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Sustainable Technology Assessment Model in Tehran's Urban Transportation

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Abstract: Considering the current problems in the field of transportation in Tehran, this paper attempts to develop a sustainable technology assessment model in Tehran's urban transport sector. The research was carried out in a mixed method. In the qualitative phase, using the principles of the data theory of the foundation, identifying the important components in the technology evaluation and compiling the paradigm model, was performed and in the quantitative phase, using the confirmatory factor analysis, the developed model was tested. The results of the study indicated that the topic of assessment of sustainable technology in the urban transport sector of Tehran is related to the use of urban transportation technologies. Due to population growth and consequently the increasing demand for urban travel, the expansion of marginalization and migration around Tehran and limited natural and ecological resources, and energy resources are created. Strategies such as strategic and prospective planning in the urban transport sector of Tehran, capacity of transportation in proportion to the demand for urban travel, assessment of compliance with requirements, national and international regulations, assessment of the economic justification of sustainable technology in the field of transportation and the possibility of creating the necessary investment with the resistance economy approach, evaluation of qualitative and technical functional considerations in the field of urban transport, assessment and monitoring of environmental impacts and life cycle analysis of transportation technologies, the use of clean and low carbon energy in transportation equipment, and so on are suggested. The strategies are influenced by the values and culture of society, the level of knowledge and public understanding of society from the risks of unsustainable technologies in the field of transportation, urbanization culture and observance of laws and regulations in the field of transportation by people and characteristics of Tehran in terms of climatic, demographic, geographical, political, infrastructure, and engineering aspects. It is expected that the implementation of the mentioned strategies could lead to events and consequences such as promoting the status of Iran in international rankings, promoting physical and mental health, vitality and welfare of the society, and labor force productivity, optimal utilization of urban infrastructure and facilities, promoting the level of knowledge and attitudes towards the use of sustainable technologies in transport, sustainable economic growth, entrepreneurship and employment, efficiency and positive performance in the field of urban transport and the environmentally sound and productive urban environment.

Keywords: Technology, Sustainability, Urban Transport, Technological Evaluation, Environment, city of Tehran
JEL Classification: N55**,** L24, L91, F18

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1- Introduction

Today, effective technology management needs a deep and comprehensive look at the technology and the implications of its development and implementation. Nevertheless, the problem is that technology management, as a distinct and vital specialist has not yet opened its place in the country. The assessment and prediction of technology, which is an integral part of technology management, is, the first and foremost, a tool for enlightening the consequences of the development and application of technology throughout the country. In planning for technology development, technology issues are usually less focused on (Malekifar & Bushehri, 2013). In spite of the limited capacity and ecological efficiency in the world, developmental perspectives focused on sustainability issues. The goal of sustainable development is to meet the needs of the present without jeopardizing the ability of future generations to meet their own needs (Zahedi, 2012). In this regard, the technological issues in terms of influencing the lives of the future are important issues, and the issue of technology sustainability has become the focus of attention. An important point in the topic of sustainable technology is the existence of a method for evaluating and adapting it to the principles of sustainability. Despite the studies, most of the technology assessment models focus on technical aspects, economics and profitability, or a brief section of other dimensions, and there is no model that can comprehensively assess all aspects, especially aspects of technology sustainability. Therefore, due to the existence of different technologies in the country and, on the other hand, the country's need to produce or transfer new technologies, it is necessary to evaluate technology from various aspects and, if it is consistent with the indicators of sustainability, the production, use, diffusion or transfer is done. To this end, it is necessary to use the principles and indicators of sustainable development in this regard. One of the important sources in this field is the upstream documents in the country. One of these documents is the general policy of the system in the technology development and development sector. Hence, by using the stated content, a native model for evaluating sustainable technology can be developed.

