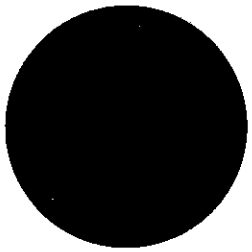
INTERNATIONAL UNION OF PUBLIC TRANSPORT

42nd International Congress

1977 22-27 May



Proceedings

Avenue de l'Uruguay 19 — B-1050 Brussels

extremely stimulating time this afternoon, and I think that we shall very often concern ourselves in a variety of ways with this subject.

I should like to thank all concerned for their interesting contributions this afternoon. I should also like to thank the undertakings, so many of which took such great care in answering the questionnaires drawn up by Dr van Zuylen, and which provided good, solid material for his paper.

Mr Klopotov, Vice-President of UITP, warmly thanked the Chairman of the Session, Mr Elliger, and congratulated the author. He expressed thanks to the speakers and declared the first part of the session closed.

Conclusions

The list of conclusions adopted by the General Assembly for the reports of the Montreal Congress appear at the end of these Proceedings (see section entitled « Ordinary General Assembly »).

Discussion of the report :

Transport services in medium-sized urban regions — Criteria and aids for decisions

Author :

G. Groche, Dr.-Ing., Vorstandsmitglied, Stuttgarter Strassenbahnen AG, Stuttgart (F.R. Germany).

Chairman :

C. G. van Leeuwen, Drs., Directeur, Rotterdamse Elektrische Tram, Rotterdam (Netherlands).

Mr K. Klopotov, Vice-President of UITP, opened the second part of the second Technical Session. He relinquished the chair to the Discussion Chairman, Mr C. G. van Leeuwen, Generaldirektor, Rotterdamse Elektrische Tram, Rotterdam.

Mr van Leeuwen (Netherlands) :

The subject of this session is the report No. 8 called « Transport services in medium-sized urban regions : criteria and aids for decisions ».

It is my pleasure to welcome you all and in particular to present to you the author of this report, Dr Groche, Member of the Board, Vorstandsmitglied of the Stuttgarter Strassenbahnen AG, in Stuttgart, Federal Republic of Germany. Dr Groche has presented to you a report which in my opinion is very interesting and valuable and I hope that at the end of this meeting it can be concluded that you share this opinion.

The subject is not an easy one, because it covers a wide range of problems. Dr Groche has for his purpose determined that a medium-sized urban region is a region with a number of inhabitants ranging from 100 000 up to 1 000 000. In doing so, he is in my opinion covering the greatest part of all the public transport activities in the world within the limits of his subject. It is inevitable therefore that he is dealing with a number of questions which have also been handled in other UITP reports at this and former meetings. I think this is not a drawback because important and valuable things cannot be said often enough.

It seems to me that one central theme of this report is the criteria for the choice of the most suitable form of transport for medium-sized regions. The author comes to a number of conclusions, one of which is that he sees little or no future for the conventional tram or street car and that the light railway or Stadtbahn can have a wide prospect in filling the gap between buses and rapid transit railways. But at the same time, he is wise enough not to claim to present a definite recipe which is usable in all circumstances. In a concrete situation, the definite choice is dependent on a number of factors which can be and will be different from place to place. In making that choice, this paper can, as I hope, be one of our guides.

It is my pleasure now to ask Dr Groche to introduce his report.

Dr Groche (F.R. Germany) :

Previous UITP Congresses have dealt mainly with problems of the major cities. Member undertakings have, however, repeatedly expressed the wish that the problems of the other cities should also be discussed. The Management Committee of the UITP therefore decided to deal with this subject at the 1977 Congress

3) With regard to the cost of the bus and the tram, no distinction appears to have been made in the report between the cost per seat-kilometre and the cost per kilometre-train (one or more vehicles).

For it should be borne in mind that during slack periods, in other words most of the time on working days, and throughout the day on other days, the cost per kilometre-train is the one which has to be considered, as service frequency is more important than capacity.

On the other hand, for rush hours the cost per seat-kilometre must be adopted, as capacity is then the predominant factor.

4) The author stresses, on page 24 of the report, the fact that the tram used as an isolated vehicle is no longer competitive with a bus. It is quite true that the fundamental advantage of rail transport is its economic capacity for mass transport through the use of vehicles coupled together requiring only a single operator. It seems to me desirable that this should be mentioned in the conclusions concerning both the tram and the light metro.

Mr van Leeuwen. — Thank you for these remarks, Mr Quarré. I should now like to call on Mr D. F. Howard, Director of Engineering, Tyne and Wear Passenger Transport Executive, Newcastle-upon-Tyne.

Mr Howard (Great Britain) :

I want to take up one of the conclusions that Dr Groche made in his very comprehensive survey of criteria and aids for decisions in medium-sized cities and I then want to go on into what I regard as a fairly fundamental point.

