 2.5 times the average, confirming the point made above about reliability.

4.4.3.5 *Trolleybus waiting times*

Unfortunately insufficient peak period journeys were made by trolleybus However in the off peak the average wait was 4.1 mins with a standard deviation of 3.1 mins. The longest wait was 11 mins, 2.7 times the average.

4.4.3.6 *Comparison between modes*

The average waiting times of the four main modes of public transport in Budapest can now be compared.

Table 7

Average waiting times of all modes

	Peak	Off peak
Bus	2.8 (3.1)	3.9 (3.3)
Tram	2.2 (2.4)	2.8 (2.7)
Metro	1.2 (0.9)	2.0 (1.2)
Trolleybus	—	4.1 (3.1)
Overall	2.32	2.56

Table 7 shows that in the off peak bus and trolleybus services have similar waiting times and reliability. The Metro has an average waiting time significantly less that bus or tram in both the peak and off peak and a better level of reliability.

Table 8

Reliability of services

Ratio of standard deviation to average waiting times

	Peak	Off peak
Bus	1.11	0.85
Tram	1.09	0.96
Metro	0.75	0.60
Trolleybus	—	0.76

All modes are more reliable in the off peak compared to the peak, when the influence of passenger volumes is less, and for road based services there is also less traffic congestion. Taking the average waiting times for each mode of transport, and then weighting it by the relative total use in Budapest gives an average overall waiting time of 3.0 minutes per trip.

4.4.3.7 *Metro access time*

Data were recorded of the time taken to reach the platform from the station entrance, and vice versa. This showed that Metro Line 1 (Földalatti) has an access time similar to that for bus, tram or trolleybus services. However for Metro Lines 2 and 3 there is a significant period needed to get to and from the platform

Table 9

Metro platform access time

	Peak	Off peak	Overall
Time to platform	2.2 (0.8)	1.6 (0.9)	1.8
Time from platform	2.0 (0.5)	2.2 (0.9)	2.1
	Total		3.9

On average it takes nearly 4 minutes to reach the platform at the origin station and the street again at the destination station. On short journeys this is a significant time element, and may be greater than the time spent riding in the train.

The times to the platform in the peak and from the platform are not significantly different. However the off peak time to the platform is less, since then it is possible to walk down the escalator when there are fewer passengers.

4.4.3.8 *Interchanges*

A record was kept of all interchanges during a journey, and the time needed for interchanging. On more than half of the journeys interchanges were necessary, once, twice and even three times to complete a journey. The distribution of these is shown below.

Table 10
Distribution of interchanges per journey

	Peak	Off peak	Overall
No. of interchanges needed			
0	45%	43%	43%
1	42%	42%	42%
2	13%	14%	14%
3	—	2%	2%

The time taken to walk from one stop/station to the next during interchanges was also determined.

Table 11
Interchange walk time

	Peak	Off peak
Average time	1.2	1.4
Standard Deviation	0.9	1.5

However interchange also adds a further waiting period during the journey, thus doubly lengthening the total time. There is also extra inconvenience, extra boarding and alighting difficulty and an extra element of danger.

4.4.3.9 *journey time*

A. Total journey time

Firstly the total time from the origin stop/station to destination stop/station was determined for every journey made. Secondly the journey distance was determined from the airline distance multiplied by the factor 1.4, representing the average on street distance to airline distance in towns. The journey lengths and times were analysed by frequency distribution.

Table 12
Distribution of journey lengths · km

	Number of journeys							
Journey length (km)	0–1.5	1.5–2.0	2.0–3	3–4	4–5	5–7	7–10	10 +
Peak period	9	11	18	21	16	20	7	3
Off Peak	28	43	63	25	39	81	11	7

Table 13

Distribution of journey times · mins

	Number of journeys								
Journey time (min)	0–5	5–10	10–15	15–20	20–25	25–30	30–40	40–50	50 +
Peak Period	1	28	15	15	20	15	10	1	0
Off Peak	15	61	51	54	46	42	22	5	4

The Ki-square test was applied to both of these distributions and there is no significant difference between the peak and off peak journey lengths, but a significant difference between peak and off peak journey times.

The average journey in the peak period was 4.1 km long, with a standard deviation of 2.3 km, and in the off peak 4.0 km (2.5 km). The average journey time in the peak was 18.1 min (9.8 min), and in the off peak 17.8 min (10.1). This would suggest that traffic congestion reduces total journey speed by less than 1% compared to the off peak.