In recent decades, the increase in urban population and the development of urbanization on the one hand, and the lack of public transportation in response to the increasing demand for urban travel, on the other hand, has led to an increase in the use of private cars in metropolises and especially in the capital. The city of Tehran, with a population of about 9 million, is the largest metropolitan area in the Middle East that faces numerous problems in its transportation system. In the past 10 years, with the increase in vehicle ownership and relative welfare, travel rates are rising, with nearly 18 million road trips per day in the city streets of Tehran. This number of trips is the source of many other problems in Tehran, so that about 10.8 million liters of gasoline is consumed daily by cars, which increases the pollution of the environment and, as a result, decreases the safety and health of citizens (Sanaee et al., 2015).

Considering the importance of the Tehran metropolis and the problems of pollution and traffic which are two major problems in this metropolis, and on the other hand, due to the technology-driven nature of the transportation industry, in this research, the sustainable technology

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model for this industry in Tehran has been tried to be developed. One of the practical aspects of this research is the choice of suitable technologies in the urban transportation industry in Tehran. Nowadays, with regard to the post-JCPOA[1] period and foreign investments in the country, especially in the field of urban transport, it is necessary to produce and select technologies that can reduce the problems caused by the use of inappropriate technology in transport.

2. Literature Review

a) Foreign Researches

The European Union (2007) reports on assessing the sustainability of technologies emphasizes factors include consideration of product life cycle (recovery), impact assessment or analysis, ownership costs, social aspects, system aspects, health and environmental impacts, and economic assessment, as important issues.

Brent et al., (2011), in a paper, highlighted the issue of sustainable technology balance sheet and the technology assessment framework with a sustainable and systematic approach. They concluded that technology is not visible and it often grained in the knowledge of individuals or physical assets. Therefore, it is very difficult to determine the scope and content of it. The categorization of technology assessment tools and tools includes economic analysis, decision-making methods, engineering or system analysis, technology forecasting, information monitoring, technical performance appraisal, risk assessment, market analysis, and external factor analysis. The important point in this study is that the areas of sustainable development (political, social, environmental and cultural) are also considered.

Ashby & Ferrer-Balas (2013) in an article titled "Sustainable Technology," outlines the dimensions of sustainable technology. In their view, the three capital of world, people and their success play role on the sustainable development. According to them, six indicators of materials, construction, design, environment, laws, regulations, and society and economy are among the most important indicators of sustainable technology assessment.

Bauer & Brown (2014), in their article entitled "Quantitative Technology Assessment", while pointing to the definition of technology assessment and the necessity of using multi-criteria decision making, outlined the following factors as indicators of technology evaluation: efficient use of resources, job creation, availability of raw materials, simplicity, ease of use, renewable resources, good adaptability and independence. For each indicator, they defined five levels from very low to very high, and based on the principles of multi-criteria decision-making, they evaluated the technologies.

b) Internal Researches

In an article titled "Technology Assessment, Needs and Requirements," Malekzadeh (2005) states that the evaluation of technology is a scientific, action and communication process aimed at helping to understand social and political views with knowledge and technology, and it examines the social aspects and the effects of a technology. In his opinion, four approaches to technology assessment are used: assessing technology awareness, evaluating strategic technology, evaluating constructive technology and drawing up the future.

In a paper titled "The Role of Technology Management in Sustainable

1- Joint Comprehensive Plan of Action i.e. nuclear agreement between Iran and 5+1

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Development," Taleghani (2005) states that technology not only changes, but also responds to a shift towards sustainable development in society. In his article, he outlines the features of the technology that are adapted to the needs of the people, the possibility of creating jobs, the attraction of manpower, the cheapness of technology, the creation of a ground for small production activities, providing maximum use of existing materials.

OstadJafari & Rasafi (2013) in a research modeled Mashhad transportation status by using dynamic system models. 20 scenarios are considered in five policy groups to assess the sustainable development of urban transport for the 20th year horizons, and based on its results; the policy has been prioritized in the year. The assessment revealed that co-modality policies, reduced car aging and improved vehicle quality have had the greatest impact on sustainability indicators and could minimize transportation dilemma over the next twenty years.

