

TRANSPORTATION MANAGEMENT AND ITS EFFECT ON THE ECONOMY OF IRAN

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ABSTRACT

Study of the current situation of the urban bus systems of Iran shows different kinds of obstacles and problems, including organizational and institutional structure, manpower structure, equipment structure and financial structure. This article with the title of “Transportation Management and Its Effect on the Economy of Iran” is prepared for the better identification of the public transportation system’s problems in Iran and provides some solutions to increase the system’s efficiency. One of the main economic – social activities is transportation which has a special position in the modern societies. On the other hand, a significant proportion of the urban passenger transportation in Iran is undertaken by the bus systems which are managed under the supervision of municipalities. As encouraging people to use the public transportation is very important, designing a system which has the minimum financial, organizational and manpower problems has a high priority. In other words, the general condition of the bus system must be designed so that not only meets the passengers’ needs properly, but also has the required efficiency in terms of financing costs, combination of manpower, and combination of transportation fleets and the equipment structure.

KEYWORDS: Bus system, public transportation vehicles, transportation management,

INTRODUCTION

In this article, while presenting an image of efficiency indices of the urban bus system such as financial structure, manpower structure, equipment structure and the combination of transportation fleets, and some quality indices, we study and compare different bus systems. In this regard, urban bus systems of Iran are divided into 3 categories of less than 50, 50 to 100 and more than 100 active buses in each bus system. This category leads to the comparison of cities with similar bus systems. In this article, while studying the indices relating to the aforementioned structures, an appropriate index is developed. Among cities of Iran, 48 cities have bus systems which cover a population more than 25 million people. It is worth mentioning that in the category of cities with bus systems, Tehran city is not placed in the category because it has a special condition (administrative and political center, etc.). Also, it must be explained that Rasht city is placed in the average category (50 to 100 buses).

Currently, the urban bus system of Iran has many problems, including financing costs, the low share of operating revenue relative to the total revenue and the high level of the government subsidies. The high dependence of bus systems on the government subsidies is another problem which is resulted from their failure in making more operating revenue. However, granting subsidies is among the government’s policies to facilitate citizens’ transportation (citizens who have low incomes and are not able to have personal cars), there is still an imbalance between the country’s revenues and the bus system’ expenses. In order to achieve this goal, the existing problems and insufficiencies must be identified, strategies must be provided and appropriate criteria must be developed and introduced. Basically, a research must have specified determinant objectives which without them it is not possible to conduct a research.

According to the issues mentioned and the significance of basic and strategic objectives, this research is conducted as follows. The main objective of the research is to develop appropriate indices for financial, manpower and equipment structures in the urban bus systems of Iran. The strategic objective of the research includes: developing appropriate indices of the financial structure in terms of the combination of revenues and expenses, the subsidies ratio in the total

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revenue and expenses, the coverage of revenue sources relative to the total expenses, and the ratio of the coverage of operating and non-operating revenues to the total expenses. Although other countries' indices are a good basis for observing the condition of the country's urban bus system among similar countries, but they cannot be an appropriate criterion for us, because the existing economic, social and cultural differences make it impossible, and it is clear that issues such as people's culture and income level, and the urban structure lead to these differences.

The strategic research hypothesis and question is that whether indices and criteria of the efficiency of Iran's bus system are in an appropriate condition in the present situation or not. Therefore, the strategic questions in the research project include: Are financial, manpower and equipment indices in an appropriate situation and how is the status of external indices of the system? According to the above question, this question is posed: What are appropriate indices of different structures of the urban bus system in Iran? This question is the basic question of the present research.

MATERIALS AND METHODS

The research process is as follows:

- 1- Exploratory studies on the preparation of indices of the bus system's efficiency and its documents.
- 2- Data extraction, process and classification.
- 3- Information analysis and the explanation of the current situation of urban bus systems.
- 4- Developing appropriate indices of the urban bus system.
- 5- Developing strategies and suggestions.