The data for total journey length and time were further analysed by linear regression, which produced significant levels of correlation (r). A model of journey length (x the independent variable) was determined against journey time (y) in the form:

$$y = a + bx\,,$$

the results of this analysis were:

Table 14

Journey length to time regression equations

	a	b	r	(Speed)
Peak	2.07	3.89	0.91	13.6 km/hr
Off Peak	1.53	4.12	0.94	13.5 km/hr

These are plotted in Fig. 2, with the addition of an average time (5 mins) for walking to and from the stop/station. Fig. 2 also shows normal walking time of 5 km/hr and car driving speed of 30 km/hr drawn for comparison. In Budapest walking is faster on average for journeys up to 1 km. There is of course a distribution of public transport journey times but for 67% of journeys up to 0.75 km, walking is faster; and 0.5 km for 95% of journeys.

Car travel is faster than public transport for all journey lengths. To be competitive, car speeds would have to be reduced to about 10 km/hr overall.

A. *Trip speeds by different modes*

a. *Bus*

Bus trip length was determined from the actual route taken by each bus service, and was compared to the in-vehicle times recorded during the survey. This produced the following regression equations.

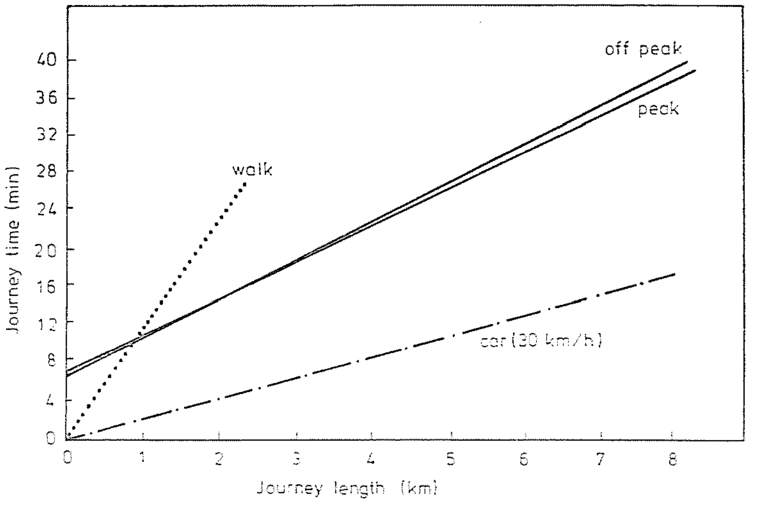

Fig. 2. Origin to destination journey time

Table 15

Bus trip length to time regression equations

	a	b	r	Operating speed
Peak	0.30	3.20	0.95	18.1 km/hr
Off Peak	0.42	2.78	0.94	21.6 km/hr

In the peak period the average length of bus trips was 2.18 km (with a standard deviation of 0.65 km), and in the off peak 2.26 km (0.81 km). The in-vehicle time was also analysed. The average peak time was 7.31 mins (3.85 mins), and in the off peak 6.73 mins (3.49 mins). Bus trip speeds were determined by adding the average peak (and off peak) waiting times to the above and the results are plotted in Fig. 3 for the peak period, and Fig. 4 for the off peak period.

Since over half the bus trips were on the same service, these were analysed separately, and the student "T" test applied, which showed a significant difference in the average values. Regression analysis was also applied.

Table 16

Trip length to time on bus service No. 11

	a	b	r
Peak	−0.08	3.39	0.98
Off Peak	0.28	2.75	0.95

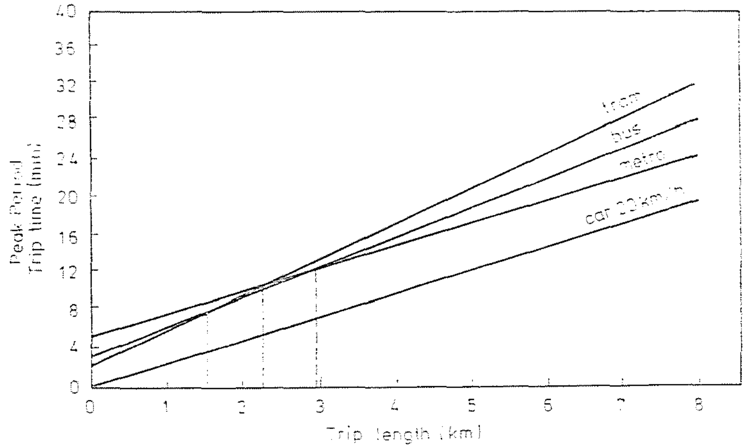

Fig. 3. Mode trip time: peak period (stop/stop)

