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Methods for Optimizing and Modeling Routes for Selecting a Routing Scheme for Passenger Transport in Buses
(On the example of Surkhandarya)

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ABSTRACT: This article states that the normal operation of urban passenger transport is important for the development of social and industrial infrastructure.Transport is a branch of the economy of any city. Currently, there are many problems with the transportation of passengers by buses in Termez, and they have not been resolved.Given the growth and development of the city, the demand for passenger transport is growing day by day. However, there are problems with the provision of transport services to the population. Methods of urban passenger transport management and increase of transport efficiency, selection of optimal route schemes, adherence to time frequencies and their accounting work. Passenger transport is aimed at improving the quality of service.

KEYWORDS:urban passenger traffic efficiency; statistical analysis, the role and importance of urban passenger transport, the important role of passenger transport and the method of optimizing the routes to solve a wide range of related problems.

I. INTRODUCTION

Improving the public transport system as a key aspect of sustainable urban development is critical to urban transport development.Normal operation of urban passenger transport is important for the development of social and industrial infrastructure; transport is a branch of the economy of any city. Given the growth and development of the city, the demand for public transport is growing. In the Republic of Uzbekistan, road transport is the leader in terms of passenger traffic. Its share in total passenger traffic is 98.2%. Shown in Figure 1.

Effective management of urban passenger transport should be oriented towards the interests of transport companies. It has been proven that managing the situation, in turn, by designing the number of routes and the frequency of bus departures can improve the efficiency of bus stations and reduce traffic congestion, which is an effective way of choosing a bus stop and stopping mode.

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Satisfaction of the effective demand for transport services in private commercial transport and the correspondence of transportation of privileged categories of the population to urban transport will lead to a reduction in transport revenues and an increase in the need for budget financing. This problem is particularly acute in small towns where public transport is disappearing due to the limited financial resources of the city government.

For passenger traffic in small towns, it is important to conduct passenger transport surveys and optimize the road network.

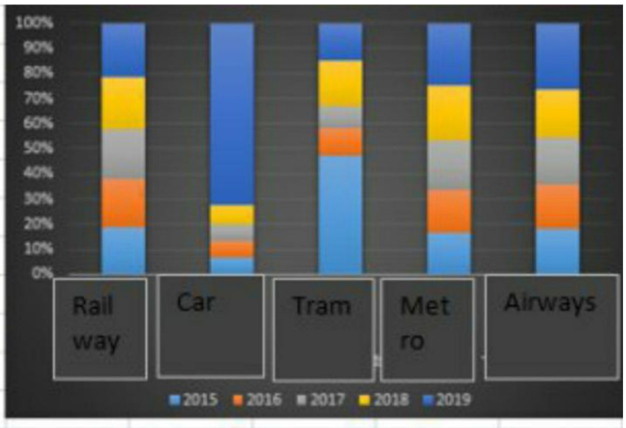

Figure 1 % of passenger traffic by modes of transport

II. THE MAIN FINDINGS AND RESULTS

At present, in order to form a route network on buses and improve its service to the population, it is recommended to pay attention to the following indicators: total time for movement, distance of bus stops, frequency of urban passenger traffic, number of transfers during movement, replenishment of bus reserve, fare, ease of transport, etc. One of the most common criteria for evaluating transport services for a passenger is the time spent on the road. As a criterion for the formation of an optimal route network, it is necessary to use the total time spent by passengers for the movement of bus routes using optimal schemes.

In general, the problem of creating an optimal route scheme of bus routes can be solved as follows.

The main points of departure and return of passenger transport - the nodes and the streets connecting them - are the transport network connections (transport network schedule).The following times of buses are known for each connection in the transport schedule. Passenger traffic between the transport schedule is determined and the intervals of buses on the routes are set.

It is necessary to define a scheme of bus routes in which the total time spent by all passengers for the movement should be minimal.(In particular, the intervals of buses within the city of Termez, non-compliance with bus stops and operational performance are also affected. It is the occurrence of delays as a result of passengers being stopped at any point.Such shortcomings can be addressed by the following limitations: the use of the capacity of buses and should not be less than the specified figure;the length of the direction shall not be less than the minimum and not more than the maximum length, whichever is pre-set; The routes do not have to start and end at those nodes that cannot be used to organize the end points of the resulting routes, and other constraints from the local conditions of the city.