Tandiseh & Rezayi (2013) dealt with strategic planning of urban sustainable transport in the holy city of Mashhad. In terms of purpose, this article is applied and in terms of methodology, descriptive-analytical. The data collection method was library and field studies (interviews and questionnaires). First, the strengths and weaknesses, opportunities and threats of sustainable urban transport development were determined and analyzed using SWOT model, and appropriate strategies were presented. In the end, the proposed strategies were prioritized using MPSQ method. The research findings showed that the final strategy of sustainable urban transport development in Mashhad metropolitan area is an aggressive strategy based on strengthening the strengths and using existing opportunities.

3- Theoretical Background

The term technology was invented from the early 1700s and became epidemic only for fifty years. Technology has a Greek root and is composed of two words Techne and Logie. Techne means art, skill, and that which is created by man and is in front of Arche, the Creator of God. Logie or Logos in ancient Greece used to mean science, knowledge and wisdom. Definitions of technology largely depend on the taste and attitude of their providers. What is common in most definitions is that technology utilizes knowledge and experience to produce products and services in line with the developmental needs of humans and society (Mahmoodzadeh, 2010).

The term sustainable development was widely discussed after Brantland's report, Our Common Future, and the Rio Summit in 1992. Since then, people have been controversial about what sustainable development means in practice and how it can be achieved. A society is sustainable in which both human conditions and the ecosystem's states of affairs are satisfying or improving. In other words, if either of these two situations is not satisfactory or is getting worse, society is not sustainable (Zahedi, 2012).

Sustainable Development is a process in which people in a country meet their needs and promotes their standard of living, without consuming resources from future generations, and wasting future investments to meet immediate demands. Therefore, we call development "sustainable" when it is not destructive and provides the opportunity for preservation of resources (including water, soil, air, genetic resources, animals, etc.).

Sustainable technology is an idea that may lead to a new level of real progress

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around the world. Usually, the attributes that sustain a technology are: energy efficiency, reduced pollution, recyclability and ease of maintenance and repair. Sustainable technology features include:

- Sustainable technology does not eliminate any irreversible resources.
- Sustainable technology has enough durability to use any renewable energy source that is needed for its lifetime.
- Sustainable technology creates the process of reducing the resources needed, so that with increasing population and economic growth, total consumption of resources is fixed or decreasing.
- Sustainable technology is durable from the perspective of economics and leads to long-term value creation.
- Sustainable technology and training are needed to implement and maintain value in creating value (Gernand, 2009).

Nevertheless, there are two contradictions in this area, which is a major dilemma in the field of sustainable technology:

- Technologies that are more efficient may use more resources and help save resources instead of storing them.
- Sustained technology with less damage may result in the transfer of production to illegal matters and exacerbate the problems (Mulder et al., 2015).

In the late 1960s, the term and concept of technology assessment followed the attention to its negative effects. Until that time, it was thought that technology was simply a factor in the advancement of society and had many benefits. The term "technology evaluation" is generally attributed to Philip A. Yagar, the advisor to the Space Science Committee of the US House of Representatives. Thus, when it was recognized that technology had negative consequences in addition to positive aspects, the technology assessment movement was formed around the world (Bagherinejad & Malahi, 2010).

Smith and Lithgen pointed to three important factors:

- Concerne about the consequences of new technologies
- Need to evaluate state-owned technology projects before it starts
- Need for more stakeholders and community members to participate (Ghazinoori, 2004).

4- Research Method

In this research, the research environment is the city of Tehran and the urban transport industry associated with it. In order to introduce the city of Tehran, Table 1, based on demographic and transportation characteristics in Tehran, has been used. Table 1 has been extracted based on the latest statistics and traffic data of Tehran, prepared by the Deputy Chief of Transportation and Traffic of Tehran Municipality. The statistics show an increase of 25% in city trips during the aforementioned years.