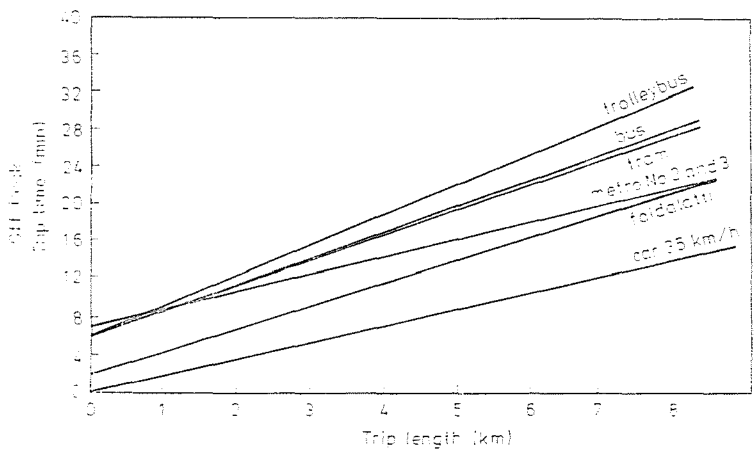

Fig. 4. Mode trip time: off peak period (stop/stop)

Thus in the peak period bus No. 11 operates about 20% more slowly than in the off peak period, and more slowly in the peak compared to the average for all services.

b. *Tram*

In the peak period the average tram trip length was 2.22 km, and in-vehicle time 7.8 mins, while in the off peak they were respectively 2.04 km and 6.0 mins. Using regression analysis the following equations were determined:

Table 17

Tram trip length to time regression equations

	a	b	r	Operating speed
Peak	0.14	3.80	0.94	15.8 km/hr
Off Peak	0.20	2.85	0.97	21.1 km/hr

In the peak tram trips take about a third longer than in the off peak, due to the effects of traffic conditions. These results are plotted in Figs. 3 and 4 for the peak and off peak respectively.

Nearly 30% of tram journeys were made on services 4 and 6, which operate on the Nagy Körút in Budapest. Since this route has some different characteristics than the others, the data were further analysed for just services 4 and 6. In the peak period the average trip length on sevices 4 and 6 was 1.95 km, and in-vehicle time 10.0 mins. In the off peak they were respectively 1.60 km and 5.1 mins. The regression equations are:

Table 18

Trip length to time on tram services 4 and 6

	a	b	r	Operating speed
Peak	0.66	4.78	0.96	12.6 km/hr
Off Peak	0.01	3.17	0.96	18.9 km/hr

In the off peak trip speeds are about 50% faster than in the peak. But for both the peak and off peak, the trip speeds are significantly slower than the average speed of all tram services surveyed

c. *Trolleybus*

Unfortunately insufficient trolleybus trips were made to allow an analysis of the peak period. However in the off peak the average trip length was 1.72 km, and trip time 6.0 mins.

Table 19

Trolleybus trip length to time

	a	b	r	Operating speed
Off Peak	0.41	3.26	0.96	18.4 km/hr

This shows an operating speed significantly slower than for bus or tram services. The result is plotted in Fig. 4.

d. *Metro*

In the peak period the average trip length was 2.15 km and in vehicle time 4 mins. In the off peak 2.25 km and 4.50 mins respectively.

Table 20

Metro trip length to time regression equations

	a	b	r	Operating speed
Peak	−0.02	1.86	0.97	32.3 km/hr
Off Peak	0.29	1.87	0.97	32.1 km/hr

Nearly 30% of off peak trips were made on Metro Line 1 (Földalatti built in 1896) which has characteristics very different from both Metro Lines 2 or 3, which have been built since 1950. Therefore a separate analysis was undertaken for the data for Line 1, which gave an average trip length of 1.34 km and time of 3.5 mins in the off peak.

Table 21

Földalatti trip length to time

	a	b	r	Operating speed
Off Peak	0.85	2.51	0.98	23.9 km/hr

All these results are plotted in Figs. 3 and 4. Although in the off peak Line 1 had an operating speed of only 24 km/hr compared to 32 km/hr on Lines 2 and 3, the average trip speed was faster up to 8 km because of the long time need to access the platforms of Lines 2 and 3.

e. *Operating speeds*

The operating speeds of the public transport modes surveyed in Budapest can be summarized as follows.

