

## THE EVALUATION OF OPTIMIZATION STRATEGIES FOR THE TRANSPORTATION SYSTEM BASED ON SWOT MODEL

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### ABSTRACT

Tehran which is a metropolis is growing rapidly as a result of being the capital of Iran and its population is approaching the population explosion. Over the recent years, some problems have emerged in relation with transportation. Therefore, the present paper evaluates optimization strategies of transportation system based on SWOT model (strengths, weaknesses, opportunities, threats). SWOT is one of the strategic tools that adapts the internal strengths and weaknesses of the system with the external opportunities and threats of the system. Since the present paper intends to apply SWOT in order to make the research more practical and increase its use, the evaluation of internal and external environments of the transportation system in Tehran has been done in four subsets. The urban transportation system which has the most efficacies in the public transportation intends to provide the best conditions for citizens. Therefore, the question is whether there are proper strategies for enhancing strengths and opportunities and for addressing weaknesses and threats. The present paper is based on the library studies, and descriptive- analytical method.

**Keywords:** Strategies, Optimization, Transportation System, SWOT, Opportunities and Threats, Efficacy

### INTRODUCTION

The research studies indicate the high value of mean of the urban population growth and this high value could lead to the increase of travel. Usually, the urban travel occurs as a result of people's different daily activities. The activities include jobs, purchase, education, recreation, and etc. They take advantage of methods such as walking, bicycling, personal car, bus, and so forth. The vastness and high population of cities have brought about a condition based on which the volume of travel and necessity of traveling have increased more than the facilities represented in a city. As a result, transportation problems emerge. Therefore, new capacities should be planed so that the represented facilities could be used optimally (Sperling *et al.*, 2009).

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Currently, traffic and transportation are one of the biggest problems of human societies especially in the large cities. The population increase in the large cities and the excessive growth of cities without a correct planning, the concentration of production centers, travel attracting, and absence of an alternative communicative technology have caused urban travel especially by personal vehicles. This issue causes many problems such as citizens' waste of time, the increase of accidents, amortization of vehicles, mental problems, and loss of economic resources, not using human resources, environmental pollution, and excessive use of fossil fuels. Many of the above problems are originated from the improper planning of urban transportation and lack of an integrated urban management system (Litman, 2009).

Today, the problems related to the transportation in big cities are increasing. According to the increasing growth of population and the increase of demand for travel, production, vehicles in the big cites, and the

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consideration of limitations for increasing the width and length of urban sidewalks, some difficulties have occurred. The difficulties are the increase of cars traffic, the increase of air pollution, the increase of visual and auditory pollutions, the increase of costs of fuel consumption, people's time loss, repairing and protecting sidewalks, car accidents, accidents assurance, car depreciation, medical costs, and the decrease of vehicle transportation speed in the cities (Oregon, 2007).

The section of transportation systems management pays attention to the effectiveness of the available transportation systems and the prediction of short-term needs of the transportation. The improvement program for the transportation system is presented after selecting the transportation systems management, and its long-term plans. The program determines the effectively execution of the transportation plan and also it predicts transportation system in the next years. Cars, taxis, lorries, public transportation, pedestrians, and bicycles are parts of the transportation system. In order to increase the efficiency of the system, the following four strategies have been applied: taking actions to get ensured that the available space of roads is effectively used, taking actions to decrease the use of vehicles in the crowded areas, taking actions to increase general transportation systems, and taking actions to improve efficiency of the internal management (Montazari, 2009).