To start off with his conclusions : he very correctly, very wisely concluded that there is no universal solution to the urban public transport problem. This will vary from place to place. In our own part of England, in Tyne and Wear County, the decision to have an integrated system based on a mixture of metro, buses and ferries, was affected by three things :

— by geography : by having a major river passing through the urban area, with a limited number or river crossings;
— by the pattern of development of a very strong city centre, but a city centre in which streets were becoming less available for wheeled traffic because in some locations new development was being built in their place, and other historic streets were converted to pedestrian use.
— and thirdly by a study of the resources available, and the fact that we have 26 miles of underused suburban railway line which provides the basis for a metro route.

In reply to a comment made this morning by one of the contributors from this rostrum, the decision to go for the metro system was arrived at after a very detailed study of all the alternatives.

Now that system is going ahead. As many of you will know it had its hiccups last year but now over 75 % of our contracts are let and all things are going fast. It is really that hiccup of reappraisal in the midst of the construction programme, and the sort of situation which arose from it, which leads me to my second point.

That is — having got the criteria for decisions — who is going to use them and how are they going to be put to the best advantage ?

In the halcyon days of the public transport industry, we were able to reach our own investment decisions, but those decisions are increasingly being taken away from us.

As operators, because of the amounts of money involved and because of the financial situation affecting public transport these days, we are not able to take those decisions. They are taken by the city government, by the state government or by the federal government or by a combination of all three.

And I think the higher you get up the governmental chain, the further you get away from the everyday practical business of operating public transport. The most difficult thing is to ensure the right decisions are taken, because on both sides of the Atlantic, many civil servants and others, advising ministers and politicians on the taking of those decisions, have no real involvement in or experience of public transport at all. Indeed, they may not even use public transport. And so I think as an industry it is extremely important that we create a situation where we can participate in those decisions.

We are fortunate in the Public Transport Executives in that we have a statutory — a legal — role to play in the transport planning process, which we do with the County Councils with whom we co-operate.

But there still exists, further up the line, the need for the public transport industry, the operating industry as a whole, to be able to actively play its part — if you like to infiltrate the highest levels of government — so that we can get positive quick and realistic decisions.

This ties in with another of Dr Groche's conclusions, which was that we must not try and wait for what is round the corner in the next five years. We must get on with the problem which has got to be solved, and all the papers we have had here confirm this by saying the technology now available is probably the soundest base to use. So, I would suggest that we in the UITP should turn our minds to deciding how do we best influence all levels of government to make sure the best use is made of public transport, both in the urban and the rural scene.

Thank you very much.

Mr van Leeuwen. — Thank you, Mr Howard, for these comments and suggestions. Our next speaker, on whom I would like to call, is Mr V. Vuchic, Professor of Transportation Engineering, University of Pennsylvania, Philadelphia.

Mr Vuchic (United States) :

Dr Groche's report has included a number of very important points relating to public transportation in medium-sized cities. I would like to emphasize and

elaborate one of the points, and then make a very brief comment on an additional point that has been brought out during the discussion.

Small cities are adequately served by buses. Large cities usually have and can have extensive rapid transit networks. But the problem exists in medium-sized cities since they need modes with higher performance than surface buses, but have limited financial abilities to construct them. The most important feature in improving public transportation service is not what technology should be used, but what type of right-of-way should be provided. Right-of-way is interrelated with the technology of transit modes to some extent, but it is important to look at the mode characteristics through the type of right-of-way, rather than through technology because of the great impact separation of public transportation from other traffic has on its performance.

At the time the number of automobiles began to increase rapidly, many cities made hasty decisions to increase capacity of streets by making public transportation « flexible » and mixing it with other traffic. But the capacity was defined in number of vehicles, rather than in number or persons ! However, cities in several countries decided at the same time that separation of transit is important even in medium-sized cities. They have now worked for some 20 years on gradual but persistent development of separate transit rights-of-way. The results of these two policies are quite obvious : cities which opted for « flexible » transit in mixed traffic have unreliable, unattractive service and congested streets. Those with largely separated transit, like The Hague, Cologne and Gothenburg, have achieved excellent public transportation, competitive with the auto for many trip categories.

It is my opinion that we should recommend or emphasize in recommendations particularly the measures which are important for achieving physical separation of transit in medium-sized cities.

Planning bodies and transit agencies should focus their efforts on obtaining as extensive separation of public transport as possible. Longitudinal separation is particularly important because crossings and intersections can be regulated by controls which favor public transport vehicles. The separation varies from the simple bus lane to fully grade-separated tunnels or aerial structures for rail vehicles.

An important point is that justification for separation should be made not only in terms of reduced direct costs and passenger time, but it should include the level of service. As Drs Pampel and Groche recently pointed out, we presently justify in most cases the provision of separated rights-of-way in our cities not so much by increased quality of service, but rather by reduction of direct costs.

Transit improvements are often analysed on the basis of the existing conditions and ridership. Actually every improvement changes modal split, i.e. distribution of trips between modes, and it is the condition *after* the improvement which should be taken into consideration for justifying the investments or other efforts for provision of separate rights-of-way.