Table 22

Operating speeds, km/hr

	Peak	Off Peak
Bus	18.8	21.6
Tram	15.8	21.1
Trolleybus	—	18.4
Metro	32.3	32.1

It is clear that the Metro operating speed is significantly faster than the other modes, and that there is no difference on the Metro between the peak and off peak operating speeds. For both tram and bus services peak operating speeds are lower than the off peak. These factors are important to the B.K.V.

which operates these services, since slower speeds mean higher operating costs for a given service frequency, and conversely higher speeds mean lower operating costs.

However to the passenger, the operating speed is of secondary importance compared to the journey time and the analysis above shows that the higher operating speeds of the Metro are counterbalanced by the long platform access time. Bus and tram services are faster up to about 1.5 km in both the peak and off peak and the Metro does not become significantly faster until trips are over 6 km or more in the peak, and about 3.5 off peak. For short trips therefore bus and tram services are faster than metro, which by definition is unlikely to be important for the majority of short trips, as the walking catchment of Metro stations covers only about 20% of the total city area (assuming 1 km catchments).

4.4.3.10. Conclusion

Even with the high operating speeds of public transport in Budapest, because of the need to walk to and from the stop/station, to wait for the service to arrive, to interchange on nearly 60% of journeys, the overall journey speed is relatively low, and cars are presently faster in all conditions. To be competitive, cars would have to be slowed to about 10 km/hr, or public transport accelerated to operating speeds of about 40 km/hr, in the peak and 50 km/hr in the off peak. Clearly such speeds are not practical for urban transport operating on unsegregated roads, with stops between 300 and 500 meters apart. Even the Metro could only go that fast by reducing station dwell times, higher levels of acceleration and braking and an increased maximum speed.

4.5 *The future probability of choosing public transport*

It is known that passengers perceive different aspects of a journey with different levels of satisfaction and include in the comparison the money costs of travel, related to the available domestic income (e.g Lesley and Várlaki 1985). Passengers find walking and especially waiting much less attractive than riding in a public transport vehicle. Since a significant proportion of a public transport journey is spent walking and waiting, particularly on short journeys, then the gap between the percieved quality of public transport and car travel is wider than a direct comparison of the travel time difference. This means that in present conditions nearly everyone with a choice of a car, will use the car for travel in Budapest.

Fortunately only a minority of inhabitants have that choice but before the turn of the century over 50% of families will have a car and thus a choice for many journeys. If traffic increases significantly as a result of this, most of the public transport services in Budapest will be affected, firstly by a reduction in operating speeds and hence increasing costs, and secondly by reducing reliability and substantially increasing waiting times (a factor most public transport passengers find very unattractive) the number of passengers will decline and hence income. If there is wide spread congestion then for many people the choice will be either to sit in a slowly moving car, or stand in an even slower public transport vehicle. It is highly probable that people will prefer to sit in their car.

4.6 *Making public transport more attractive*

At the very least public transport must be as fast as private transport, if car owners are to be persuaded to use public transport. However passengers percieve the quality of travel in a more complicated way than the total travel time. In particular walking and waiting times are felt to be more onerous than in-vehicle time. Every minute saved in walking or waiting time is percieved as about two minutes of in-vehicle time. For an average journey in Budapest reducing the need to interchange would save both walking and waiting time. Even a modest reduction in the need to interchange from 0.72 times per journey to 0.50, would save nearly half a minute of walking time and almost a minute of waiting time. This 1.5 minutes would have the same perceived value to passengers as a 3 minute reduction of in-vehicle time.

This percieved or generalized cost can help to identify the most effective ways of making public transport attractive to an increasing number of car owners. Given that there is a range of values perceived by passengers, then public transport should be improved in step with the increase of car ownership, about 5% pa . .

4.6.1 *Walking time*

This can be reduced by increasing the number of stops on a route, or increasing the geographical dispersion of routes, which depends on suitable roads being available. However if the number of stops is increased, then the vehicle speed will be reduced, which will increase the cost of operations. If more routes are operated, then for a given vehicle fleet the frequency of each will be less and so the waiting time will increase.

4.6.2 *Waiting time*

This can be reduced by operating more frequent services. However that would increase operating costs. Another way to reduce waiting time is to improve the regularity and reliability of services. In all cases observed, the standard deviation is of the same order as the average time, and in some cases longer. Reducing the variability will reduce average waiting time. If the variability was limited to only plus or minus 50% of the advertised frequency, then this would reduce average waiting time by at least half a minute. If services could operate perfectly to time, then average waiting times would be reduced by over a minute.

