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Case Study

Methodology explanation for providing an appropriate structure to increase the sustainability quality of urban transportation network in metropolitan areas using the AHP technique

(Case study: Tehran City)

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ABSTRACT: Sustainable transportation management considers the effects of transportation development on economic efficiency, environmental issues, energy consumption, and social justice and aims to reduce environmental impact, increase the efficiency of the transportation system, increase access, and Improving the social life of the people. Therefore, in the field of indicators of energy consumption, environmental pollution, access, traffic, health, and social vitality and income as indicators of sustainable urban transportation and technical studies of urban transportation, observing the principles and rules Driving, using the right and standard fuel, increasing safety and health, and making more use of technology are considered as strategies to achieve sustainable transportation. The purpose of this study is to identify the factors and strategies for implementing sustainable transportation in the metropolis of Tehran. Methodology of the research is applied in terms of purpose and their prioritization has been done using the descriptive-analytical method; After categorizing the effective factors and solutions into 7 main groups and 34 sub-groups, 30 experts related to urban issues were collected using a questionnaire and prioritized using the AHP hierarchical analysis method. The results show that because in most cases urban transport planning issues are such that decision elements have feedback and interdependence, the network analysis process can have many applications in this field. Have. Conclusion: The most effective policies in the field of ensuring the stability of transportation networks are: First - technical studies of urban transportation, second - increasing safety and health. According to the sensitivity analysis, the variables of accessibility, energy consumption, and social vitality have the greatest impact on the final ranking of options.

Keywords: Methodology, Sustainable Transport, AHP, analysis method, Tehran metropolis.

RUNNING TITLE: Sustainability Quality of Urban Transportation Network

INTRODUCTION

Sustainable transportation management considers the effects of transportation development on economic efficiency, environmental issues, resource consumption, land use and social justice, and aims to reduce environmental impacts, increase the efficiency of the transportation system, and increase access. And improve the social life of the people. Sustainable transportation management considers the effects of transportation development on economic

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efficiency, environmental issues, resource consumption, land use and social justice, and aims to reduce environmental impact, increase efficiency. The transportation system is to increase access and improve the social life of the people. Today, transportation issues and problems have become one of the challenges of governments and studies show that to achieve a sustainable city, transportation issues can not be separated from urban development (Kunaka & Carruthers, 2014).Traffic congestion, increase Significant time of movement, increase in accidents, noise pollution and air pollution approaching the borders threatening human health, inequality of access and lack of social justice, are the consequences of unsustainable transportation system in urban areas. According to Igitcanlar et al., The need for sustainable transport has four main issues, including the use of fossil fuels, which are used by almost 97% of vehicles, and environmental pollution, especially air pollution, and the effects of global warming on production. Greenhouse Gases; Many transportation options in the world's metropolises are overcrowded, which has led to social problems; Principle of safety with respect to fatal accidents; The transportation system must be land use related and prevent surface scattering. The Australian Society of Engineers cites seven reasons for adopting sustainable transport policies: improving the economy and the environment, tackling traffic and psychological costs, reducing transparency in facility pricing, and Transportation services, scarcity of resources and the need to protect them, reduce greenhouse gas emissions, sustainability of financial mechanisms and the cost of infrastructure construction and maintenance, to reduce the destructive health and environmental effects of current energy consumption patterns (Savelsberg, 2008). Despite problems such as air pollution, traffic congestion and spending a lot of money and time, inequality of access, social inequality and lack of attention to pedestrians, in our country, including the metropolis of Tehran, sustainable transportation policies have received less attention. [4] Narrow width of passages in the central part of the city, high density and concentration of population-absorbing uses in this area such as commercial, administrative and medical centers, without considering sufficient parking for these uses, inability of structure and body to serve the volume It has caused cars and traffic jams. Also public transport inefficiencies etc., tendency People have increased the use of private cars and the share of public transport in city travel has decreased. Sustainable development is the dominant thinking approach of the last century. It is a category that has been strongly reflected in national, regional and even local policies in developed countries in recent years and is one of the accepted categories for transportation. Transportation has several indicators under the set of economic, social and environmental goals that in order to achieve a sustainable urban form, it is necessary to pay full attention to these goals. There are several definitions of sustainable transportation, some of which need to be clarified here:

• Sustainable urban transportation is in fact the smooth movement of vehicles, people and goods that requires the comfort of people and the stability of the environment with the most desirable cost and effort.