The lack of required theoretical sources of appropriate indices and determination of these sources for the urban bus system is the most important problem of the present study. For obtaining the mentioned information, Plan and Budget Organization's libraries, Tehran University, Department of Transportation of Sharif University of Technology, Amirkabir University of Technology, Tehran Transportation and Traffic Comprehensive Research Company, and Shahid Beheshti University were studied and only the book "Janes Urban Transport System" included some required information. For obtaining the appropriate indices, first urban bus systems of Iran are classified in three groups based on the number of active buses and in each group, first the current situation is studied and then, an appropriate index is developed. The population of the areas under the coverage of bus systems in different cities of the country (except Tehran) ranges from 83,000 people for Masjed Soleyman to 2,157,000 people for Mashhad. As the number of buses used in the urban bus system results from the need of each city and the number of active buses in each city indicates the population of that city, instead of using the population of each city in the classification of the three groups and developing appropriate indices, the number of active buses was used and the appropriate indices were separately determined for each of the three groups.

RESULTS AND DISCUSSION

According to the number of buses used in bus systems of different cities and the number of active buses of the public transportation fleet, the number of existing active buses (47 bus systems except Tehran bus system) was studied and classified in three groups as follows:

- 1- Bus systems with less than 50 active buses, 2- bus systems with 51 to 100 active buses, and 3- bus systems with more than 100 active buses.

Table 1. Three categories of urban bus systems of Iran

Group	Name of City	Number	Percent
1	Maragheh - Khoy - Khomeini Shahr - Kashan - Najaf Abad - Ilam - Bushehr - Shahrekord - Bojnourd - Birjand - Sabzevar - Neishaboore - Abadan - Khorramshahr - Dezful - MasjedSoleiman - Semnan - Zabol - Kurdistan - Borojerd - Amol - Babol - Sari - Qaemshahr - Gorgan - Bandar Abbas - Malayer	27	57.4
2	Ardabil - Islamshahr - Qazvin - Zanjan - Zahedan - Rasht - Tehran - Arak - Hamadan - Yazd	10	21.3
3	Tabriz - Urmia - Isfahan - Qom - Karaj - Mashhad - Ahvaz - Shiraz - Kerman - Kermanshah	10	21.3
Total	-----	47	100

Table 2. Classification of the second group of the urban bus system of Iran according to the population size and the number of active buses

Name of City	Population (1,000 people)	The Number of Active Buses	The Number of Active Buses + (the Number of Minibuses divided by 2)
Ardabil	330	70	115
Islamshahr	240	53	240
Qazvin	299	73	143
Zanjan	281	63	63
Zahedan	420	81	101
Rasht	374	80	88
khorrabad	277	61	68
Arak	378	67	113
Hamadan	406	82	93
Yazd	306	78	81

Buses of a bus system need money for the maintenance management system which must be supplied by the revenues made, and as the number of active buses is very important in making revenues in the bus system, considering the number of active buses and total buses is significantly important in terms of the method of providing services and the method of making revenues. In the second group, 5, 3 and 2 bus systems are 90%, 72-85% and 58-63%, respectively. The average ratio of active buses to the total buses is 82.2% and their average lifetime is 4.8 years which are in a good situation, and among the second group buses, only Hamadan and Yazd buses have an average lifetime of over 7 years (i.e. those bus systems among the second group which have the less ratio of active buses to the total buses) which shows a direct relationship between the ratio of active buses to the total buses with an average lifetime.

According to the appropriate condition of the second group buses (both in terms of high ratio of active buses to the total buses and the low level of buses' lifetime), the value of 85 to 90% can be an appropriate criterion for the mentioned index in the second group. As the mentioned ratio in the current situation is 90% and more in 5 bus systems and is close to this percent in three bus systems, the value of 85 to 90% is logical for the mentioned ratio, and Hamadan and Yazd bus systems must attempt to achieve the suggested criterion which requires the lower level of average lifetime of buses in these bus systems. The average ratio of active buses to the total buses was 78.6% for 106 bus systems in 250 cities of the world which their information was available and this ratio was 81.7% for the triple bus systems of Iran. Therefore, the urban bus systems in Iran have a better condition compared to the urban bus systems in other cities of the world.

