

Application of Research Works to Metropolitan Transportation Development

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SOME EXPERIENCES AND PROBLEMS IN BUDAPEST TRANSPORT DEVELOPMENT

1. Introduction

Transportation, that is the movement of persons as well as goods through space, is a vital function of the urban organism comparable in its significance to the circulation of blood in the human organism. The welfare of citizens depends considerably on how well and by what technical means transportation problems are solved. The appearance of motor vehicle communication on the scene offered almost unlimited possibilities to serve all urban areas which, in turn, led to their considerable extension, and thus to the agglomeration of hitherto separate settlements. This unlimited possibility has grown, however, into an obstacle to further development since transport service requirements of individual areas have exceeded supply potentials in their present form. These problems are concentrated, fundamentally, on the metropolitan areas and today they represent the key to their future growth.

With the explosive and world-wide growth of metropolitan agglomerations, transportation in the area affected has developed into a problem of cardinal importance also in Budapest.

During the past twenty-five years the population of Budapest increased from

1,3 million in 1950, to

2,02 million in 1975, which represented 20 per cent of the whole population of Hungary. During the same period the number of passengers using the public transport network increased from 2,5 million to 3,6 million per day, and the number of motor vehicles increased from 15,000 to 150,000.

The need for transportation increases steadily and transportation networks, especially in the old historic part of the city, are no longer capable of satisfying many modern transportation needs. Masses of people move between residential quarters, increasingly developed on the fringes of the city, and their places of work or education in the inner part of the city. These flows result in overloaded transportation facilities, risks and other inconveniences.

The problems created by traffic are going to be extremely serious, as in other big towns, in Budapest, too, so that in a short time the city will be unable to fulfil its main functions.

The solution of the organizational, technical and technological problems of the rapid growth has required intensive and broadscale research.

2. The system for the financial support and management of the research works in Budapest

2.1 Development of the system during the past twenty years

After world war II the basic principle in Budapest was the development of the public transport system. Therefore research works concerned mainly the development of a public transport network with a rapid transit railway having an important part in it.

In connection with the development of motorization in Hungary transport research has had greater importance, becoming more and more regular and better organized since the early sixties. When the Government accepted the concept of the progress of motorization, the National Long-term Scientific Research Plan set the most important tasks for transport research. At the same time the need for a comprehensive general transport plan for Budapest has become clear regarding the rapid growth of motorization. The basic principles prepared by the Budapest City Authorities were presented in 1963 as a starting point for planning and research, and a series of research works started. Most of them had been commissioned by the Transport Directorate of the Budapest City Council and that is why a considerable proportion of research pursued practical aims, and served for providing a basis for the transport development plan and for urgent traffic policy decisions.

The provision for a higher motorization level in Hungary particularly needs long-term planning to promote planned development and calls for forecasts ranging further ahead than the usual general town planning period.

The forecasts beyond the end of this century need particularly extensive research. The longer period means greater uncertainty. These, and some other different conditions are the reason why the practice of countries with high-scale motorization could not be accepted without any changes. Particular investigations were needed for providing particular development methods and models. In addition computerization was relatively poor at that time. In spite of the difficulties some good results largely contributed to the augmentation of the financial support for transport development.

2.2 New Conception for Transport Policy

On the basis of the new requirements the Hungarian Government made fundamental transport policy decisions to solve as far as possible the problems referred to above. Taking into account the available resources of the Hungarian national economy, these decisions seek, on the basis of the economic and social

requirements of the country and at a national level, to achieve the most economical division of labour among the individual branches of transport in order to encourage the rationalization of transport and communications industry.

In the orientation of this transport policy, as a part of the national economy, a uniform concept is appropriately reflected. As a result of the realization of this concept a national transport system will be created in which the two branches would form a uniform scheme by their integrated relationship.

Urban transport policy is an inherent part of the national level concept. In a summarized form this involves the following main objectives:

- satisfaction of transport requirements within the urban area and, particularly, in the city core, in accordance with the importance and development of the town concerned;
- coordinated development of urban and regional transport systems, with particular regard to their existing connections;
- coordinated development of both public and individual transport with a proper ratio in a rational labour division ensured in this field;
- introduction of correct labour division among individual branches of the urban public transport system within the entire mass communications system;
- development of the urban main road system with provisions for the necessary services to be coordinated for the most appropriate use of available land;
- improvement of the level of urban transport planning, drawing up a planning scheme related to the necessary land use, and a consistent realization of the transport development plans accepted;
- reduction of the harmful environmental effects of urban transport.