In many cities finding the space for rights-of-way is a very difficult task. Many planners have been discouraged by these difficulties and gave up their efforts, or waited to get sufficient funds for an « ultimate solution », i.e., construction of entire fully grade-separated lines or systems at once. Yet, the experience has shown that through step-by-step improvements, such as continuous upgrading of light rail systems in Cologne, Gothenburg and Stuttgart, and more recently bus preferential treatments in Paris, significant improvements can be made. Actually cities which have followed the policy of continuous improvements are now in a much better situation than cities which have waited for « ultimate solutions », often unrealistic ones, to be constructed in a single effort.

Separation of public transport is most important in congested areas; in outlying areas grade crossings and even street running not only by buses or trolley-buses, but also by rail vehicles can be satisfactory under certain conditions. For many cities, particularly medium-sized cities, full grade separation of entire networks, however desirable, may never be a realistic or a financially viable solution. Partial separation of transit can be adequate for service in cities of that physical size and population.

The importance of the separation of public transport should be given particular emphasis now, since the general atmosphere for transit priorities has improved. This is the most important single physical measure for upgrading of public transportation service in medium-sized cities.

I would like to make, if you allow me, a short comment on Mr Quarré's intervention. He mentioned in the discussion the dispute about the capacity of bus lines. It was quoted in Dr Groche's report at 5 000 to 6 000 persons per hour. Mr Quarré mentioned the example of New York where capacities of 25 000 persons per hour have been achieved. This example of approach to Lincoln Tunnel in New York City is quoted very often. It is really striking since it seems to contradict a lot of established numbers about capacities of buses. However, this information is actually incorrectly presented and it is badly misinterpreted. The capacity of 25 000 persons per hour is achieved on the access freeway to the tunnel, which does not have any station. It is therefore *way capacity*, and not *station capacity*. This freeway section leads into a terminal which has over 80 berths for bus unloading, i.e., a situation which does not exist on any transit line serving several points. On urban transit lines *it is the station capacity that governs*. Consequently, the figure of 25 000 persons per hour is completely irrelevant for all bus transit services. The figures of 5 000 to 6 000 persons per hour are realistic ones. This point will be further discussed in connection with another report. I thank you for your attention.

Mr van Leeuwen. — Thank you, Mr Vuchic. I would now like to ask Mr Quinby, Deputy General Manager of the San Francisco Municipal Railway, San Francisco, to come to the stand.

Mr Quinby (United States) :

I would like to direct your attention if I may to section 5.1.1, p. 18 of the English edition of Dr Groche's excellent report here. In that section, there is a statement « No new development trends are re-

Tuesday 24th May 1977

THIRD TECHNICAL SESSION

Discussion of the reports of the International Metropolitan Railways Commitee

a) The place of metropolitan railways and other forms of tracked transport to serve the needs of large cities

Authors :

M. Liberatore, Dr.-Ing., Direttore Generale, Azienda Trasporti Municipali, Milan (Italy), and
J. McConnon, Chairman, Southeastern Pennsylvania Transportation Authority Philadelphia (United States).

Chairman :

R.M. Robbins, Managing Director (Railways), London Transport Executive, London (Great Britain).

b) Passenger information and orientation systems in metropolitan railways

Author :

E. A. Legostaev, General Manager, Moskovsky Metropoliten Imeni Lenina, Moscow (USSR).

Chairman :

L. Gambaccini, Vice-President and General Manager, Port Authority of New York and New Jersey, New York (United States).

Mr Gutknecht, Vice-President of UITP, opened the first part of the third technical session and welcomed the participants. He introduced the Discussion Chairman, Mr R. M. Robbins, Managing Director — Railways, London Transport Executive, London.

Mr Robbins. — It became evident in yesterday's proceedings that those who were particularly concerned with the running of buses in large cities felt sometimes that the contribution to the general good was not always appreciated and that the bus sometimes failed to make its mark in the public discussion in the way they would have wished. Now on the side of the metropolitan railways, there can be no possible complaint of that kind.

Every large city which has or is just thinking of having a metropolitan railway is constantly in the thick of controversy as to the type of railway, whether it should be orthodox or light, or light-light; and it appeared to the Metropolitan Railways Committee that a professional analysis and investigation of the place of rail urban transport in the life of large cities ought to be undertaken.

The two authors who were appointed and whose report has been in your hands were Dr Liberatore, from Milan who, as has just been explained by the

I would define « town » in the following way :

— small towns : having a population of up to 100 000;

— medium towns : between 100 000 and 500 000;

— large towns : between 500 000 and a million, and

— conurbations : when population exceeds a million.

Recently I analysed the UITP statistics of 108 cities in 27 countries with populations exceeding half a million in what I described as the « developed world ». Looking at the density of population, one found the British, Eastern-European and old American cities had population densities of the same order, that is, 4 500 persons/km², whereas in Western Europe and particularly in the Latin countries, the densities were considerably higher.