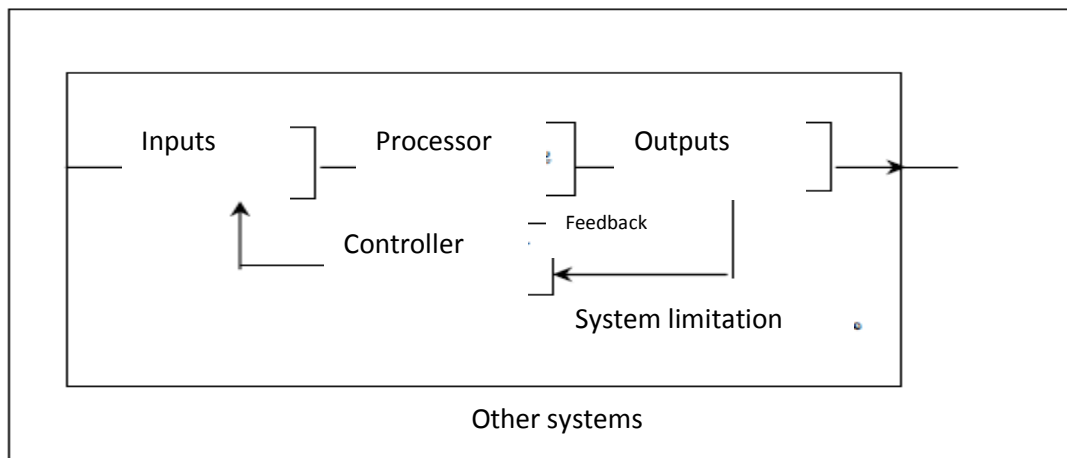
In fact, the increase of quality and efficiency of the urban transportation causes the public tendency to take advantage of the transportation vehicles in the cities. However, the quality and efficiency depend on reaching the standards of the transportation system management. In an urban transportation system, easy; safe; comfortable, and economic transportation is the most important issue, and then the economic growth of cities increases the need for the goods and humans transportation. In fact, the urban transportation includes 25 percent of the space of cities and also provides the field for evolution and dynamism of cities and citizens. The urban transportation is considered because of the aforementioned reasons and also for polluting the urban air. The urban transportation system has the most efficiency in the public transportation and it should be selected based on factors such as safety, rapidness, comfort, and capacity of transportation systems, passengers' satisfaction, and so forth (Aswanth and Sarathy, 2008). In between, it seems impossible to reach the sustainable urban transportation without assessing different models and patterns which are compatible with the environment. Certainly, assessing urban and construction plans and projects play an important role in increasing efficiency and improving their applied quality. They also represent new attitudes for the urban managers and planners in order to achieve a more sustainable society. Any plan and project which is executed cannot achieve all of the purposes regarding issues such as time and place conditions, social issues, and level of technology. Therefore, such plans and projects confront a series of strengths, weaknesses, opportunities, and threats (Henrik and Carl, 2006).

### *The Strategic Policies of the Spatial Structure*

The total strategic policies of the spatial structure should pay attention to this issue that urban elements are not separate from one another and they should be integrated in order to create active urban centers. The purpose of urban planning is to decrease contrasts and congestion, improve the efficiency of the urban environment, and improve the quality of the urban environment which is resulted from the congestion. In order to have access to the sustainable transportation system as well as economic development of cities, and macro policies of the state, the present paper has presented strategies to improve the quality of urban transportation system (Poister, 2010).

The urban transportation system makes integrated substructures in order to move passengers, their allowed goods, and satisfy he passengers. The inputs of the system include passengers, staff, financial resources, fixed and unfixed equipment, and information (time tables, finance, personnel information and etc.). While the outputs of the system includes represented services, and information (quantity and quality of moving passengers, the saved costs, the exploitation costs, and etc.). Since the urban transportation systems permanently receive inputs from the environment, the demand for travel; quantity and quality of accidents, environmental pollutions, urban traffic status, optimized governmental instructions, exploiting new routes and systems, and performing based on the time tables should reach a relative balance, therefore, urban transportation systems are considered as open systems. The processor of each system encompasses organizational tasks, job explanation, financial processes, service representation, and human

resources; moreover, the controlling part of the system encompasses qualitative and quantitative purposes, policies, strategies, instructions, plans, standards, and observing factors.



**Figure 1: The environment and system**

Tehran not only confronts problems in the fields of housing, health, air pollution, environmental pollution, immigration, the increase of crimes, lack of cultural and recreational spaces but also it confronts traffic and transportation especially in the public transportation area. Today, the problems associated with the traffic and transportation in Tehran is so complicated that solving it is possible only via research studies. The experts are all aware of the costs related to traffic and transportation affairs. Currently, the policies and plans related to the transportation are the prior issues in many of the countries. The majority of urban plans related to the urban traffic and transportation leads to the selection of the optimized transportation system (Malekzadehfard, 2002). Therefore, the officials and those who are involved in the traffic and transportation systems have seriously considered a comprehensive study on the traffic and transportation of Tehran. In order to solve traffic problem of Tehran, different solutions have been presented (Jonson *et al.*, 2005).

In order to execute a plan related to addressing urban problems, the following questions should be answered:

1. What is the best plan?
2. What are the criteria to select a plan?
3. What does “the best” mean?
4. Is decreasing congestion without considering the costs the best plan?
5. Is the executive cost the only cost that should be considered to execute a plan?