On the basis of this conception the Science Research Council of the Ministry of Transport defined the main research programs. Among them there are three programs for urban transport research:

1. Transport network planning on the basis of the interdependencies between land use and transportation demand

2. Development of public transport systems

3. Transport development in Budapest.

Demand for a separate research program for Budapest results from the great differences between Budapest and other Hungarian towns in the structure of the city, in the number of inhabitants, in functions and conditions, in the motorization level etc. and therefore in the solution of the main problems. Despite the differences, part of these research works can be adopted, naturally, for other towns and vice versa. The important task of the Science Research Council is to coordinate, and provide a nation-wide use of the results in planning. The whole system is fully described in the paper prepared for the conference by K. Hegyi.

Transport research in Budapest has been under the direction of the Transport Directorate of Budapest City Council. Much of the research has been supported financially either by this Directorate or by the Ministry of Transport. Research works commissioned by industry, firms or authorities are very few.

Allowance proposed by the Science Research Council for the next fifteen years is shown in table 1.

2.3 The basis of the transport research in Budapest

At the beginning of the progress, in the early sixties, transport research started at the universities, mainly at the Civil Engineering and Transport Engineering Department of the Technical University of Budapest.

Table 1 – Allowance proposed by the Science Research Council
Million forints

Main themes	1976-80	1981-85	1986-90	
Transport demand Investigations	4,0	4,0	5,0	13,0
Transport planning models and methods	5,0	6,0	6,0	17,0
Transport management and control	3,5	3,0	2,0	8,5
Long-term planning requirements	11	15	16	42
Other themes	6,5	10	13	23
Total	30	38	42	110,5

People working on transport research in these places usually took part in preparing the Transport Development Plan of Budapest as consulting planners, they proposed urgent themes for research in several areas of this field and that is why a considerable proportion of research works pursued practical aims and served for providing a good basis for the transport development conception. At the same time the increased research effort at these places has brought important benefits to their teaching work.

As the demand on research quickly increased, the claim to a widened basis became evident. First, a research group was organized within the Communication Planning Company of the City Council and later it became the Research and Long-term Planning Department of the Transportation Directorate.

At the same time universities are keeping on with their research on the main themes and help the City with solving its traffic problems to a large extent.

Although there are many more people working on transport research at the universities and in the Research Department of the City Council than before, and generally the work they are carry out is more relevant and of a higher quality than in the 1960s, further extension is needed in both the personal and the technical field. There is particularly much progress to be made in multi-disciplinary working, in relating transport considerations to those of economy, land use and other aspects of public policy.

3. The main aims of investigations in the last fifteen years

3.1 Development of methods and models for the Budapest transportation planning

- Planning methodology considering the limited computer-technique and the need of a particularly long-term forecast

- Simplified trip generation and distribution models

- Assignment models for road network and for public transport network

- Investigations in the problems of modal split

- The characteristics of long-range plans and plans for the near future, the cost-benefit analysis

- System of data collection and registration in cooperation with the other fields of town planning

- Interrelation between land use and transport demand including persons and goods movement

- Week-end traffic investigations in cooperation with the future development plans of resort places and recreation areas, special generation and distribution model for week-end traffic

3.2 Research in transport management and organization

- Local and overall control systems, regulations and restraint
- Investigations in traffic safety
- Demand, distribution and possibilities of pedestrian movement, control and safety problems
- Parking possibilities, control and restraint, park and ride system
- Goods movement, loading and service, demand and restriction
- Organization and coordination in the integrated public transport system

3.3 Special investigations

- Urban environmental pollution and environmental planning
- Administrative and social problems of the urban transport system
- Regional development problems in the Greater Budapest Region, and several other themes in addition.