Table1. General Information of Tehran

Description	Amount	Unit
Population	8.9	Million people
Area	751	Square kilometers
Total area	22	Area
Population density	119	Person per Hectare
Working population	33.7	Percent
Studying population	423	Percent
Daily consumption of gasoline	10.9	Million liters
Daily consumption of gasoline for transport	2.3	Million liters

Source: (Department of Transportation and Traffic of Tehran Municipality, 2015)

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The onion research model that has been created by Saunders, which according to its name has a layered nature, was used as the methodology. Methodology of the present research and its implementation phases are in accordance with Table 2 and Figure 1.

Table2. Summary of research methodology based on research onion model

The philosophical basis of research	Positivism (quantitative phase) and post-positivism (quantitative phase)
The main orientation of the research	Application
Research approach	Inductive
Research design	Combinatory (exploration, development of data collection tools)
Research environment	Library and survey
Research strategy	• The qualitative part: Grounded Theory • The quantitative part: Survey
The main aim of the study	Predicting a concept
Methods of data collection	• The qualitative part: Interview and study of literature and documents • The quantitative part: questionnaire

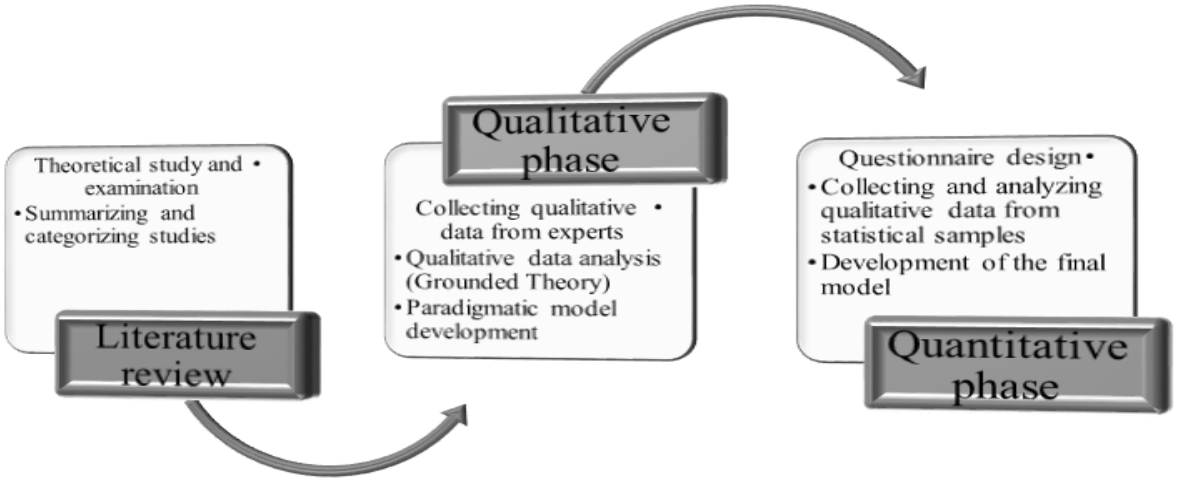


Fig1. Different stages of research in different phases of implementation

To collect data in the qualitative section, studying the subject literature and in-depth interviews (performing interviews, examining the documents and notes of the researcher in terms of Grounded Theory) and in the quantitative section, a researcher-made questionnaire based on expert opinions and documentary studies were used. The statistical population of the present study consists of two sections:

- The population of qualitative part: in this part, statistical population includes professional and scientific experts in the field of urban transport technologies, automotive and transportation managers in Tehran, environmental management and executive of Tehran, its municipality, as well as its subsidiaries.
- The population of quantitative part: in this part, the population consists of experts in the fields of urban management, environment domains, sustainable

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development, Tehran municipality, and automotive technology expert.