• The Center for Evaluation and Decision-Making on Sustainable Transport considers sustainable transport as a system that is accessible, safe, environmentally friendly and affordable.

• Sustainable transportation refers to transportation that does not endanger public health or ecosystems and meets the needs for achieving sustainability by using renewable resources at the lowest reconstruction rates and using non-renewable resources at the bottom. Estimates the highest consumption rate (Kunaka & Carruthers, 2014).

In order to achieve the goals of sustainable transportation, various factors are involved, the most important of which can be referred to freight companies, shipping companies and drivers. Freight companies can help the sustainable transport system by providing suitable loads for a transport machine, and on the other hand, by standardizing their transport fleet, they can help reduce energy consumption and environmental pollution.

Shipping companies with the right packaging of their goods can help with the risks that disrupt sustainable transportation. In addition, drivers can create sustainable transportation in large cities by observing traffic rules [4]. Accordingly, the present study seeks a model to help transport goods in large cities, especially Tehran.

RESEARCH BACKGROUND

Yousefi Navid and his colleagues (2017) studied the evaluation and prioritization of sustainable transportation implementation strategies in the metropolis of Hamadan with the approach of sustainable urban development. Findings indicate that the most important factor in creating sustainable transportation is land use, and in the next stage, public transportation and among the sub-categories, the most important factors are the observance of service hierarchy and access to planning, attention to traffic effects. Uses on the main street are land use mixing and efficient management of land separation system, so in order to reduce transportation problems in the city of Hamedan, organizing land uses, improving the quality and quantity of public transportation system and improving urban management should be considered (Yusefi et al. 2015).

Effendizadeh et al. (2012) examined the presentation of a decision model to increase the sustainability of the urban transport network using the network analysis process (ANP) technique. In this study, the results of the final model show that based on the weights obtained, according to experts, the establishment of facilities for non-motorized transport has the highest priority among other policies to achieve a sustainable transport network (Effendi Zadeh et al. 2012). Abdolmanafi et al. (2011) examined the model for prioritizing the development and construction of urban road network based on traffic criteria. In this research, the executive priority is presented based on the method of hierarchical analysis for the development of road network units and economic, environmental and traffic indicators are used to evaluate the strategies. The results of the final model based on the criteria show that first: the city of Tehran needs the construction of new highways, especially in the eastern regions. Third: In the central part of the city, the construction of new thoroughfares is not very desirable (Abdul Manafi et al. 2012).

Tafazli et al. (2011) examined the prioritization of major sustainable transport policies based on effectiveness in each of the three dimensions of sustainable development and based on a combination of three dimensions. 25 General Policies, after conducting a survey of experts related to the three areas of sustainable development and using Choice Expert software to quantify the values, were prioritized in each of the sustainability dimensions as well as in a combination of dimensions. Finally, the most effective policies in the field of simultaneous provision of all three dimensions of sustainable transport goals are: 1- Establishment of facilities and promotion of walking, 2- Management of exploitation of natural resources and 3- Elimination of travel. Work that can be replaced by the Internet, telephone or fax. Many studies in this regard have been done in other countries (Tfazzoli et al. 2012).

John Pucher et al. (2007) examined the sustainability of transportation networks in seven major Canadian cities and also presented solutions to increase transportation sustainability. In this article, first, the contribution of each mode of transportation in the movement of passengers and goods in these cities is examined, as well as the conditions of each mode in terms of local policies, investments, infrastructure, safety, comfort. , Comfort and pollution level of each fashion are examined. As a result of this study, two strategies have been proposed as the key to achieving sustainability in transportation (Pucher & Buehler, 2007).

Saulsberg (2008) examines European transport innovation in a book. In this book, various problems in European transportation such as transportation in crowded crossings, environmental pollution, etc. are expressed and the ways to achieve sustainable transportation are the use of information technology and the use of automation (Mommens, 2016). Momenes et al. (2016) have examined a model

for the transportation system. The results of the present study show that there are models proposed for the transport of goods, among which nine models have been reviewed, which finally show that the model in which the driver's movements are controlled and in accordance with the rules and the company sending the goods from Used wooden pallets and tanks for transporting liquids is the best model for transportation (Savelsberg, 2008).