The second point was the relative size of the cities to the conurbations. In Europe, the city usually represents between 60 and 75 % of a conurbation's population, whereas in North America it represents between 30 and 50 %. From six land use population related factors I attempted to deduce an Index of Travel, the number of passenger journeys by public transport per head of population per year. And this indicated that the North Americans made the fewest journeys by public transport and the Eastern Europeans the most, which is not surprising.

The British travel considerably more than their Western European or North American counterparts. All this basically shows a remark made, I think yesterday afternoon, that no two cities or conurbations are alike, except in the most general terms. In terms of transport system planning the mode selected must be influenced by practical factors. There are two points I would like particularly to stress :

The first one is the importance of the existing tramway or railway systems, that if these are already there, in whatever condition, it is relatively easy to build them up and develop them. This would be a major influencing factor on the decision to have a tramway or a railway. Two examples are obviously Cologne, which has just been mentioned, and Tyneside in Britain. So you might find that a medium-sized town with no trams may in fact develop a local railway system because the track is already there and it is a suitable location for upgrading either for light rapid transit or a suburban railway.

My second point is to draw attention to p. 20 of the last paper which indicates the overlapping system capacities and shows particularly that there is no real distinction between the different types of tramway. Tramway leads to light rapid transit or to pre-metro then, later, to full metro. Following a visit to Europe last year, specifically to look at light rail transit or pre-metro, I reviewed 16 basic designs of rolling stock that are operating at the moment in Western Europe or North America. The results of this are published in the ' Railway Gazette International ' of this month.

There is a considerable degree of overlapping of designs for what appears to be the same traffic objectives. Indeed I identified there were about three basic types of cars and there was very little relationship between their capability of dealing with low and high platforms and such things.

I therefore enter a plea that there should be a degree of standardisation in this field of tramway development. I postulated, for the sake of argument, a car based on the Zurich 2 000 design, a car based on the Frankfurt P8 design and then for the light rail transit the Cologne B-type car or for Britain, obviously, the Tyne and Wear car.

I think that there is a great danger that what starts out as being an upgrading and a modernisation of the tramway gets heavier and heavier and consequently more and more expensive, therefore defeating one of its first objectives.

Mr Robbins. — Thank you, Mr Hellewell, for that contribution. Now I will call on our next speaker, Prof. V. Vuchic, Professor of Transportation Engineering, University of Pennsylvania, Philadelphia.

Prof. Vuchic (United States) :

The report prepared by Messrs Liberatore and McConnon presents an important view of rail transit. It shows the entire « family of rail transit modes », which consists of streetcars, light rail transit, rapid transit and regional rail. This is important because there is often a tendency in planning and analysis of these modes to view rail transit as a single mode with fixed characteristics, thus over-looking the great diversity which rail technology offers.

There is presently a definite trend towards development of a nearly continuous range of modes. The dividing lines between the four modes are not very sharp. Yet, it is important that each mode be defined by correct professional terms and that terminology be standardised. Here is one remark I want to make. The report utilizes quite non-standard terminology which can increase already appreciable confusion in this respect. Instead of « high-capacity tramways », the standard term is *light rail transit* in English, Stadtbahn in German, métro léger in French. Metro or rapid transit are equally valid terms for that mode. However, I would object to the term « metropolitan railway-like lines ». I suggest the standard term *regional rail*. Moreover I would also draw attention that « tracked transport » is quite an unusual term and should not be used. The terms *rail transit* or *rail public transportation* are well known and understood.

Now several technical remarks. In the analysis of rapid transit rolling stock, cars with joint trucks, such as those in Hamburg and Rotterdam, should not be considered as single vehicles. They have separate bodies. They are basic operating units like married pairs, but not single vehicles.

Another comment is that average values should be handled very carefully. For example, Table 12 presents some average costs which vary greatly with many local factors. There should be a strong warning about possible major deviations from the presented numbers.

A very important aspect of rail transit is its interrelationship with city planning and land use, which has not been sufficiently mentioned in the report.

I believe that this is an extremely important aspect, since it is a major element in the decisions to build rail transit. It goes hand in hand with urban growth and development.

With respect to capacity, we keep using some numbers which are actually deceiving for several reasons. First, capacity in terms of passengers passed a point per hour is a very crude number, since it totally neglects the level of service. Many aspects of level of service (comfort, safety, etc.) cannot be quantitatively included, but one of them can, and it greatly improves this indicator. If we take capacity in terms of persons per hour and multiply it by the average speed which this system performs with that transportation capacity, we get a *productive capacity*, an indicator which much better reflects performance of modes. It prevents the paradox that old type streetcars travelling at 8 km/h have a higher capacity than much higher speed light rail transit. When productive capacities of different modes are plotted on a diagram, they provide a very interesting grouping of modes which characterises their performance much better than capacity alone.