4.6.3 *Interchange*

On average there are 0.72 interchanges per public transport journey in Budapest. If the need for interchange could be reduced to 0.50, then the average time saved per journey would be nearly two minutes, including both the extra walking and waiting times. Compared to the average journey time of 20.1 mins, such a reduction represents a 10% improvement in actual travel time. This could be achieved by linking separate services, especially in the direction of major flow. This would introduce some control problems if reliability is not to deteriorate. However there are already long cross city bus services, so it should not create a problem that has not already been solved.

4.6.4 *Operating speeds*

Every time a public transport vehicle has to stop, it reduces the operating speed. The ideal situation would be only to stop at passenger stop/stations. Only on the Metro is this easily achieved. For bus, tram and trolleybus the influence of motortraffic and delays at road junctions, especially in the peak period, makes such an ideal difficult to achieve.

However public transport services on public roads can be protected from some of the adverse effects of traffic congestion in two ways: exclusive lanes, and the control of traffic signals. Exclusive public transport lanes require little capital investment, needing only appropriate traffic laws and a white or physical line to segregate public from private transport. This would have the effect of reducing the vehicle capacity of a road but would greatly increase the *passenger carrying capacity*, especially in the peak period when demand is highest.

Traffic signals can be improved in two ways: either by having signal control programmes set for public transport needs, or by public transport vehicles pre-empting the signals on approach, to ensure a delay free crossing. The former method was used in Glasgow, where a central computer improved bus operating speeds by over 25%. The pre-emption of traffic signals requires appropriate detection equipment and can also significantly reduce the delay.

a. *Tram Services*

There are special extra problems for tram services. These include traversing curves, and negotiating point work. As a policy during track maintenance it should be possible to increase tram speeds through curves by increasing the use of superelevation and transition curves, and by easing curves. This would be easier where tramways are segregated from other traffic, which at present is only 29% of route length (1984). This compares to much higher levels in other European cities, eg. 80% in Gothenburg. It should also be possible to operate points automatically without failure. On a significant proportion of journeys (10%) the driver had to leave the tram to change the points manually. This disrupts speeds and reduces reliability. Also trams should be able to negotiate points faster than at present and it ought to be possible to design, construct and maintain points for 40 km/hr operation.

b. *Trolleybus services*

On trolleybus services there is the problem of negotiating complicated overhead wire junctions. This presently reduces trolleybus operating speed by about 3 km/hr compared to buses. Increasing operating speeds by an average of 3 km/hr could reduce operating costs by about 15%.

4.7 *Conclusion*

From the above discussion it is clear that in all circumstances presently found in Budapest, public transport is slower that car use. The majority of people do not now have the choice of using a car but the number of families with a car is increasing and because of the movement of population to the outer areas (discussed in 2.1 above), the majority of these cars will be concentrated there, for practical reasons.

Since the structure of the city is changing, and circumferential journeys will become more important, then most of the people in the outer areas, within 10 years, will have the choice of a car or bus for the journey to work. Given the significant advantages of the car, it is likely that the car will be used.

5. Prognoses and conclusions

5.1. *Introduction*

The structure of Budapest is changing, and by 2000 more than half of the population will live outside the Hungária Körút. This will have a number of effects. It will increase average journey lengths, and therefore traffic demands, even if car use can be restrained. The city centre will become relatively less important as a destination for journeys, as the new District Centres take over many of the functions of the city centre. However with more poeple in the outer areas being able to choose to travel by car, it will put further pressures upon the city centre for traffic circulation and parking, and on the radial routes into the centre, increasing congestion and reducing the quality of public transport. This is even more so because road construction plans, though ambitious, will not keep pace with the increase of the car fleet, and particularly usage. Nor can traffic management as presently developing be able to increase effective road capacity, since it will take to the turn of the century to link the traffic signals at all road junctions to the central control computer near Kálvin Tér.

5.2 *Public transport*

If public transport could be developed onto separate routes, and so become less affected by traffic congestion, and traffic signals were controlled to minimize the delay to public transport, then it may become competitive with the car in terms of journey time. Metros have these advantages and present plans envisage the completion of Metro Line 3 to Újpest and beyond, and then the construction of Lines 4 and 5. However at present rates of construction it will take until past the middle of the next century for the Metro network to be completed. On present indications the competition from cars will be strongest and most crucial between 1990 and 2000. The planned Metro network will not be ready and so road based public transport must meet most of the competition.