METODOLOGY

The present study is descriptive and survey branch. This research is also in the field of experimental research and is applied in terms of purpose. Finally, the research in terms of data collection is a field research through a questionnaire. The statistical population for the present study includes activists and academics active in executive work related to transportation and urban sustainability development. Among these people, 30 specialists are selected and a questionnaire designed by the researcher is distributed among them. Questionnaire Findings they were evaluated and processed using AHP technique (hierarchical analysis), which is a group decision-making method in complex environments. What management thinkers have been paying attention to since the early 1980s did, considering more from a criterion for each issue and also to know the quality criteria along with the criteria there was little in the decisions. Hence a researcher named Tomay El Saati in the 80's in order to systematize decision making in a situation where a combination of quantitative and qualitative criteria is considered and managers are interested in comments and apply their personal experiences in decision making, using the hierarchical analysis process as one created multi-criteria decision branches. The basis of this method is the formation of a hierarchical decision-making structure is. Each decision problem can be designed in the form of a tree. The first level of this tree is the goal of the decision shows the recipient and prioritizes competing options to achieve this goal. Level or levels the middle represents the criteria and criteria that planners want to achieve the goal in level one and level finally it shows the options available to achieve the goal.

In this research, the levels of the fuzzy hierarchical decision tree structure are as follows:

The second level includes the main solutions to

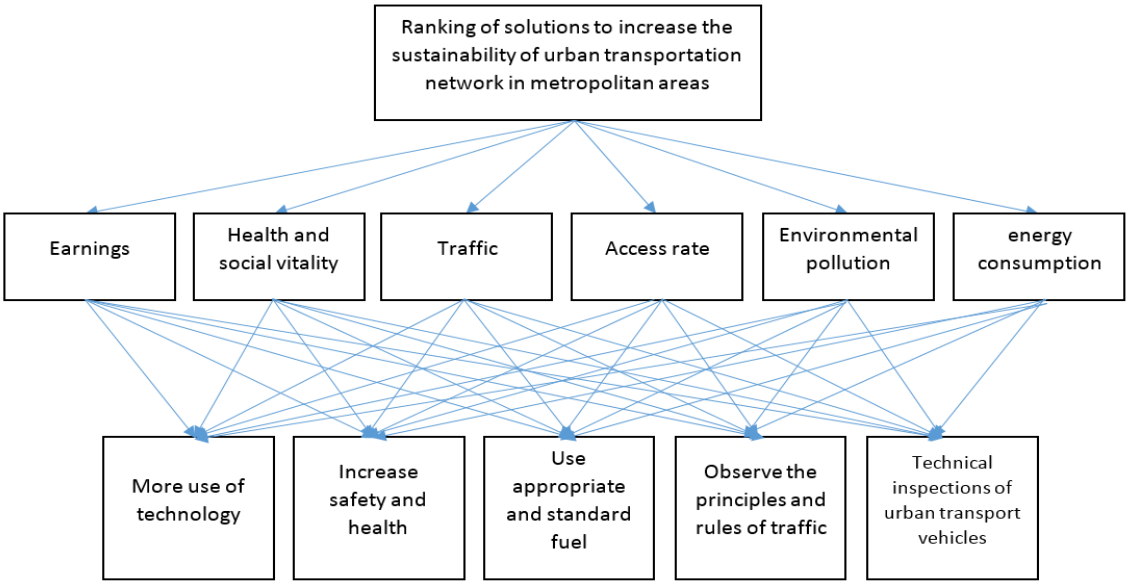

Fig 1: The general hierarchical structure of the first level includes the main purpose, prioritizing the factors affecting the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran.

increase the stability of the urban transportation network in the metropolis of Tehran. The last level also includes important options derived from the criteria category factors to review the construction process and design assistance, workshop equipment planning, scheduling and operation sequence construction is the estimated cost of construction. Parallel comparisons of the factors listed in each level of the hierarchy are in response to achieving the goal or meeting the needs of the goal or higher level factors. These comparisons are entered in a matrix called the "pairwise comparison matrix". This matrix has two main properties. The first is that the diameter of this matrix is one, and the second is that the preference of factors over each other is reversible. Table 1 is used to compare the two options.

Tab 1: Assigning Numbers 1 to 9 and Quantifying Options (Hourly Description)

Intensity of importance	Description	explanations
1	Equal importance	Two objects or factors are equal in the desired attribute.
3	One object or factor is implicitly preferable to another.	Experience or judgment is gently and implicitly in favor of one over the other.
5	One object or factor is clearly preferable to another.	Experience or judgment seriously prefers one over the other.
7	Very important	Evidence suggests that one object or factor is unquestionably preferable to another.
9	Infinitely important	Experience, evidence, and judgment show that one factor or object is infinitely more pronounced than the other (the predominance of one attribute in one object over the other is one hundred percent).
2, 4, 6, 8	Intermediate values between two adjacent judgments	A coalition is needed between adjacent judges.
Reverse property		When activity I assigns that number to activity I (in relation to an attribute) inversely.