Second, capacity figures are very often exaggerated and I would like to disagree here with Mr Quinby about the figures he presented yesterday for light rail transit. I think they are far in excess of those typical for realistic conditions. The figure of 35 000 persons per hour is not only extremely difficult to physically achieve, but it would be completely out of economic range of that mode of transit. Similarly the capacities quoted in the report for rapid transit of 40 000 to 80 000 persons per hour are far in excess of most systems, the upper range probably of all systems. The dangerous implication of these extremely high figures is that only very high volumes can justify contruction of rail transit. I should again quote Dr Pampel that in most cases we build rapid transit for better quality service, not only for higher capacities in terms of passengers per hour. Many of our highly successful lines carry only 10 000, 8 000 or 6 000 passengers per hour in the peak hour. Moreover, peak hour is not the only item that should be analyzed.

Finally, let me briefly discuss a broader aspect highly relevant to this topic : the current trend in planning and construction of rail transit. The report does point out that there has been and currently is a clear, strong trend toward greater interest in rail transit. A problem that has developed in recent years, however, has been a tendency to over-design and excessively complicate mechanical, electrical or even more so electronic aspects of vehicles, controls, rights-of-way and other components. This has led to excessive costs on one side, and decreased performance, especially in terms of reliability, on the other. This phenomenon has caused strong criticism, partially by opponents of public transportation who have welcomed this problem but partially also by many of us who are concerned with creating sound, economic and efficient public transport and improvements of cities in general.

The trend toward light rail transit is very strong and logical for the present conditions. However we must be careful not to develop extreme « unimodalism », or advocacy of a single mode as the best solution for all urban transportation. That sometimes exists in this area, as well as its exists between different technologies. In many cities or entire countries, light rail transit has been considered until recently as an « inferior mode ». Even in some smaller cities rapid transit was claimed to be always the « superior » one. The discussions led to many years of delay of any action and in many cities the choice has not really turned out to be light rail or rapid transit, but light rail or nothing, since rapid transit plans were excessively ambitious.

However, this does not mean that light rail transit is the best mode for all rail applications. In many cities the need for capacity, speed, reliability, safety, etc., is such that rapid transit was, is, and will be the best mode. This has been clearly shown in many cities in the United States which studied this problem very carefully, and some of them, like Buffalo, Pittsburgh and in Canada Edmonton and Calgary, chose light rail transit. Miami, after giving a careful attention to light rail, selected rapid transit for very good reasons.

A direction which has received very limited attention but has, in my opinion, a great potential for the future, is a mode between light rail and rapid transit. It is the mode which has vehicles similar to light rail transit, but which operates on fully separated rights-of-way, and therefore can eventually be *fully automated*. This mode is referred to as *light rapid transit*; we can also call it « mini-rapid transit », or « Mini-U-Bahn » in German.

In many cities we need highly reliable, frequent, high-quality service. But we cannot pay and often do not need such standards as 3 m wide vehicles, 300 m minimum radii, 150 m long stations, etc. Costs which can be saved by reducing these standards, can be used for many more kilometers of lines and thus better serve entire urban areas. We need larger networks, rather than more Taj Mahal monuments in our cities.

Thus an important conclusion is that the future of rail transit is generally bright, but it is bright only if we work hard on careful planning and design, particularly the design for reliable, highly efficient, low-cost operations. Realism in planning, design and operations is required. That is what the cities will increasingly need in the foreseeable future. Thank you.

Mr Robbins. — I should like to thank and congratulate Mr Vuchic for his clarity and realism. I now call on Mr P. Appelmans, Directeur Général, Société des Transports Intercommunaux de Bruxelles, Brussels.

Mr Appelmans (Belgium) :

The interesting report by Messrs Liberatore and McConnon shows very clearly the importance of tracked modes of urban transport.

However, we should like to make the following comments on this matter.

It seems to us that there is a new trend in certain networks towards a mode of transport that can be included in the classification at the beginning of the report between the tram and the metropolitan railway and which can be called « light rapid transit ».

Thursday, 26th May 1977

FIFTH TECHNICAL SESSION

Discussion of the reports of the International Commission for the Study of Motorbuses

a) **Development of the motorbus and its integration in modern surface transport systems, dial-a-bus and taxi services included**

Author :

T. Johansson, Technical Director, AB Storstockholms Lokaltrafik, Stockholm (Sweden).

b) **Report on the activities of the Commission**

Author :

Y. Savary, Directeur du Réseau Routier, Régie Autonome des Transports Parisiens (France).

Chairman :

J. Deschamps, Directeur Général, Régie Autonome des Transports Parisiens, Paris (France).

and of the report of the International Commission on Automation

Automation of the control of public transport operations

Author :

W. W. Maxwell, Member for Engineering, London Transport Executive, London (Great Britain).

Chairman :

F. Pampel, Dr.-Ing., Hamburger Hochbahn AG, Hamburg (F.R. Germany).

Mr K. Robinson, Vice-President of UITP, opened the fifth and last technical session. He introduced Mr J. Deschamps, Director General of the RATP, Session Chairman.