Proportional to the population, sample consists of two parts as follows:

- Sampling of qualitative part: regarding the nature and methodology, i.e. Grounded Theory, if we study on a particular type of population or on specific times, purposive sampling is used. Since in the qualitative part, professional experts from the field of technology are chosen and they are interviewed based on Grounded Theory, a theoretical sampling method is used and with the use of experts, i.e. the above population, in the field of urban transport technologies, information is collected. Of course, as long as new data in connection with the issue are obtained, we will continue the data collection so that the intended criteria and indices to reach a saturation in the field of sustainable technology assessment.
- Sampling of quantitative part: since in order to solve structural equation the PLS software is used, according to a well-known rule of determining the necessary sample size in PLS, which is proposed by Barkolay et al. in 1995, the minimum sample size required for using PLS is the largest amount obtained from the following two principles:
  - 10 multiplied by the number of indices of measurement model that have the highest index among the measurement models of the main model of the study.
  - 10 multiplied by the highest number of existing relationships in the structural part of the main model of research that are related to a given variable.

Considering the above-mentioned cases and according to the qualitative model of research that was obtained by the grounded theory, the most existing relationships in the main structure part of the main model is equal to 14, issues related to the action strategy, which multiplication of this number in 10 will be equal to 140. Thus, the sample size for the quantitative part is equal to 140. It should be noted that the purposive and convenience sampling were used.

After initial compilation of the questionnaire, in order to evaluate the content and face validity, 10 experts were selected from the people interviewed in the qualitative section. According to them, the CVI index was calculated to determine the content validity. In addition, the coefficient of influence was calculated to determine the amount of formal validity. According to the results, the questionnaire was corrected. Finally, the results indicate that the content and formality validity of the completed questionnaire is acceptable. It is worth noting that in order to determine the reliability of the tool, 30 people of the population were randomly selected and after completing the questionnaire (pre-test), Cronbach's alpha coefficient was calculated, which is 0.91, which indicates the high reliability of the tool.

After finalization of the research tool and the final compilation of the questionnaire, the samples were sent to the statistical community. According to the calculation, 140 samples were needed, with 170 percent prediction as overhead (prediction of inadequate and return questionnaires), 170 questionnaires were distributed among the samples. It is worth mentioning that available samples from the community were used in this regard. After collecting the questionnaires, 155 items were completed that were based on statistical calculations. The raw data was loaded into the SmartPLS3 software after logging in to Excel software, and the statistical analysis process started.

In this research, for the qualitative and quantitative phases, different techniques are used to analyze data, which are as

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follows. In the qualitative part, grounded theory strategy is used and in the quantitative part based on survey strategy, the structural equation modeling is used.

In this research, in qualitative and quantitative phases, different methods have been used to analyze the data, which are referred to below. In the qualitative section, grounded theory strategy was applied and in a quantitative part based on the survey strategy, structural equation modeling was used.

In the theory of data base (grounded theory), the collected data are analyzed by coding and theoretical sampling and the theory is obtained by means of interpretative procedures. In this research, after interviewing and reviewing the notes of the researcher and other sources, the information gathered in the MAXQDA version 10 version of the analysis was introduced and the paradigmatic model was explained with respect to axial coding. The paradigm model includes the following components:

- Causal conditions: the causal conditions mean events and happenings that lead to the occurrence or development a phenomenon.
- Phenomenon: it means an idea, event, happening, or a main event that a series of actions or reactions are routed to handle it.
- Context: it includes a specific set of characteristics that are related to a phenomenon, i.e. the place of events or incidents related to a phenomenon over an area that has a given dimension. Context represents a specific set of conditions within it action/interaction strategies are implemented.
- Intervening conditions: structural conditions related to action/interaction strategies that relates to a phenomenon. They are facilitator or limiter of strategies that place within a particular area. Action/interaction strategies are used by actors to manage, handle, transfer, or respond to a phenomenon under specific set of observed conditions.
- Consequences: they are outputs or results of action and interactions (Khaki, 2013).

In the following, the general paradigmatic model is presented in Figure 2.