3.4 The main elements of the long-term plan of Budapest on the basis of the research works mentioned above

- To maintain and improve public transport so that it carries as many passengers as can safely, reliably, comfortably and as quickly as possible, and to make the best of public transport's main advantages, that is to carry a large number of people with relatively little environmental nuisance, with economy of space used, and with availability to all
- The extension and development of the road system, principally by the building of high quality primary roads so that a hierarchy of primary, secondary and local roads is formed
- The restraint of the use of cars in central and busy areas at the busiest times where public transport will provide an acceptable alternative
- Restraint and traffic management and control will have to be applied more intensively and extensively to make the best of the present and future road network.

The most difficult task is to achieve an optimal split and division of labour and cooperation between public and private transport.

The degree of freedom for private traffic should vary in different urban areas. The degree of restriction of private traffic should be based upon the road system capacity and parking potential. Restriction of private traffic in certain areas should be carried out if possible in a natural manner through an appropriate design of the control. The balance of parking capacity in certain areas and the traffic capacity of roads which carry traffic to these areas has a crucial meaning. According to the law of critical speed, traffic volume will always stabilize itself on a certain level and will not increase. Public transport operation should not be influenced by vehicular traffic; which means that, in the areas with a restriction of vehicular traffic, a complete segregation of public transport and vehicles should take place.

In the remaining areas a coexistence for both types of transport is quite possible. Public transport should be a coordinated and integrated system.

Integration means better service for the whole area and increased efficiency. In urban conditions an absolute priority should be given to pedestrian traffic in areas of concentration of traffic (city centre, suburban centres) and in the residential areas as well. This integrated system would be balanced because of the equilibrium which exists between public and private

transport and also between road network capacity and the parking potential.

These ideas are not new, the majority of the elements of this concept may be found in various theoretical and practical works, but they represent a particular problem in the countries where explosion of motorization is expected. The Budapest public transport system consists of suburban rail and underground lines which form the rapid transport system. This system will cooperate with bus, tram and trolleybus transport through improvement and expansion of the feeder lines serving areas adjacent to metro stations.

At main metro stations land is being reserved for parking areas to realize the "park and ride system".

Special attention has been paid to facilities lying close to future underground lines.

4. Main development trends in transport research

4.1 Analysis of traffic demand and circulation

- The system of continuous and systematic data collection and registration in land use, socio-economic factors, travel characteristics and volume informations to reduce the expensive and long-term comprehensive survey
- Developing the system of measuring traffic stream characteristics, speed, saturation flow, lost time, etc. in cooperation with the investigations in users' characteristics
- Research in traffic flow characteristics, speed volume-density, use of probabilistic descriptions, car-following models, capacity and level of service
- Characteristics of week-end traffic. Socio-economic and physical aspects of development of recreational areas, origin-destination studies, planning models for week-end traffic distribution and assignment
- Interdependencies between land use patterns, urban structure and travel demand.

4.2 Transport network planning methodology

- Simplified direct demand or general share models to overcome the worst errors of the current models by including economic demand functions, by incorporating levels of transport service as variables and by considering elasticity of demand and urban structure
- Traffic restriction possibilities, parking control, goods movement and other services in the city centre and suburban centres
- Urban and transport network structure of new settlements, secondary road and pedestrian networks, parking systems, environmental elements, relationship between city structure and travel demand.

4.3 Research on transport management

- To develop computer-controlled traffic control system, preparatory examinations, before and after examinations
- Traffic safety studies, accident analysis, relationship between safety and traffic conditions.

4.4 Other research works

- Research on innovative transportation systems, improvement in transport technology, organization and management
- Environmental quality problems, effect of land use and transportation on pollution levels, aesthetics, urban form and space, park and recreation areas and overall quality of life.

The basic condition of these research works is to develop the Research Department of Budapest City Council by increasing the number of research workers, technicians and equipment in close collaboration

with universities. Investigations should be based on international level cooperation and exchange of views and experiences.

5. Conclusions

5.1 Demand for international cooperation in research activities

Transportation is the most variable and dynamic component of systems of settlement. Decisions on transportation should be oriented primarily towards achieving community development objectives within the framework of comprehensive planning of urban functions. Transportation must be perceived, planned, designed, financed and operated as part of a multipurpose urban system.

Spatial and economic planning on national and regional scale can contribute to solving the problem of urban transportation, particularly in large agglomerations. This comprehensive approach to planning can be used to control the process of urbanization in order to avoid the negative consequences of excessive uncontrolled development of metropolitan areas. In many respects, these problems have only recently been fully recognized.