Mr Deschamps. — All towns use motorbuses, whether they be large or small, and whether or not they have a « heavier » system such as a railway, tramway or metropolitan railway.

All towns need an efficient motorbus network.

Since this subject is of interest to all UITP members and the work of the International Commission for the Study of Motorbuses is always awaited with impatience, I am happy to chair the session at which that work is to be presented.

As the President has just said, we have two reports on our agenda : that of Mr Johansson and that of Mr Savary. I propose that we examine each of them in turn.

Mr Johansson, Technical Director of the Stockholm network, has produced a very full and very

Mr Vuchic (United States) :

The concept of public transportation modes is rather complex, but it is extremely important to define it precisely. A transit mode is defined by :

1) its type of right-of-way, or the path on which it operates;

2) its technology and

3) its type of service.

It is often believed that different technologies, such as highway vehicles or rail vehicles, represent modes. Actually it is the right-of-way on which it operates which gives each mode most of its characteristics. If we classify and compare different modes, we will notice that streetcar (or tram) is much more similar to bus by its performance and cost characteristics, than it is similar to metro or rapid transit.

Type of service also plays a major role. Transit bus is more similar to trolleybus operating on the same service than to a charter bus which is the same technology or even the same vehicle, but in a totally different service.

Each mode represents a separate combination of performance and cost. The family of transit modes consists of modes which offer different such combinations. Generally, the higher the performance, the higher is the investment cost, but also the higher are the benefits.

Evaluation of costs alone without considering mode performance leads to conclusions which are usually quite misleading. A statement that one mode is « the cheapest » without specifying under which conditions is *a priori incorrect*. There is, however, sometimes a tendency to present a single mode as the best one, playing down all other modes and incorrectly generalizing the advantages of that mode for all conditions.

I must say, Mr Chairman, that the report of Mr Johansson has several of these deficiencies. It treats together such different modes as bus and taxi without adequately defining their fundamental difference, and it strongly recommends buses in their realistic as well as unrealistic forms, downgrading virtually all other modes. Many of the author's arguments are such that they may lead to serious misconceptions and distortions of facts. Therefore some major corrections are called for. If you permit me, Mr Chairman, I would like to discuss some of the most important deficiencies of the report. An exhaustive set of corrections cannot be included in this short discussion.

The report states in the beginning (p. 5) that « it is quite clear that with some exceptions the rail systems were often too rigid and unable to adapt to local developments in such a way as to retain their total share of the transport market ». First of all, discussing rail systems as one mode is an over-generalization. Streetcars and rapid transit or regional rail have little more than vehicle technology in common. Their passenger attraction abilities are drastically different. Similarly, passenger attraction of different bus services, which we can clearly define as different modes — one would be bus on streets, another one would be express bus, another would be dial-a-bus, etc. — is also highly variable. So the generalization to that effect cannot be made.

Second, the numbers Mr Johansson uses compare bus networks which have been expanded extensively, sometimes many times over, with rail networks which have been decreased in many cities. When a city converts a rail line into a bus line, it is natural that the rail line cannot retain its passengers. But if we compare comparable systems, we obtain opposite conclusions to those in the report : in most cities with rapid transit, this mode has retained passengers much better than buses on surface streets. London is one of the many examples. The analysis of the United States systems gives even more drastic results in this respect. During the period Mr Johansson quotes in Table 1, 1950-1970, there was a major increase in auto ownership and serious neglect of public transportation in the United States. Rapid transit annual passengers decreased from 2 264 to 1 881 million, or by 17 %. Bus ridership decreased during the same period from 9 420 to 5 034 million, or by 46 %. But that is not the entire picture. In 1950 streetcars and trolleybuses carried a total of 5 562 million passengers. The vast majority of these services were substituted by buses : in 1970 93 % of surface transit was operated by buses. This conversion to buses actually *accelerated* passenger losses. Taking into account the services buses acquired from streetcars and trolleybuses, bus passenger losses amounted to some 64 % ! These figures are from the official reports of the American Public Transit Association. Mr Johansson's information is therefore totally wrong : the loss of bus passengers was much greater than he states in Table 1 (17 %), and it was more than three times greater than the loss in rail rapid transit passengers.

The costs presented in Figure 4 are also incorrect, because the unit costs decrease with passenger volume until the capacity of the mode is reached. The capacity of buses, particularly in surface operation, reaches this limit much below the region which is shown in the Figure and the costs go sharply up. It is also impossible to show one set of fixed numbers for comparing two groups of modes. Nor is it possible to give specific cost values for all services, all countries, and all times. The same stands for Figures 5, 34 as well as for figures projected on a slide this morning, comparing costs of different modes for different volumes. Conceptual deficiencies and numerical errors of this type of comparison have been documented in the Transportation Research Board literature in the USA (TRB Record 559, p. 52).