The structure of travel will also change from being strongly radial where public transport presently offers its best service, though still not as good as the car, to tangential (suburb to suburb), where because of the dispersed nature of origins and destinations, demand will rarely be more than can justify a bus service. In Liverpool for example, 60% of all travel is tangential, and the car accounts for 80% of those journeys. In Budapest the car will be very attractive for suburb to suburb journeys, which will be longer on average than now, and the car will provide real time savings compared to public transport.

5.3 *Incremental approach*

For very practical reasons it is rarely possible to effect a radical change to the transport system in a short period. Therefore concern should be directed to those measures which can be implemented incrementally and sequentially. In general we can consider two approaches to achieving the goal of "keeping car traffic within limits of reason". These can be classified as either "carrot" (persuasion) or "stick" (coersion).

5.3.1 *"Carrot" policies*

These aim principally to attract car owners onto public transport. Some possible ideas are considered below.

a. *Better vehicles*

As more people own a car they become very aware of the quality of public transport vehicles, both in terms of comfort and style. The comparison between sitting in a car, and standing or sitting in a public transport vehicle does not help public transport. Seats need to be more comfortable, and more passengers should be able to sit. Ironically speaking, if operating speeds can be increased, then there need be no increase in costs to provide more seat km by bus, tram and trolleybus. At present these vehicles are also difficult to board and alight from, especially for infirm people, with either 2 or 3 steep steps. Stop times could be reduced by making entry and exits easier, that would be welcomed by passengers and increase operating speeds, so reducing costs. On services which are wholly on reserved routes, it should be possible to raise the height of the loading platforms (to say 300 mm), so that entry can be made with only one step. Buses must also be quieter, and operate with fewer uncomfortable (sometimes dangerous) jolts. The vehicle is the part of the public transport system with the highest visibility. It should be a good advert for a good service.

b. *Stops*

Passengers do not like waiting, so anything which will make the wait less onerous will be good. For services which operate less than once every ten minutes, the actual times of departure should be at the stop so that passengers may come just before the vehicle arrives. If passengers know how long they must wait, that gives further opportunities for alternative travel, eg. walk for short journeys, use an alternative service etc. With modern electronics it is possible to display at every stop, the time of arrival of the next service.

The stop is also the place passengers may wish to be assured that he/she is going the right way or to get information about connections. Unfortunately fellow passengers are not always reliable sources of information. However telecommunications should make it possible to provide a link to an information centre.

In the end however the best way to improve the perceptions of stops, is to make services extremely reliable and so reduce the time passengers have to wait.

c. *Public transport lanes*

Public transport vehicles are extremely efficient users of road space for moving passengers, particularly in the peak periods when demand is highest. A bus with 65 seated passengers takes up the same road space as 3 cars which can carry at most 12 passengers. Therefore it does not make good engineering sense, in trying to maximize capacity, to give the same access to road space to inefficient as well as efficient road space users. This is particularly true for tram-trains, which in the peak carry up to 400 passengers. Is it right that a tram-train should be held up to allow perhaps twenty cars with up to 50 passengers to move?

The incremental extension of bus lanes, as e.g. in Rákóczi út and Árpád fejedelem útja, and protected tramways so that early in the next decade approaching 75% of routes will be protected, would neither be difficult nor expensive. That would allow public transport to operate at faster speeds, make higher frequency services more economical and improve the quality of service offered to passengers, especially by improving reliability and so reducing waiting times.

The choice then for future car owners will be either to sit in their slowly moving car, or travel at higher speed by public transport. In this case the probability of choosing public transport is much higher than in 4.4 above.

The implementation of this policy should begin on wide streets where the loss of vehicle capacity will be small, so that the idea of public transport priority becomes accepted by car drivers. However the real benefits will only come when public transport priority lanes are introduced in congested streets, since this will greatly increase the passenger capacity of those streets.

d. *Priority at junctions*

There are presently many examples in Budapest where full public transport vehicles are stopped at traffic signals to allow a few cars out of a side street. If the traffic signals were controlled to permit public transport vehicles unimpeded crossings of road junctions, then the extra delay to motorists would be more than counterbalanced by the time savings to public transport passengers. With a central computer to control traffic signals it ought also to be possible to identify and monitor the progress of public transport vehicles, and then display the expected arrival times at the stops ahead. Passengers will then have their delays en route reduced and more information to help reduce their waiting times.

e. *Park and Ride*

When most of the population is living at relatively low density in the outer areas, it will be difficult to provide high quality public transport. However for some journeys, especially to the city centre, it may be possible to encourage the use of the car only in the outer areas to act as a collector and distributor to stations on high quality public transport services, e.g. Metro. However such Park and Ride stations will have to be very carefully chosen, firstly to provide adequate parking, and secondly so that car drivers feel they are going in the right direction. Keeping cars out of the city centre, and providing passengers for public transport is probably going to be the best compromise in the long term, between unlimited car use, and the limited capacity of roads in the inner area of Budapest.

f. *Advertising and presentation*

In the future passengers cannot be assumed either to know what kind of public transport service is available, or to have any views about its merits.