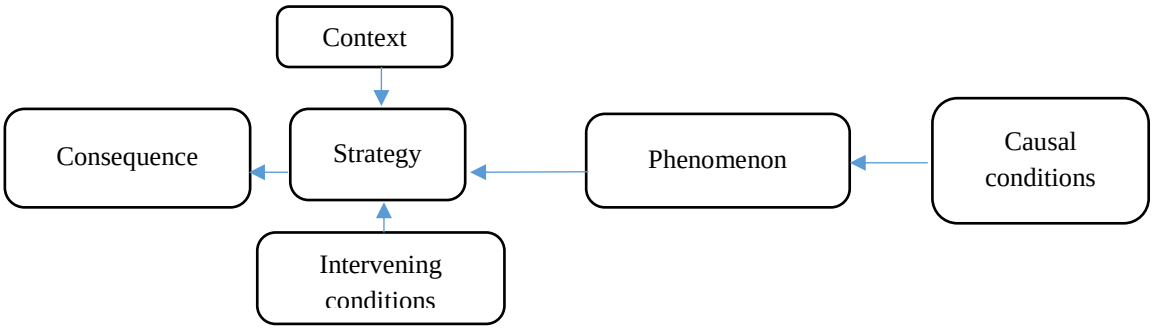


Fig.2.The general format of paradigmatic model

Source: (Khaki, 2013)

5- Results

Qualitative Section

As previously mentioned, using grounded theory method, a paradigmatic research model was developed that is described in more detail in the steps below.

- Open Coding: In this research, interviews and coding were conducted at the same time as the interviews began.

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Regarding the multiplicity of the issues raised in the interviews, at first, 1332 key sentences or phrases were interviewed, and 295 codes were extracted. In the following, the first level codes reduced by a second level of 101 decrement codes. Found After extraction of 101 codes in the second level, the abstract concepts were applied to them. It is worth mentioning that after the summing up, 89 concepts were extracted in this regard, and 34 categories were then explained.

- Axial coding: Based on the process of grounded theory, after determining the categories, the paradigm model was compiled and the categories were categorized in the form of six categories of causal conditions, main phenomena, background or context, action strategy, intervening conditions and outcome. In fact, by identifying the relationship between 34 identified categories, a paradigm model was designed which follows these categories in accordance with Table 3.

Table 3.Axial coding and determination of constructs

Category	
Causal conditions	Population and urban travel demand growth
	Increase in urbanization area and pendulum migrations around Tehran
	The limited natural, ecological and energy resources
Phenomenon	Sustainable technology in urban transport
Context conditions	Society's values and culture
	General perception of community about the risks of unsustainable technologies in the field of transport
	Urban culture and adherence to laws and regulations in the field of transport by citizens
	Tehran characteristics in terms of climate, population, geographical, political, facilities, infrastructure and engineering
Limiting / facilitator conditions	International sanctions
	Ability to attract government support and relevant organizations and national determination for promoting sustainable transportation technologies
	The ineffectiveness of supervisory bodies monitoring the implementation of rules and requirements in the field of urban transport
	The role of non-governmental organizations in promoting sustainability of transportation with state supervision
Action strategy	Strategic planning in the field of urban transport of Tehran
	Providing transport capacities proportional to the urban travel demand
	assessment of compliance with national and international requirements, laws and regulations
	assessment of economic considerations and investment in sustainable technology in transport with an approach to resilient economy
	assessment of functional, technical, qualitative and technological considerations in the field of urban transport
	assessment of environmental considerations and life cycle of transport technologies
	The use of clean and low-carbon energies in transport equipment
	Practical development of E-government and E-commerce
	Evaluating localization and technology production
	Modernization of equipment after completion of their construction life
	Providing social justice in the use of sustainable transport technologies (the use of all community people)
	Strengthening scientific research and international cooperation in benchmarking and empowerment in the field of transport
	Decentralizing in Tehran and homogeneous distribution of urban facilities
	Design and development of urban infrastructures in accordance with the principles of urbanism
Consequences	Enhancing Iran's position in international rankings of outcomes
	Promoting the knowledge and public attitude in using sustainable technologies in transport
	Promotion of physical health, mental health, and vitality and well-being of society and labor productivity
	Optimize exploitation of facilities, urban infrastructures and transport equipment
	Sustainable economic growth
	Entrepreneurship and employment development
	Positive efficiency and performance in the area of urban transport
	Healthy and productive urban environment

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Quantitative Section

After developing the components of the paradigm model of grounded theory (categories), in this section the quantitative model of the developed model was tested. For this purpose, an analytical method was used in the framework of structural equation modeling and PLS3 software.