The energy diagram in Figure 6 shows a single set of values for different modes. Again, we know that energy consumption per unit of capacity is highly dependent on many factors; moreover, energy consumption per passenger is extremely sensitive to vehicle occupancy (number of persons per vehicle). So it varies among cities, lines, types of services, etc. A single fixed number has little meaning.

The statement that investigations in the United States have shown that « capacity limit of buses is very high, much the same as of metropolitan railways », is based on the tests that were made by General Motors Research Laboratories. That was an interesting test, but, as I briefly mentioned the other day, it is

erroneous and does not have any relevance for real world transit systems. Let me elaborate on this point a little bit.

If we would make a circular track and couple rail cars into a continuous train and start that continuous train to move in the circle, we could increase that capacity in terms of units past a point as much as we can increase the speed. We would get some astronomical numbers, but these numbers would be totally irrelevant for our transit operations in real cities.

The tests that were made by GM have several basic deficiencies. One is that they do not include level of service : speed drops drastically as operations near capacity, which is actually well below capacities which were quoted. Simple computations of vehicle dynamics show that the claimed capacities cannot be achieved with quoted speeds with any degree of safety. Such operating regime would be totally unacceptable for transit vehicles. Further, theoretical volumes under test conditions are drastically different from those which occur in operation in the real world. And finally, the quoted capacity is *way capacity* rather than *station capacity* which dictates capacity or lines. These deficiencies of GM tests have also been presented in the publications of the Transportation Research Board (TRB Record 546, p. 42).

Another statement in the report is that accidents and damage are comparable for buses and rail systems. The data from the American Public Transit Association indicate that the ratio of accidents of buses compared with rapid transit is not 1 : 1, but approximately 10 : 1 ! If we compare streetcars with buses, the picture is completely different and the statement quoted may be quite correct. It may be even somewhat more favourable to streetcars than it should be. Different rail modes are again confused.

Next, we come to another point that is emphasized many times in the report : that buses are very « flexible » and « unpretentious », and that allows them to operate efficiently and attractively. This is a very important concept which is not necessarily related to technology : it is the type of service that is offered. Let me first quote an example of these features relating to two different modes, and then to one mode.

The Lindenwold Line operates between Philadelphia and its New Jersey suburbs, running across the Benjamin Franklin Bridge. The line has only 6 stations in the suburban area. So it is, as is usually criticized with rail transit, limited with its service to very few points. It is strongly « fixed »; it does not go directly where people go; it is « rigid ».

We also have, across the same bridge, serving the same suburbs, but a much larger area by its network, 17 bus routes which do go closer to where people go, which involve fewer transfers, which have express and local services, etc., and which also bring people somewhat closer to the city center in Philadelphia. Yet, the single rail line carries from those 6 stations 30 % more people per day than the 17 « flexible » bus lines covering over 3 000 km² of area !

Now let us look at a similar situation with buses alone. First is the type of service we have in several cities : buses serving suburban areas and having extensive networks, which then go to a busway and do not stop anywhere on their way to downtown. They operate only during morning and afternoon peaks. They really represent a *commuter service* rather than *regular, all-day transit service.*

Second, we have El Monte busway in the Los Angeles area which has a similar type of service, but with stations along the busway, and it operates throughout the day. That type of service is proving more attractive in performing the duty of a regular service throughout the day, rather than only for commuters.

Consequently, right-of-way and type of operation often determine performance, not only technology. For all services except those with very low passenger volumes, the more fixed, precisely scheduled, all-day, easily identified service always attracts many more passengers than a « flexible » and « unpretentious » type of service.

The improvements of infrastructure which are needed to upgrade performance of buses make this mode also more investment-heavy. Often such investment is similar or exceeds that for light rail transit; thus, once we improve the quality of service by buses, we lose its flexibility and its feature of low investment. We actually have the trade-off typical for any technology : higher types of service, but at a higher cost.

Just a brief comment on dual-mode buses. To introduce any new mode, two basic conditions are required : one is that it must be physically and operationally feasible; and second, in its total cost/performance characteristics, it must be at least equal to the existing modes, which it is supposed to substitute or improve.

In my opinion, the dual-mode buses have been characterized in the report much too optimistically. The studies that are quoted were quite superficial, never applied to cities and assumed many unrealistic conditions. There are many operational and mechanical problems that would have to be solved, so that the concept is very far from reality at the present time.

The statement that 80 % of operation on streets and only 20 % off-street would be adequate is not realistic. If we look at light rail transit which operates with only 20 % separation, that type of service is usually not adequate, except in small cities or cities with very low congestion.

Thus, significant improvements of buses should be expected mostly in medium- and light-volume areas. They will decrease « flexibility » of buses and decrease their « unpretentiousness », but will make them more reliable, with stronger image and with conspicuous presence. We must make them more, rather than less, identifiable.