Therefore, the issue of assessing different plans in different time periods based on the urban specialists’ view is very important (Sperling *et al.*, 2009).

In Iran, problems which are caused as a result of lack of an integrated transportation system in cities especially in the metropolises, and lack of the relevant plans have encouraged the experts to use the public transportation systems with the ability to move mass volumes of passengers especially at rush hours. Since public transportation systems have a high capacity, they have a priority over the personal cars regarding issues such as energy consumption, occupying sidewalks, and causing environmental pollution. Obviously, any transportation system should be selected based on the local facilities, conditions, and limitations. First, the performable policies should be recognized based on the urban policies and then the technical, economic, social and environmental aspects should be evaluated to determine the most proper system. Over the recent years, the progresses in the traffic and transportation have led to solving the problems based on different options. The options solve the problems, however, they have consequences that distinguish them from one another and the decision-makers have to study the consequences in order

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to minimize negative consequences. The main question in discussing the represented suggestions for improving public transportation is which of the suggestions could minimize the cost and negative effects for the users of the system. In order to respond to the question, many studies are needed. The studies include two parts, the first part is recognition and classification of effects and consequences, and determining quantitative and qualitative criteria for measurement, and the second part refers to how the quantitative values and the final decision making are combined together (Walsmsely and Perrett, 2006).

Tehran as the capital of Iran and with an approximately 12 million population faces the crisis of traffic and its consequences such as high consumption of fuel, air pollution, and high statistic of accidents. Urban rail transportation has drawn public attention to itself as a public transportation network which is safe, rapid, cheap, and comfortable.

Exploiting subway lines in Tehran and its undeniable impact on everyday life indicate the development of Tehran subway as one of the optimized capacities of transportation. Moreover, railway transportation is one of the clean transporting systems that minimize environmental disadvantages through the process of production and exploitation. It helps to decrease the air pollution, public costs, and time of urban travel. Finally, it has caused people's satisfaction. The subways encompass 30 percent of the transportation portion in Tehran. As a result, making new railways is one of the purposes of the urban planners in order to provide optimized capacities in the transportation network. Making special lines is another way to provide the optimized capacity in the urban transportation. In fact, the increase of crowded area and urban traffic has led to the need for new transportation solutions. BRT (British rapid transport) is one of the public transportation systems represented over the recent years in order to solve traffic problems.

Different countries have applied different methods to increase quality and speed of bus services, and BRT is one of the successful experiences in many of the metropolises. Rapidness, short waiting time, and accessibility are the advantages of BRT. In this system, the special lines have been applied. Safety improvement, optimizing traffic, optimizing fuel consumption, and the decrease of environmental pollution are the purposes of BRT system.

The special line means that one of the lines of the street is dedicated to BRT. Dedicating the middle line of the street to BRT is merely possible in conditions that the street is wide. According to this system, marginal parking, and movement of other vehicles are relatively done easily. Therefore, dedicating special lines to the bus even during all day long is not difficult.

The special lines of vehicles with high capacity and changing of the travel pattern of people lead to the decrease of the presence of vehicles with few passengers and the decrease of crowdedness of highways (Aswanth and Sarathy, 2008). The increase of operating characteristics of transportation system, the increase of public use of the transportation system, attracting more passengers, the decrease of travelling time, the decrease of costs, the decrease of fuel consumption, the improvement of air quality, traffic controlling, the increase of efficiency of individuals' mental condition through highway travels, and the better use of highway facilities are the positive consequences of BRT (Cain and Darido, 2009).

## **MATERIALS AND METHODS**

### **Methodology**

The present paper is based on the library studies, field method, and descriptive-analytical method. The documentary and library studies are used to collect data. In order to gather the data, the field studies have been used via distributing questionnaires. Moreover, the documentary and library information is used. In order to evaluate BRT system internally and externally, and recognize the relevant components, the questionnaires, scientific interviews with the experts, field observation, and the information of relevant organizations such as traffic and transportation department of Tehran ministry have been used. The information is analyzed based on an analytical process and via SWOT model. SWOT analysis stands for strengths, weaknesses, opportunities, and threats and it helps to determine strengths, weaknesses, opportunities, and threats in relation with a certain purpose. SWOT analysis is usually used in the strategic decisions and it could be used both in the planning for business targets and the planning for personal purposes.