The PLS model is evaluated and interpreted in two steps:

A) Evaluation of the validity and reliability of measurement models

B) Evaluation of the structural model (Tenenhaus et al., 2005)

The PLS estimates the validity and reliability of the measurement models in terms of the criteria for reflection and development external models. When sufficient evidence has been obtained that the measurement models are valid and reliable, a structural (internal) payment model can be evaluated (Ghanavati et al., 2012). The base model studied in the qualitative section is presented in Fig. 3:

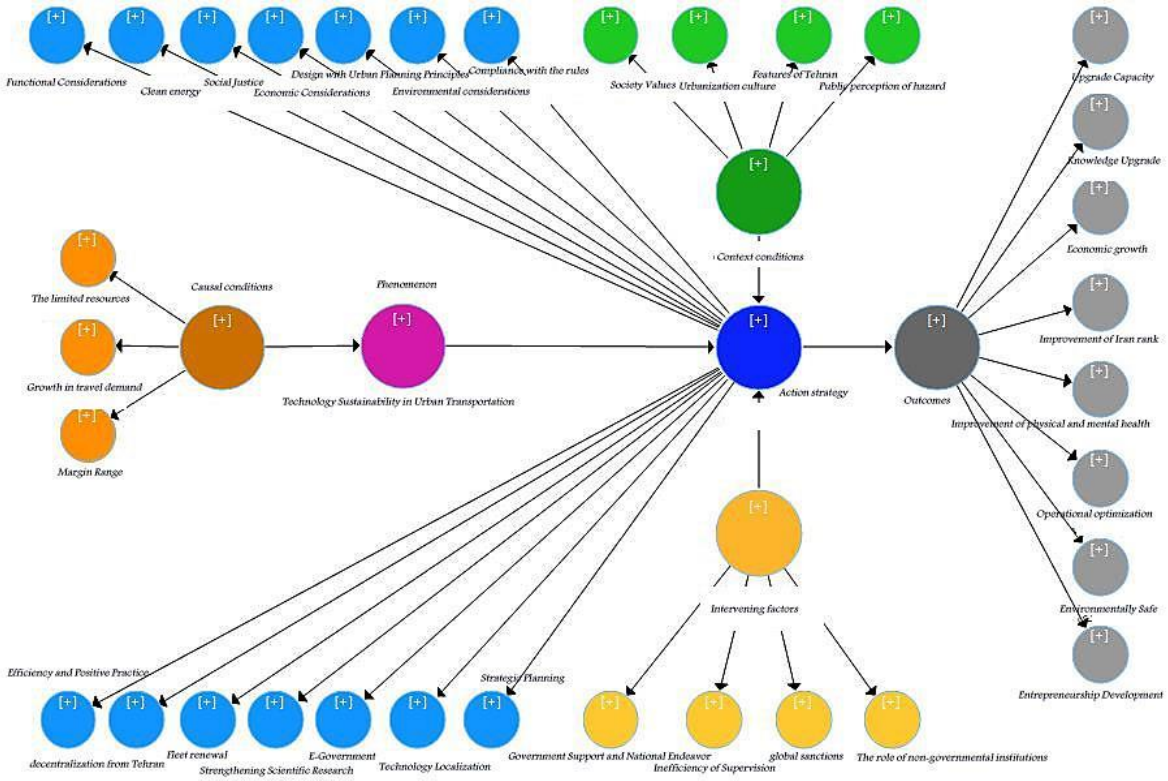


Fig3. Model drawn in PLS

Based on the calculations, the reliability of the reagents-factor load and also the calculation of Dillon-Goldstein (composite reliability) of the model are reliable. As shown in Table 4, the composite reliability values are more than 0.7, indicating a satisfactory reliability in the model.