Thus it will be very important to supply service information and to provide a positive image for public transport, that will stand comparison with the car. Since perception is so important in a consumers' market, good publicity is needed to form and improve peoples' image of public transport. Every opportunity must be taken, including service changes, to increase awareness. Most journeys are planned at home, and people need good information there, so that travel decisions can be made with a proper knowledge of the alternatives.

5.3.2 "*Stick*" *policies*

These aim principally at restraining car traffic, when there is a public transport alternative.

a. *Increase costs*

If the money costs of motoring were increased, then car owners would trade off the extra costs against the time savings of driving. This could be done in a general way by increasing the price of petrol but that would be a national policy decision. It can also be done with greater precision by increasing the cost of parking in certain areas, for example the city centre, to use market forces to bring demand in line with supply. There could be a charge to drive into special areas. A higher daily charge would be an effective way to restrain motorists. Given the present imbalance between the service quality of public transport and the car, then any cost increase to be effective must be substantial and progressive.

b. *Parking controls*

By reducing the number of parking places available and preventing illegal parking, then in theory the demand for motoring into those areas would decrease. However in practice much depends on the duration and turnover of parking, and the increase of parking just outside the controlled zone. This is not an adequate method by itself, since it is indirect, but applied with other policies it could be effective.

c. *Reduce capacity*

If the amount of road space available for car traffic is reduced, than car traffic will become congested, and a new balance between demand and supply will be found. Capacity can be reduced by closing certain streets to cars and reducing the number of available lanes on other roads. This is a direct method of influencing car use, and ought to be very effective. In practical terms, capacity should be reduced incrementally over a number of years, since that will be more readily accepted by motorists. In this case motorists will have the choice of sitting in their congested car, or travelling in a faster moving public transport service.

d. *Restrict access*

Certain areas of the city can have their access restricted. For example Margit Sziget is now car free, except for those with a special licence. It would be impractial and unreasonable in the short term to prohibit access to a very large area, eg. the city centre. However it would be possible to control access and circulation in the most congested area, without reducing at first the demand for car travel to that area. The "Zonal" system, used in several European cities, would be a relatively easy way to achieve that. The city centre would be divided into zones. Access would be free into each zone but would not be permitted between zones. This has two effects: firstly motorists go to the zone nearest their destination, and secondly they park in the first available space.

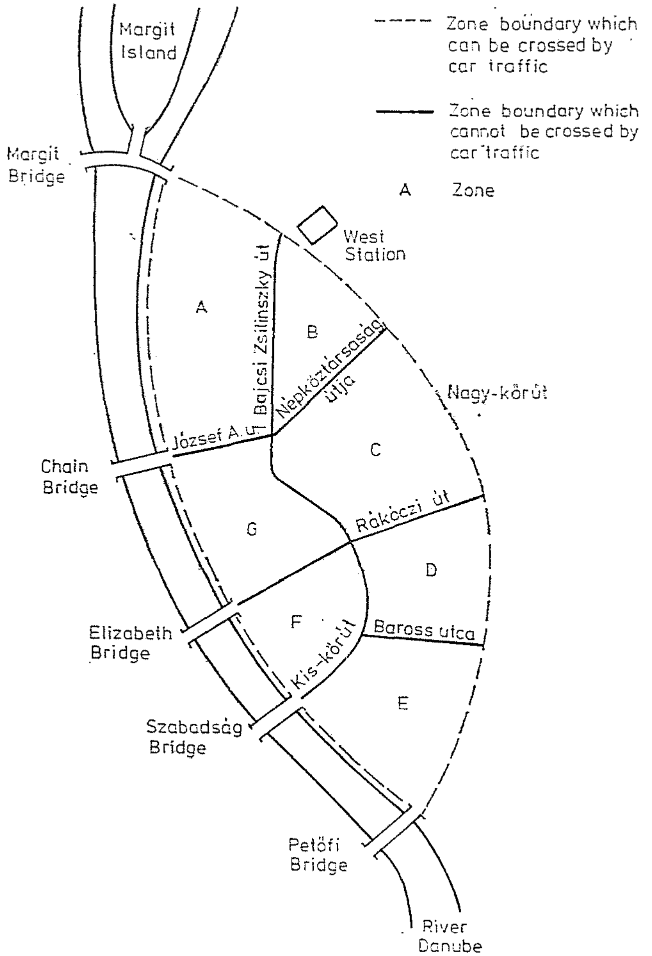

Fig. 5. Proposed zonal system for central Budapest

walking the final part of their journey. This reduces circulating traffic, especially that seeking a parking space closer to the final destination. On the zone boundaries, which are public transport routes, there would be a reduction in car traffic, which would make public transport operation easier and faster. A possible Zonal scheme for the centre of Budapest is shown in Fig. 5.