Based on the above, the purpose and function can look like this:

$$F = \sum Q_{ij} * T_{ij} \rightarrow \min, \quad (1)$$

Here Q_{ij} – passenger transport, transition; T_{ij} – =movement time.

Based on the above formula, the following basic information is required to solve the problem of selecting the optimal bus route scheme on the basis of the minimum total time spent by all passengers on the following [2,3,4].

With a transport network consisting of departure points and passenger transport, you can use a city map (city traffic areas) and bus traffic between the streets connecting these points. The zoning takes into account that the time of

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Vol. 7, Issue 9 , September 2020

passage of passengers to the transport zone center should not exceed 5 minutes, so it is assumed that the solution to this problem depends on the branching of the transport network, rather than pedestrian crossings and route scheme from the stop. In this regard, the total time spent by passengers in foot movements is considered to be constant, independent of the route scheme, and therefore the calculations for the selection of the route scheme are not taken into account.The transport timetable indicates the length of each connection and the travel time of the bus along these routes, taking into account the technical speed indicated for each connection.

Identification of passengers based on a survey of passengers will allow processing questionnaires to determine the volume of passenger traffic between all points (areas) of the city, the beginning and end of passenger traffic. It is advisable to develop a route scheme, taking into account the location of large enterprises, shopping malls, educational institutions in the city center at “peak times” in the morning and evening. Thus, determining the passenger flow at the specified time gives a good result.

Specify the start and end of the routes, and the minimum or maximum length of routes.Based on the presented initial data, the number of possible options for constructing the route scheme is represented by a very large value, and the best solution lies among the extreme options.

Option 1. All sections are directly connected to each other along routes, then during the movement all grafts are completely removed and the number of routes becomes more, and their number becomes more:

$$m = [(n - 1)\ n] / 2 \qquad (2)$$

At the same time, the flow of passengers on each route will be small, and given the use of their capacity, the range of buses will be very large, causing passengers to waste time waiting for the bus to stop.

Option 2. With the linear location of the zones, all directions are marked only between adjacent regions and will be their number:

$m = (n - 1)$

However, the maximum possible number of passengers and associated time costs will be incurred. Thus, it is necessary to select a specific combination of routes that provides the minimum total travel time for passengers. The route network optimization technique consists of the following sequence of actions [4,5,6].

Create a transport graph showing the shortest distances between all connecting vertices and the operating speed of the bus for each link in the graph. The data is tabulated and calculated for input into a computer program. It is done manually.
It is possible to form a matrix of passenger correspondence (passenger movement tables), including labor, educational and cultural activities. The matrix is built for the most loaded time and has a path (for calculations we use the morning and evening “tight” hours).

Construct a passenger traffic flow graph based on the shortest (in time) path matrix between the passenger surface matrix (passenger moving table) and the verticals of the graph. It is done by computer program (in the form of a matrix) and manually (in the form of a graph).

Determining the direction of movement of buses (formation of the route network) on the passenger map.

Redistribution of passenger transport along the established routes of bus traffic is carried out by selecting a route. In case of passing several routes along the link, the passenger traffic on this link is distributed proportionally between the routes passing through this link.

Taking into account the redistribution of passenger transport is the target function for the established routes of bus traffic (formed route network)Taking into account the redistribution of passenger transport is the target function for the established routes of bus traffic (formed route network):

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Vol. 7, Issue 9 , September 2020

$$F = \sum Q_{ij} * T_{ij} \rightarrow min \quad (3)$$

Qij – passenger traffic (from the redistributed matrix of the passenger flow chart), yshchl / s;

Tij – movement time (from the matrix of the minimum movement time), h. is performed using a computer program.

Designed for bus routes (existing road network).

The estimated power of the MS on each route is determined.
(q_{rasch}):

$$Q_{rasch} = Q_{ij мах} * I, \quad (4)$$

Qij is the maximum passenger traffic in the route segment (from the redistributed matrix of the passenger flow chart), road / s; I-bus range (set manually for each route). The comparison is made between the power and the maximum power of the buses (*sqm max*) available SAZ NP 21 ISUZU bus type. If the estimated power is higher than the maximum, the power is equal to the maximum power and the new traffic interval (I_n) is calculated based on the next.