Regarding the average lifetime of buses, it must be mentioned that "as a bus is the fixed property of a bus system and the annual depreciation percent is usually considered for fixed properties, by assuming 15 to 20% annual depreciation rate for a bus, its useful life is on average 7 years which is introduced as an appropriate index". The classification of urban buses in this regard does not make any difference. So, for urban buses of Iran with 15% annual depreciation rate, the average lifetime of 7 years is introduced as an appropriate index. The high level of bus lifetime leads to the increase of maintenance expenses and also has environmental consequences, including air pollution and noise pollution which are harmful for citizens and some measures must be taken in this regard.

In the second group bus systems, the minimum average bus lifetime is related to Ardabil and Islamshahr bus systems with 3.1 years and the maximum one is related to Hamadan bus system with 7.3 years. In this group, 20% of bus systems (2 bus systems) have an average bus lifetime of more than 7 years and others (80%) less than 7 years. The average bus lifetime in the second group is 4.8 years which has the minimum value among the three groups. The average bus lifetimes for Ahmedabad (India), Kolkata and other 26 cities in other countries are 11.3, 4.4 and 6.5 years, respectively which show that the situation of urban bus systems of Iran (without considering Tehran bus systems) is appropriate and favorable compared to urban bus systems of other countries. In terms of the urban population size, for each active bus, the number of required buses in a city must have a direct relationship with the population and the amount of travel demand so that the three-group classification of urban bus systems of the country confirms it (table 2).

In the second group of bus systems with the urban population of 3,311,000 people and 1105 total active buses, for each 2,996 people, there is one bus. The maximum urban population for each active bus is related to Zanjan bus system with

4,460 people and the minimum one is related to Islamshahr bus system with 1,000 people for each active bus. From all bus systems in the second group, only the urban population of Islamshahr bus system is less than 250,000 people and others are more than 250,000 people in which 9, 6 and 3 cities have the population of more than 250,000, more than 300,000 and 250,000 – 300,000 peoples, respectively. In this group, the urban population rate is less than 3,000 people for each active bus in three bus systems and is more than 3,000 people in other bus systems (7 bus systems). The mentioned average ratio for the total urban bus systems of Iran (47 bus systems) is 2,426 people and the global average is 3,744 people. The reason of high value of the ratio in 104 cities of the world can be the presence of other public transportation systems such as metro, tramway and urban train and alike, while in Iran, among different public transportation systems, only bus is used. The mentioned indices for some Asian cities are as follows:

Yokohama 3,524 people, Ankara 3,333 people, Karachi 23,300 people, Singapore 1,104 people, Ahmedabad 5,555 people, Hong Kong 13,960 people.

As currently, the urban bus system is the main public passenger vehicle in the cities of Iran and there are no other public transportation systems such as metro, tramway and urban train in the country, bus is the only public transportation vehicle which transports a large volume of passengers in cities. As most bus passengers in our country are people without personal cars or with low incomes, it is suggested that by adding the number of active buses in the triple bus systems of the country, the index rates in the first, second and third groups decrease to 3,000, 2,500 and 1,500 people, respectively. For determining the average daily passenger transportation per bus, this ratio must be calculated through the total number of daily passenger transportation in an urban bus system divided by the total active civilian and supervisory buses plus the half number of active civilian and supervisory minibuses. In the second group of bus systems, the maximum index rate is related to Rasht bus system with 1,511 people and the minimum rate is related to Islamshahr with 750 people. In the total bus systems in the second group, three bus systems (30%), six bus systems (60%) and only Rasht bus system (10%) transported less than 1,000, 1,444 – 1,148 and more than 1,500 (1,151) passengers, respectively by one bus per day. The average index rate for the second group of bus systems is 1,171 people per day. The main index for the total urban bus systems of Iran is 1,030 people and its average is 637 people. In other words, buses in the total bus systems of Iran transport passengers 1.6 times more than other countries' buses which show the lack of buses in our country's bus system.