As a basis for rational decision intensive research and exchange of information and ideas in this field, particularly with respect to comprehensive planning of the transportation function in the urban system, is desirable.

The main subjects, in which the international cooperation seem to be particularly promising and fruitful are:

- Comprehensive assessment of various transport modes and systems, so that decisions on alternatives could be taken with full knowledge of their possible economic, social and ecological consequences rather than being imposed by available technology, with greater attention to institutional factors. Studies and research works should offer guidance to the formulation of a number of economic and legal measures that could be employed to promote more efficient use of infrastructure capacity, and should indicate not only new technological alternatives for transport, but also consider new densities, forms and patterns of settlements.

- Studies to investigate interdependencies between land use patterns and travel demands, costs and benefits of the alternative ways for abatement of pollution and noise in urban areas including an evaluation of alternative transportation innovations and improvements, as well as of physical planning measures.

- Investigations into the conditions under which new transport systems may be introduced to replace traditional systems, and space and energy requirements for various systems.

- Research on technical, organizational and other measures in order to integrate different transportation systems.

- Research, not directly in the field of transport, to determine in the planning period the expectations created by the development of increased motorization and of human life itself, to develop different town planning models taking into consideration the features of different countries.

5.2 Main faults and shortcomings of current models

One of the most important tasks for further research is to develop a new urban transportation planning process to overcome some of the shortcomings of the present model-systems used at many places as well as in Budapest.

Demand for a revision brings different points of view and it is extensively being discussed nowadays. Further follows a very short description of the critique of the conventional metropolitan transportation planning process on the basis of some experiences in Budapest.

The current transportation planning is static rather than dynamic, it is inflexible. It is based upon measurements and estimated relationships from a given point in time, with an assumption that these relationships and estimates will not change with time. Models are calibrated against base year conditions, which inherently implies an assumption that no significant changes in social patterns or behaviour will take place in the design period.

Trip generation models do not take into account either any measure of the economic benefit expected to be derived from a trip or the ability of the network to influence the demand. Models only offer the estimation of total travel demand, and therefore do not allow and specification of the particular transportation system links, which would allow an easy assessment of the accessibility of the zone. So there is no real supply or demand function included in the models.

A trip distribution model - a kind of gravity model in Budapest - does not permit travel time to be included as an explicit variable, therefore an assumption has to be made that the existing relationship between travel times and trip making propensity will remain the same throughout the whole forecast period.

The main problem of modal split and network assignment is, too, that some of the assumptions are unfounded.

The whole planning model, to some extent, is unresponsive and insensitive to many of the questions the decision maker should ask. The whole process is centered around a concept of attempting to produce a plan satisfying a particular demand. There is insufficient attention paid to the question of implementation. Some of the staged implementations that have occurred have been in direct response to budgetary and political constraints, and have not been a consequence of a planned implementation strategy.

In addition, the form of planning is so rigid that no possible way is provided by which technological innovations could even be considered, and the existing strategies take little account of effects or wider impacts upon the environment as a whole, and particularly upon the whole spatial organization of urban areas. However the evolution process is beginning to be expanded into the areas of social and environmental consequences.

Another fault of these models is inaccuracy. Errors occur when the model does not take into account all the factors which may affect the output, and simply from sampling. One of the important consequences of this inaccuracy is that the model is suitable only for broad strategy analysis and not for detailed design work.

Last but not least this planning process as practiced currently is too complex and extremely expensive.

5.3 Some possible changes

Although some promising approaches have been taken in the recent years and transportation planning is in a period of change all over the world, the problem has not been solved yet.

The main question to be answered is how we can achieve the transport situation we want in 25 or 30 years in the best way. Alternative transport policies are needed, transport planning must define the best system for the community.

The changes are likely to be in the trip generation distribution and modal split developing general share models or direct demand models, which include explicit economic demand functions and levels of transport service, such as partly suggested in some studies in the United States.

At the same time simplification and reduction of complexity are needed to reduce the data requirements of the model and the interaction between variables, and to reduce the cost of studies. Better balance is needed between short term and long term problems of implementation.