1. We compare the new interval of bus traffic with the accepted minimum allowable interval (I_{min}) of 3 min on the basis of the minimum required time for travel and disembarking passengers for calculations. In $I_n < I_{min}$ mode, the new bus range is at a minimum and the estimated capacity of the rolling stock is recalculated relative to the latter.

2. Determines the number of buses operating on each route ($A_м$):

$$A_m = t_{ob} / I = (2*L_m) / (V_e*I) = (2*L_m* Q_{ij мах}) / (V_э* q_{rasch}), \quad (5)$$

$t_{об}$-the rotation time of the bus on the route,

L_m-route length (from the shortest distance matrix),

V_e - operating speed of the bus, km / h. it is possible to change bus routes (form a new route network) according to the passenger traffic map. Perform the described actions. 6-8, each time performing a comparison of the newly created version of the road network according to the criterion of optimality, with the same earlier calculation. For example, with an existing version of the routing network.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 9 , September 2020

Optimizing bus routes when determining the sufficient number of employees on the bus line to increase capacity, such as reducing waiting, when its passengers receive significant benefits, planning traffic, and so on. Carriers operating with different capacities can use them at will. At the same time, the cost of running on low-capacity buses is high. They do business because of the ease and speed of passenger delivery.

Buses can be used on the streets when passenger traffic is reduced, but the fare is the same as the fare on buses. In some areas, the number of routes served by small and especially small-capacity buses is 70%.

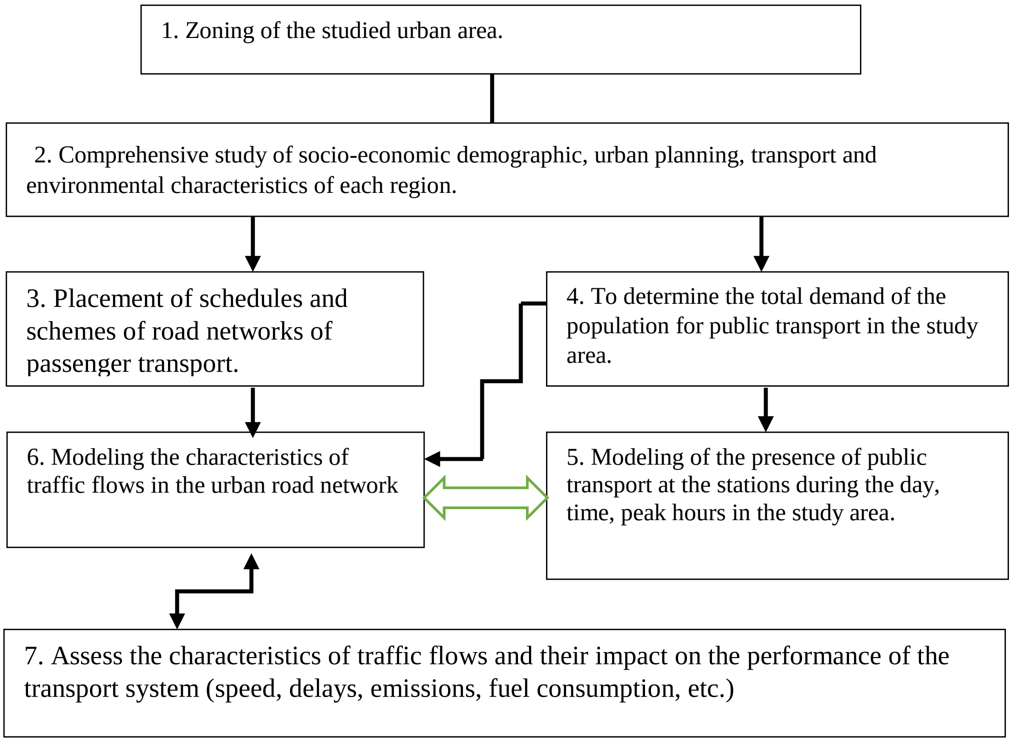
Based on the above, it is possible to create and calculate optimal schemes of routes in small cities.