RESEARCH FINDINGS

The final weight and prioritization of the criteria affecting the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran, presented from the perspective of experts by the AHP method, are as follows: Table 2:

Tab 2: Priority of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of experts using the AHP method

Index (criteria)	Weight	Priority
energy consumption	0.24	2
Environmental pollution	0.101	5
Access rate	0.28	1
Traffic	0.026	6
Health and social vitality	0.179	3
Earnings	0.156	4

Figure 1 is related to the output of expert choice software regarding the prioritization of criteria affecting the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran, presented from the perspective of experts as follows.

Fig 2: Software output for the solutions provided

The final weight and prioritization of the components related to the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of revenue generation by AHP method from the perspective of experts are in Table 3, respectively:

Tab 3: The main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of revenue generation criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
Technical inspections of urban transport vehicles	0.364	1
Observe the principles and rules of traffic	0.198	2
Use appropriate and standard fuel	0.170	3
Increase safety and health	0.143	4
More use of technology	0.124	5

Figure 2 related to the output of expert choice software regarding the final prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of revenue generation is as follows:

Fig 3:Software output to earn revenue

According to the above findings, the incompatibility rate is below 0.1 and is approved.

The final weight and prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of AHP method access from the perspective of experts are as follows: Table 4 is as follows:

Tab 4: The main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of accessibility criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
Increase safety and health	0.176	3
Technical inspections of urban transport vehicles	0.258	1
Use appropriate and standard fuel	0.222	2
Photovoltaic	0.128	4
More use of technology	0.107	5

Figure 3 is related to the output of expert choice software about the final prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of access from the perspective of experts as follows.

Fig 4:Software output for access rate

According to the above findings, the incompatibility rate is below 0.1 and is approved. The final weight and prioritization of the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of energy consumption with the AHP method from the perspective of experts are in Table 5, respectively:

Tab 5: The main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of energy consumption criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
Observe the principles and rules of traffic	0.088	4
Technical inspections of urban transport vehicles	0.267	1
Increase safety and health	0.188	3
Use appropriate and standard fuel	0.237	2
More use of technology	0.087	5

Figure 4 related to the output of expert choice software regarding the final prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of energy consumption is as follows:

Fig 5: Software output for energy consumption

According to the above findings, the incompatibility rate is below 0.1 and is approved. The final weight and prioritization of the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of environmental pollution with the AHP method from the perspective of experts are in Table 6, respectively:

Tab 6: The degree of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of environmental pollution criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
Technical inspections of urban transport vehicles	0.264	1
Observe the principles and rules of traffic	0.264	1
More use of technology	0.066	4
Use appropriate and standard fuel	0.118	2
Increase safety and health	0.117	3

Figure 5 related to the output of expert choice software regarding the final prioritization of the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of environmental pollution is as follows:

Fig 6: Software output for environmental pollution

According to the above findings, the incompatibility rate is below 0.1 and is approved. The final weight and prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from the perspective of traffic with the AHP method from the perspective of experts are in Table 7, respectively:

Tab 7: The main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of traffic criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
Use appropriate and standard fuel	0.259	1
Technical inspections of urban transport vehicles	0.219	2
Increase safety and health	0.065	5
Observe the principles and rules of traffic	0.167	3
More use of technology	0.116	4

Figure 6 is related to the output of expert choice software regarding the final prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran from a traffic perspective as follows:

Fig 7: Software output for traffic

According to the above findings, the incompatibility rate is below 0.1 and is approved. The final weight and prioritization of the components related to the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of health and social vitality with the AHP method from the perspective of experts are in Table 8, respectively:

Tab 8: Degrees of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran in terms of health and social vitality criteria using the AHP method from the perspective of experts

Index (criteria)	Weight	Priority
More use of technology	0.085	5
Use appropriate and standard fuel	0.196	2
Technical inspections of urban transport vehicles	0.408	1
Increase safety and health	0.176	3
Observe the principles and rules of traffic	0.134	4

Figure 7 related to the output of expert choice software regarding the final prioritization of the main indicators of increasing sustainability in the urban transportation network in the metropolis of Tehran from the perspective of health and social vitality is as follows.