## RESULTS AND DISCUSSION

Since the present paper intends to apply the SWOT model in order to increase the application of the research, the analysis of the internal and external environments of the transportation system in Tehran has been done based on four subsets and with regard to the recognition of strengths, weaknesses, opportunities, and threats of the transportation system. The subsets consist of the special lines, vehicles, ITS, and the station and services.

**Table 1: SWOT for the four subsets**

Vehicles	Internal	Strengths	The ease of getting off and on the double-cabin buses regarding the number and width of doors Using high-capacity transportation system Proper facilities for the new double-cabin buses
		Weaknesses	Not using intelligent systems for stopping in the stations Crowded buses especially for the single-cabin buses Smallness of the space dedicated for women
	External	Threats	Type of vehicles' fuel which is compatible with the environment The hardness of having access to the stations in the middle of pathways and the decrease of health and safety Other vehicles use the special lines and disturb the buses
		Opportunities	Making an opportunity to improve qualitative level of domestic buses The possibility for privatizing based on accurate observation
Special lines	Internal	Strengths	Passing through routes with high potential Very low time interval
		Weaknesses	Not using systems of guiding the path Lack of extra services at the rush hours Low lightness of the special lines
	External	Threats	High number of passengers and low number of buses Lack of air conditioners in some of the buses The increase of delay in intersections for personal cars
		Opportunities	Safety increase of the pedestrian and riding paths regarding the decrease of pedestrians' access to the riding path The colorfulness of rails related to the special lines and helping the beauty of urban space
ITS	Internal	Strengths	Using system of electronically collecting fair Making visual observation systems
		Weaknesses	Lack of executing intelligent informing systems in the stations and some of the buses Lack of implementing transportation management systems which is traditional at the present time

Servicing	External	Threats	Simultaneous presence of several buses in a station Non-repairing the intelligent systems of transportation by the bus transportation company The weakness of mechanized controlling center and moving toward the old systems
		Opportunities	Cooperating the applied intelligent systems and SCAT systems The officials' positive attitude toward the intelligent systems
	Internal	Strengths	Very low time interval between the stations The possibility of making pedestrian bridges in the margin of some of the stations
		Weaknesses	Low quality, low capacity, non-comfort of passengers in the single-cabin buses Not respecting principles of citizenship and not taking turns The impossibility of overtaking buses which have stopped in the stations
	External	Threats	Non-proper performance of some of the drivers Lack of a scientific planning for the staff Disturbing women by some men at the crowded buses
		Opportunities	The possibility to use cement in the making routes

Regarding the urban BRTs which are considered as one of the short-term and effective strategies for improving urban transportation, it should also be considered that the citizens are not familiar with the BRT systems and they need to be informed on the correct decision making and the decrease of time loss at the time of getting off and on the bus.

Consequently, they need to be educated in this field and an informing system should be designed within the buses to announce the distance up to the next station, and the name of the next station.

In order to facilitate it, a simplified map of the bus location and its movement toward the final destiny should be displayed for the male and female passengers, GPS systems should also be installed on BRTS and their stored data should be unloaded at the end of the day. The presence of separate urban traffic routes is one of the strengths that increase the efficiency of such transportation systems.

### **Conclusion**

Transportation is the backbone of urban spaces and it affects the urban development. Therefore, the recognition of changes which have occurred in the transportation and evaluating the relevant theories and viewpoints have a considerable role in the investigation of urban structures and predicting the future processes in this field.

This issue is more considerable in the developing countries such as Iran which are moving from the traditional urbanization toward the modern urbanization.

The study on the history of urban transportation indicates the relatively constant process of it up to the industrial revolution and making sudden changes in transportation system during the industrial revolution. The majority of theories related to the transportation have been presented over the last century and during the presence of vehicles in the cities.

Moreover, the studies indicate that the increase of population of cities, and the complication of communicating tools and methods have led to the increase of viewpoints toward the urban transportation.

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The comprehensive plan of traffic transportation in Tehran is the most valid plan related to the recognition of traffic and transportation problems of Tehran. The most important problem which has been recognized refers to the unbalanced distribution of public transportation systems, unbalanced physical structure of districts, safety, environmental pollutions, neglecting the children and the elderly, easiness of travelling, fuel consumption, the variety of transportation systems, the methods of using transportation systems, facilities, traffic behaviors of citizens, lack of financial resources, the intervention of domestic entities in decisions, and accidents. The most important parameters related to the traffic and transportation problems in Tehran have been mentioned as follows:

#### *Congestion*

The traffic congestion could be considered as the most important cause of inefficiency in traffic and transportation in Tehran. It results from overuse of the vehicles in comparison with the capacity of streets. The lack of parking capacity, the improper street networks, high concentration of population, inefficient management of parking areas, low accessibility to the public transportation vehicles, limitation of railway network, low level of vehicle safety, and so forth (Kashanijoo, 2009).