In particular, for the modeling of Termez city route schemes, the following work is necessary and the following is proposed. (Figure 3): [8]

* topological scheme (maps of regions or micro-districts cited as an example in Figure 2);
* List of routes;
* Passenger flow matrices.

Figure 2 shows a cartographic representation of Route 15 as an example

Route system optimization model. (Figure3)



ISSN: 2350-0328
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Table 1 Procedure for modeling the intra-city and suburban route network

№	Work to be done	What needs to be done		Parameters
1	Create a route network list	1	List of city routes	brand and number of buses, year of route opening, route length, name of stations
		2	List of intra-city and suburban routes	
2	Creating a topological scheme of routes passing through the city streets	1	City mapping by city, interior, suburbs and directions	Route numbers on city streets
3	Draw a topological diagram of the length of the streets on which the routes run	1	Directions The length of the streets passing through Zone 1	1. The length of the streets in each area. 2. The length of the street sections in each area
		2	Routes 2- The length of the streets running through the zones	
		3	The length of the streets operating in Zone 3 of the routes	
		4	The length of the streets where 4 routes operate in the area	
4	Calculating its route network performance	1	Density ratio	K_P= 1,5-2,5 km / sq.km
		2	Route adaptation coefficient (duplication)	K_m= 1,2–1,4 km / km, a very dense with network – 2–4
		3	Quality assessment	Determining the area where the accident occurred
5	Preparation of traffic flow maps. Loading uds	1	Study the traffic flow of all vehicles	When the whole stream is moving
		2	Study of passenger and freight traffic flow	Division of cars into cars and trucks
		3	Study of bus traffic	Separation of buses in high-capacity and very low-capacity buses
6	Create a list of breakpoints	1	The length of the stop stations for the incoming bus flow depends on the length	Length of bus stops, volume of incoming traffic of buses
		2	Conformity of distances between stages to normative requirements	Distances between stops (stages)
		3	Mapping stop stations	Mapping stop stations with transition length
7	Pedestrian access to passenger parking lots	1	Determining the number of people living in houses	City map by blocks and neighborhoods with houses and population drawn
		2	Determining the walking distance of passengers to bus stops	City maps of the area drawn with a 500 m pedestrian

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				access radius at the stop points
		3	Definition of transport discrimination	Creating schedules for determining pedestrian access to parking lots.
		4	Determining population flow in areas where pedestrians are present	Determining the indicator for the population zones and districts
8	Creating a cartogram of passenger flows on each route	1	Conducting a survey on passenger traffic	The amount of daily and passenger traffic on each route.
9	Create a cartogram of passenger flows for each of the stops	1	Compilation of passenger exchange cartograms of stopping points based on the results of passenger calculations	The cost of passenger exchange at the station by the hour of the day.
		2	Determine the number of passengers for each bus and route	The value of the number of passengers per hour of the day on the route.
10	Number of buses on the route	1	Number of buses on city routes	Counting the number of buses on the routes.
		2	Number of buses on suburban routes	
11	Number of flights on the routes	1	Time of technical speed	Determining the number of flights.

III. CONCLUSION

In short, it can be said that there are a number of socio-economic problems in other sectors of the urban economy and urban planning that affect passenger transport.

These include the lack of stops, non-compliance with intermediate intervals and late arrival of passengers. The urban passenger transport system needs to upgrade its vehicles, which will improve the quality of passenger service and improve economic performance. The operation of new buses will increase the efficiency of working time. The problem of growth at the regional border is a serious problem with the limited road network. Poor road infrastructure leads to an increase in road traffic accidents.Thus, expanding city roads and transportation outlets, and sidewalks, and transportation service systems need to upgrade bus stops and establish a modern dispatch service. Congestion on city roads and intersections leads to increased walking time, which in turn affects economic performance. Assessing the prospects of some sectors is on the way to further development of urban passenger transport, but it should be borne in mind that, first of all, a balance must be struck between the interests of consumers. To do this, it is necessary to manage the passenger transport system, reduce the negative impact and take into account the interests of passengers, improve the quality of transport services provided by transport companies, and raise the level of carriers.Therefore, this method is the most sensible in the organization of bus transport services in small towns.It is advisable to develop and mathematically model the optimal options of route schemes.If the above work is done, passenger transportation will be considered more efficient and this will contribute to economic growth.

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