Fig 8: Software output for social health and vitality

According to the above findings, the incompatibility rate is below 0.1 and is approved. In this part of the research, an

attempt is made to measure the final weight of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran based on criteria. In this regard, the following formula is used for each technology. Index of each final weight = Benchmark in this index * Total benchmark weight.

The main indicators of increasing the stability of the urban transportation network in the metropolis of Tehran: technical studies of urban transportation vehicles, observance of the principles and rules of traffic, use of appropriate and standard fuel, increase of safety and health, more use of technology.

Criteria: accessibility, health and social vitality, environmental pollution, traffic, energy consumption, income.

Tab 9: Determining the degree of importance of BIM failure indicators based on criteria from the perspective of experts

Service delivery channels	energy consumption		Environmental pollution		Access rate		Traffic		Health and social vitality		Earnings	
Technical inspections of urban transport vehicles	0.267	1	0.264	1	0.258	1	0.219	2	0.408	1	0.364	1
Increase safety and health	0.188	3	0.177	3	0.178	3	0.065	5	0.176	3	0.143	4
Observe the principles and rules of traffic	0.088	4	0.264	1	0.128	4	0.167	3	0.134	4	0.198	2
Use appropriate and standard fuel	0.237	2	0.118	2	0.222	2	0.259	1	0.196	2	0.170	3
More use of technology	0.087	5	0.066	4	0.107	5	.0116	4	0.085	5	0.124	5

Table 9 shows the weight of the indicators according to the considered criteria. For calculations, Table 9 is also used, in which the weight of each criterion is determined independently.

Technical inspections of urban transport vehicles

=0.258*0.28+0.267*0.24+0.264*0.101+0.219 *0.026+0.408*0.179+0.364*0.156=0.298494

Increase safety and health

=0.176*0.28+0.188*0.24+0.117*0.101+0.065 *0.026+0.176*0.179+0.143*0.156=0.266255

Observe the principles and rules of traffic

=0.128*0.28+0.088*0.24+0.264*0.101+0.167 *0.026+0.134*0.179+0.170*0.156=0.138472

More use of technology

=0.087*0.24+0.066*0.101+0.107*0.28+0.116 *0.026+0.185*0.179+0.124*0.156=0.112981

Use appropriate and standard fuel

=0.237*0.24+0.118*0.101+0.222*0.28+0.259 *0.026+0.196*0.179+0.170*0.156=0.199296

Table 10 shows the final prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran based on the final weight of the criteria. As it is known, the most influential in terms of weight are first the issues of technical inspections of urban transport vehicles, then the issues of increasing safety and health and the use of appropriate and standard fuel, while the least impacts are related to observing the principles and rules of traffic and There is more use of technology (Savelsberg, 2008; Badland et al. 2017).

Tab 10: Prioritization of the main indicators of increasing stability in the urban transportation network in the metropolis of Tehran based on the final weight of criteria

Index (criteria)	Weight	Priority
Technical inspections of urban transport vehicles	0.298494	1
Increase safety and health	0.266255	2
Use appropriate and standard fuel	0.199296	3
Observe the principles and rules of traffic	0.138472	4
More use of technology	0.112981	5

CONCLUSION

In this paper, strategies to increase sustainability in urban transportation networks were examined and prioritized based on their response rate from the point of view of each indicator and compared to other strategies. In this study, the indicators presented in previous studies were re-evaluated and classified into six categories: energy consumption, environmental pollution, accessibility, traffic, health and social vitality, and income achievement (Savelsberg, 2008; Shariat Mahimani& Irannejad, 2009). After that, the indexes were weighed and based on the weights obtained, five strategies were evaluated by expert choice software introduced by experts. In this paper, unlike previous decision-making methods that considered the communication of decision network elements only one-way and hierarchically, decision network elements are a network of clusters in which the elements of each cluster can interact with other elements of the same cluster or Other clusters are considered to be related. Finally, after using the AHP technique and with the help of expert choice software, the following results were obtained:

1. The results show that given in most cases urban transport planning issues are such that decision elements have feedback and interdependence, the network analysis process can have many applications in this field.

2. The most effective policies in the field of ensuring the stability of transportation networks are: first - technical studies of urban transportation, second - increasing safety and health.

3. Based on the sensitivity analysis, the variables of accessibility, energy consumption and social vitality have the greatest impact on the final ranking of options.

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