The average daily passenger transportation per bus can be one of the indices of the travel convenience. In other words, the high rate of this index indicates the more pressure and crowd of passengers and therefore, the ratio of seated passengers to stood-up passengers increases and consequently, passengers will be uncomfortable. According to the mentioned cases, in this regard, the urban bus system of Iran has an inappropriate condition compared to urban bus systems of other countries in the world. As the low rate of the mentioned index shows the high number of active buses in a city and also, the high number of active buses can affect the policy of encouraging people to use public transportation vehicles which leads to the reduction of environmental pollution, especially in large cities, it is suggested to decrease the mentioned index which seems to be logical. But, according to the financial status of the urban bus systems of the Iran which cannot purchase many buses in order to decrease the daily passenger transportation per bus to the minimum value, the average daily passenger transportation is 900 to 1,100 people per active bus that seems to be appropriate and therefore, this value is suggested as an optimal index. Regarding the average distance between bus stations, it is worth mentioning that based on the studies conducted, the average distance between bus stations in interurban lines of 47 cities with bus systems (except Tehran) is 562 meters and in the second group of bus systems, it is 678 meters. The average distance between stations in interurban lines of 63 urban bus systems in other countries is 385 meters, the distance between stations is less than 400 meters in 65% of cities, and it is 400 to 800 meters in 35% of the cities. Therefore, the average distance between stations is not more than 800 meters among different bus systems in the world which are under study, while this distance is more than the previously mentioned value in 6.4% of Iran's bus systems and only in 25% of bus systems of the country, it is less than 400 meters. According to the long distance between stations in most cities which have bus systems, it is suggested to place stations in a proper distance from each other. Two points must be considered regarding the distance between stations: The high distance between stations leads to the increase of waiting time of passengers in the bus stations and the low distance between stations leads to the decrease of the bus speed in the interurban lines, both of which are inconsistent with the convenience of travelling by bus because the short waiting time in stations and spending a limited time to arrive to the destination are characteristics of the travel's convenience. The average distance between stations in some cities of the Asian countries is as follows: Kawasaki 380 meters, Istanbul 400 meters, New Delhi 500 meters, and Hiroshima 350 meters.

Table 3. Indices of the urban bus systems of Iran (the second group)

Row	Name of City	Percent of active buses to the total buses	The average bus and minibus lifetime (year)	The city population for each active bus	The average daily passenger transportation per bus (people)	The average distance between stations (meter)
1	Ardabil	90	3.1	2870	1304	412
2	Islamshahr	100	3.1	1000	750	2750
3	Qazvin	90	3.4	2090	1203	473
4	Zanjan	85	3.4	4460	1444	579
5	Zahedan	90	5	4158	911	402
6	Rasht	78	6.6	4250	1511	400
7	Khorramabad	74	4.4	4073	941	279
8	Arak	94	3.2	3345	1212	567
9	Hamadan	58	7.3	4365	1290	588
10	Yazd	63	7.2	3778	1148	325
Average	-----	82.2	4.8	3996	1171	678

The average bus speed is an index of quality performance which can be considered in the evaluation of the system's performance. The average bus speed is the distance traveled by a bus in 1 hour from the origin to the destination. One of the reasons of the significance of using personal cars and taxis inside cities is the speed and the limited time of transportation by vehicles. According to the studies conducted, the average bus speed in Iran's bus systems is 15.2 kph. As this speed in a city is a function of different factors, including the demand rate of travel in that city, the average distance between stations, urban traffic management systems and networks, etc., the mentioned index is calculated without considering the triple classification of urban bus systems. Only in 3% of cities in other countries, the average bus speed is less than 10 kph and in 26% of them, it is more than 20 kph. While in 87% of cities with bus systems in Iran, it is less than 20 kph and only in approximately 13% of cities, it is more than 20 kph (table 4). The average bus speed in regular bus lines of the bus systems in 127 cities in the world is 17.7 kph and in other cities of Asian countries, it is as follows: Bangkok 18 kph, Istanbul 13.5 kph, Lahore 17 kph, Ahmedabad 12 kph, and Kagoshima 15 kph.