#### *Fuel Consumption*

Before the purposeful execution of subsidy plans, the cheap fuel was considered as the most important cause of high consumption of fuel in Iran. Moreover, not using new technologies for decreasing fuel consumption and not using other fuels which are compatible with the environment have led to the increase of fuel consumption in Iran in comparison with the other countries.

#### *Environmental Pollution*

The environmental pollution resulted from congestion and high consumption of fuels is the other fundamental problem of traffic and transportation in Tehran. The topography and geographical location of Tehran influences it. Moreover, the auditory pollution resulted from vehicles, green spaces destruction, and respiratory diseases are other problems related to this section.

#### *Economic Problems*

The high cost of owning lands for making urban transportation networks, the establishment of non-grade intersections, the limitation of financial resources for executing plans related to urban railways, the purchase of equipment, the increase of prices, and the increase of cost of materials lead to the increase of final cost of projects.

#### *Management*

The dispersion of decision-making centers during policy-making stages, the concentration of service units' management, the separation of planning units from servicing units, and lack of exploiting servicing plans in the public transportation sector are the main problems related to the urban management area.

### **REFERENCES**

- Aswanth Yedavalli and Sarathy (2008).** Decision Support System for Bus Rapid Transit, in School of Planning College of Design, Art, Architecture & Planning.
- Bernroider E (2002).** Factor in SWOT analysis applied to macro, small to medium and large software enterprises. *European Management Journal*, pergamon (5).
- Cain A and Darido G (2009).** An Overview of Bus Rapid Transit (BRT) in the United States and Lessons Learned from South America, National Bus Rapid Transit Institute, Center for Urban Transportation Research University of South Florida. Available: [www.nbrti.org](http://www.nbrti.org).
- Camilo German (2003).** Bus Rapid Transit: Impacts on Travel Behavior in Bogota, Master Thesis in City Planning, Massachusetts Institute of Technology, Colombia.
- Dayson RG (2004).** Strategic development and SWOT analysis at the university of war wick. *European Journal of Operational Research* (Elsevier) **52**.
- Gray and Hoel (2010).** *Public Transportation*, second edition (prentice hall).
- Henrik Hall and Carl (2006).** A Framework for Evaluation and Design of an Integrated Public Transportation, Department of Science and Technology, Linkopings University.
- Jonson Guilla and Emin Tengstron (2005).** *Urban Transport Development. A Complex Issue* (Springer, e-book).

**Research Article**

**Kamran Nia J (2008).** *New City, New Transportation: Urban Transportation in the 21<sup>st</sup> Century* (transportation industry pub.) **283**.

**Kashani Khashayar (2009).** *The Evolution Process of Theories Related to Urban Transportation* (the identity of city pub.).

**Litman TA (2009).** Sustainable Transportation Indicators: A Recommended Research Program for Developing Sustainable Transportation Indicators and Data.

**Montazeri Mohammad (2009).** *A Study on Traffic Components of Urban Transportation Systems and Factors Affecting Them* (the identity of city pub.).

**Oregon (2007).** Transportation Planning Rule (TPR). Transportation and Growth Management Policies & Plans. State of Oregon.

**Poister T (2004).** NCHRP Synthesis 326: Strategic Planning and Decision Making in State Departments of Transportation. Washington, DC: Transportation Research Board 99.

**Poister T (2010).** The Future of Strategic Planning in the Public Sector: Linking Strategic Management and Performance. *Public Administration Review* 246-254.

**Poister T, Pitts D and Edwards L (2010).** Strategic Management Research in the Public Sector: A Review, Synthesis, and Future Directions. *The American Review of Public Administration* **40**(5) 522-545  
**100**.

**Safarzadeh M and Malekzadehfar A (2002).** Selecting a proper public transportation for an urban corridor from economic perspective. *Transportation Magazine* **41**.

**Sperling Daniel and Gordon Deborah (2009).** *Two Billion Cars, Driving Toward Sustainability* (Oxford University Press).

**Vukan R Vuchic (2005).** Urban Transit Operations, Planning and Economic.

**Walsmsely and Perrett (2006).** The effort of Rapid Transit on Public Transportation and Urban Development, *TRL*.