5.3.3 *Combination methods*

Some of the "carrot" and "stick" policies can be linked to be more effective:

a. *Supplementary licence*

If a Zonal system was introduced for the centre of Budapest, the next step could be to make entry only possible with a supplementary licence. However if that licence could also be used to travel on public transport free, then motorists would have the choice of driving all the way, or travelling free, part or all of the way by public transport. This links policies 5.3.1.f and 5.3.2.a. If car traffic still exceeds supply, then the price of the supplementary licence could be increased until a new equilibrium is reached.

b. *Bus/Tram lines*

These link policies 5.3.1.b and 5.3.2.c, reducing capacity available for car, and releasing public transport services from the effects of traffic congestion. It would then be possible to operate service at higher speeds, all day: a situation found today only on the Metro.

c. *Inner area controls*

The inner area could be controlled more strictly, linking policies 5.3.1.d and 5.3.2.b and d. By reducing the access for motorists to the city centre, many of those who would drive will travel instead by public transport. Given a decline in the total travel to the central area, then this would have the effect of maintaining the absolute demand for radial public transport services.

5.4 *Discussion*

The impact of increasing car ownership and use will be felt in Budapest. Public transport services will be affected; as congestion delays vehicles, costs will go up, and the car will become even more attractive, reducing further the patronage of public transport.

Steps must be taken now to restrain the use of cars, and to maintain the role of public transport. Car users will not be attracted to a public transport system without improvements in quality, faster journey times, less waiting and more comfortable vehicles. The construction of the Metro will be too slow to influence car users before the year 2000. Therefore the major effort will have to be to improve services which operate on public streets. The most effective way to do that will be by providing priority lanes, which would also restrain car use, especially on narrow roads, and by giving priority to public transport at junctions and traffic signals. Generally policies which aim to persuade people to good behaviour are more effective than those which try to coerce. Therefore the main effort should be to improve public transport, then car users will have a rational reason for using public transport.

In the end the choice is stark for Budapest: either it remains a public transport city, or it becomes a car city. It is nearly impossible to have a middle way. This means that investment should be concentrated into improving the public transport system, since any investment in roads will only make cars, which now offer a better service, more attractive, and so will result in a further decline in the use of public transport. Without an early start to such a programme, public transport will face an inevitable decline, with the most severe competition from the private car. This decline once started is difficult and very expensive to stop. Further given the change in the structure of the city and the increase in car ownership in the outer areas, public transport must be improved on circumferential routes, by e.g. having priority access to district centres. Because the travel demand in the outer areas will be dispersed and low, only buses will be economic. Therefore a major effort should be made to provide a new network, integrated to provide a high quality service in this area. In terms of the radial routes, public transport services must be quickly given priority, and after the completion of Metro Line 3 to Újpest, the need for further Metro Lines should be reconsidered, especially as a modest increase in the speed of bus and tram services, due to priorities, would make them as fast as or even faster than travelling by Metro from origin to destination.

5.5 *Conclusions and recommendations*

If public transport in Budapest is not to face the serious problems of congestion and subsequent reduced demand, experienced in America and Britain, then policies must be started now to insulate public transport from the effects of traffic congestion. Service quality can then be increased offering a better alternative, and at the same time restraining car use. Policies to achieve these have been discussed above. In practice some or all of them will be necessary, and they will need to be implemented incrementally and progressively, in order to prevent increasing congestion disrupting public transport services, when most families have a car, and many people have a real alternative.

The change in the structure of the city will make the use of cars even more attractive and therefore will make it doubly important to improve public transport. Although there are long term plans to construct a comprehensive Metro network, it will not be ready in time to meet the increasingly severe competition from motoring. Therefore improvements must be concentrated on bus, tram and trolleybus services. Given the easier access to those services, a modest improvement in operating speed would make them on average as fast as the Metro for most journeys. In the long term, there must be doubt as to whether further Metro Lines will be necessary.

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