According to the significance of the increase of speed which can affect the improvement of bus systems' performance and the increase of the number of passengers, it is suggested that this issue is paid attention in bus systems with the average bus speed of less than 15 kph. The speed of at least 15 kph is suggested as an appropriate criterion for the urban bus systems of Iran.

Table 4. The average bus speed in cities with bus systems in Iran (the second group)

Row	Name of City	The Average Bus Speed per Hour (kilometer)
1	Ardabil	16.8
2	Islamshahr	26.4
3	Qazvin	13.5
4	Zanjan	12
5	Zahedan	10
6	Rasht	18
7	Khorramabad	8
8	Arak	13.4
9	Hamadan	12.5
10	Yazd	13

Regarding the average waiting time of passengers in the bus stations, the most important problems relating to the mentioned index in urban bus systems in Iran are as follows:

- 1- The crowd of passengers and long waiting time in bus stations, due to the lack of a schedule for the activity and frequency of bus movements.

- 2- The lack of appropriate distribution of buses relative to the passengers transportation demand in different lines.

For solving these problems, it is suggested:

- 1- For the fleet movement in lines and their entry into the stations, a schedule must be designed and implemented so that passengers can go to stations based on the schedule.
- 2- Buses must be allocated based on the passengers transportation demand in different lines.

In addition, the ratio of stood-up passengers to seated passengers can be estimated through studying the index of “the average passenger’s transportation per bus”. In other words, the high rate of the index of the average passengers’ transportation per bus indicates more pressure and crowd of passengers, and consequently, passengers will be inconvenient and the low rate of the index of the average passengers’ transportation per bus indicates the low ratio of stood-up passengers to seated passengers. Therefore, in this regard, urban bus systems in Iran have an inappropriate condition compared to bus systems of other countries. The average daily transportation per bus for all urban bus systems in Iran is 1,030 people for each bus and its global average is 637 people. Therefore, it is suggested that by adding the number of active buses in all urban bus system of Iran which leads to the decrease of daily passenger transportation per bus, the ratio of stood-up passengers to seated passengers is reduced.

The study of the current situation of financial, manpower, equipment and qualitative structures of bus systems in Iran indicates that indices under study do not have an appropriate situation. The inappropriate situation of indices under study led to the decrease of the system’s efficiency. Although bus is the only public transportation vehicle in the cities under study in Iran, it has a low level of performance and many shortcomings in terms of equipment and facilities. The number of buses in bus systems of Iran is low compared to the population size of cities and the average daily passenger transportation per bus is an index similar to other cities in the world. Therefore, passengers cannot travel conveniently. The long waiting time in stations and the low average of bus speed are some of the problems of bus systems in Iran. Therefore, considering appropriate (suggested) criteria, it must be attempted to solve the problems of urban bus systems in Iran (table 5).

Table 5: Financial, equipment and qualitative structures’ indices for urban bus systems in Iran (suggested)

Row	Index	The average current situation of the second group	The average current situation in Iran	Global average	The suggested criterion for the second group
1	The ratio of active buses to total buses	82.2	81.7	78.6	85-90
2	The average bus and minibus lifetime in bus systems (year)	4.8	5.7	6.5	7
3	Urban population for each bus (people)	2996	2426	3744	2500
4	The average daily passenger transportation per bus (people)	1171	1030	637	900-1100
5	The average distance between stations (meter)	678	562	385	*
6	The average bus speed (kilometer)	14.4	15.2	17.7	15 (at least)

* based on the study of the special condition of each city

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