I am not downplaying the importance of bus vehicle development. I am highly complimentary about the UITP Committee's work in recent years, and about the results we have seen in Mr Schultz's presentation this morning. This is highly beneficial and I am sure this will continue to bring benefits to bus transportation. But my point is that most improvements, as Mr Johansson mentioned this morning that 76 % of the undertakings stated, will be mainly in the operations and treatment of buses on city streets, highways and freeways. I would also fully concur with Mr Savary's statement that stations and stops should be given increased attention.

In conclusion, buses will continue to dominate public transportation in small and many medium-sized cities. Their competitiveness with the automobile will depend on their treatment on streets, which has been improved. The improvements have been very slow, and yet the trend is encouraging.

Major construction of busways and other exclusive facilities is quite doubtful, however, since bus systems on exclusive busways have physical and economical limitations. Among others, exclusive busways combine the high investment typical for separated rail modes with a high operating (labor) cost caused by relatively small capacity vehicles. With respect to the dual-mode bus, I think if the concept is carried on further through logical steps, we would eventually rediscover the concept of rubber-tired Metro, which has been serving this city and us, its visitors, so well during the days of this Congress.

I am sorry, Mr Chairman, that I had to be so critical about this report, but I do believe it is important that we improve our understanding of transit systems and modes, which are becoming increasingly complex. It is important to ensure that misunderstandings in exchange of information and literature are minimized. It is particularly important to maintain UITP studies and publications at a high professional level and prevent them from becoming superficial, inaccurate information and unjustified favoring of individual modes. A frank professional exchange is the best way to make progress in this direction. Thank you for your attention.

Mr Deschamps. — Thank you, Mr Vuchic, for these numerous comments. They illustrate clearly that choice of a transport mode requires serious study and that the results will vary from place to place according to the basic criteria chosen. I will now call on our final speaker, Mr M. T. Smith, General Manager, British Leyland UK Limited, Preston.

Mr Smith (Great Britain) :

I intend to refer to three particular subjects : wheels and steps, braking and vehicle safety.

The report recalls the universal search for lower floors in all major advanced bus projects. However, it also clearly records the main concern of the majority of UITP members is with the height of steps and not necessarily with the number. The paper seems to confuse the adoption of small diameter, low profile types with the achievement of low floors and steps. These are not necessarily directly related. The only direct effects are smaller wheelboxes and possibly wider throat or passage dimensions.

With two steps of approximately 180 mm and side seats fitted on raised platforms, the wheelbox intrusion with 10/70 × 22,5 tyres is already minimal.

And so we say : are the smaller tyre sections now being proposed therefore really justified ? They would inevitably bring shorter tread life with increased operating costs; the higher inflation pressures do bring problems of ride. Increased dynamic loadings on road surfaces bring with them problems of road surface wear and damage. Inevitably there will be increased problems of brake ventilation.

The low profile, small diameter type may be well for city operation, but in the open rural areas problems of ground clearance will appear.

The Congress should address itself particularly to this question of wheel and tyre sizes which will be crucial to city bus design trends of the next few years.

Under the heading of braking, section 7.4.9, fig. 23 outlines an automatic braking profile. This profile shows that the proposal does equal work in shorter time. It will increase brake temperatures and it will make a retarder essential, particularly if we follow the trend towards reduced brake sizes. The combined effects will increase the retarder work requirement. The ability to function down to very low or zero speeds will therefore become increasingly important in forward retarder design.

My final comment concerns references by Mr Schultz to vehicle safety and the investment currently being made in protecting the driver. There is of course now wide practical operational experience of the effect of the investment made some years ago in this area by British Leyland.

In the Leyland National vehicle, the driver was particularly protected by a « crash » barrier. But more than that, the total integrity of the vehicle was aimed at giving overall protection to the passenger.

I think probably as the last contributor to this morning session, I could on behalf of the manufacturers thank the world bus operators for their patient co-operation in providing that wealth of information which let Mr Johansson prepare and present to us today such an excellent paper. It is a paper which I am quite sure we shall all find of increasing value during the next two or three years.

Thank you.

Mr Deschamps. — Thank you very much, Mr Smith. That brings us to the end of our list of speakers. I will now therefore ask Mr Johansson to reply to the interventions.

Mr Johansson :

I would like to make comments on some of these points. I was quite aware of the fact that my report would cause a lot of discussion. I am a bit astonished that there has not been more discussion about the choice between different modes of transportation.

It was my intention from the beginning to be a bit controversial on that point. Above that, it was also my intention to show that it is possible to make a better bus transportation system. I will also try to show that the bus transportation system has a large potential for development and in the future can compete with private cars, rail systems and unconventional transportation systems. Bus transportation systems can offer passengers a higher transport quality earlier than any other type of system.

On the other hand I will underline that I have never said that a bus transportation system can replace existing rail systems. I think both systems can live together and we have to look for a balanced type of