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Table4. Composite reliability values

The name of the compound	Composite reliability
Knowledge Upgrade	0.936
Upgrade Capacity	0.912
Economic growth	0.896
Compliance with the rules	0.900
Environmental considerations	0.934
Improvement of Iran rank	0.931
Improvement of physical and mental health	0.926
Society Values	0.907
Design with Urban Planning Principles	1.000
Economic Considerations	0.821
Social Justice	0.886
Clean energy	0.905
Functional Considerations	0.896
Strategic Planning	0.902
Urbanization culture	0.950
Operational optimization	0.885
Environmentally Safe	1.000
Technology Localization	1.000
The limited resources	0.916
E-Government	0.909
The role of non-governmental institutions	1.000
global sanctions	1.000
Inefficiency of Supervision	1.000
Strengthening Scientific Research	0.926
Fleet renewal	0.881
Growth in travel demand	0.89
Features of Tehran	0.775
decentralization from Tehran	1.000
Technology Sustainability in Urban Transportation	0.888
Margin Range	1.000
Entrepreneurship Development	1.000
Government Support and National Endeavor	0.910
Efficiency and Positive Practice	0.846
Public perception of hazard	1.000

In addition, by calculating convergent validity and differential validity, the model is valid. According to Table 5, the convergent validity values are more than 0.5, which indicates a desirable validity.

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Table5. Convergent validity values

the name of the compound	Convergent reliability
knowledge upgrade	0.838
upgrade capacity	0.879
economic growth	0.811
compliance with the rules	0.695
environmental considerations	0.704
improvement of Iran rank	0.818
improvement of physical and mental health	0.759
society values	0.765
design with urban planning principles	1.000
economic considerations	0.605
social justice	0.767
clean energy	0.827
functional considerations	0.682
strategic planning	0.821
urbanization culture	0.863
operational optimization	0.794
environmentally safe	1.000
technology localization	1.000
the limited resources	0.846
e-government	0.834
the role of non-governmental institutions	1.000
global sanctions	1.000
inefficiency of supervision	1.000
strengthening scientific research	0.759
fleet renewal	0.788
growth in travel demand	0.800
features of Tehran	0.638
decentralization from Tehran	1.000
technology sustainability in urban transportation	0.618
margin range	1.000
entrepreneurship development	1.000
government support and national endeavor	0.718
efficiency and positive practice	0.616
public perception of hazard	1.000

In order to determine the differential validity of Fornell and Larker criteria and transverse load test, the results show that the model is desirable for differential validity.

In order to evaluate the model, the path coefficient was used. Each path coefficient in a PLS structural model can be considered as a standardized beta coefficient in ordinary least squares regressions. Structural paths, whose markings agree with the algebraic sign of the prior assumptions, provide an empirical validation of theoretical assumptions about the relationships between the variables. The paths whose algebraic sign is contrary to expectations do not support previous hypotheses. The path coefficients of the structural model are presented in Table 6.

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Table6. Path structural coefficients

Structural paths	Path coefficient
Causal conditions → Phenomenon	0.47
Phenomenon → Action strategy	0.22
Context conditions → Action strategy	0.42
Intervening factors → Action strategy	0.24
Action strategy → Outcomes	0.92

In the following, using the results of the structural model test, we seek a significant test of the path coefficients. As shown in Table 7, path coefficients have positive and direct effects. The significance test of these coefficients shows that all of them are statistically significant and their effect is confirmed. This means that the components developed in the paradigm model have a good confidence. In fact, the extracted conditions have a positive and direct effect on the category of traffic (functions associated with the use of urban transport technologies). The 14 extracted strategy strategies can improve the functions of transportation technologies, and the underlying conditions and identified intervening factors influence effective strategies. In addition, by implementing strategies one can expect that the desired consequences in the field of sustainable technology will be created.

Table7. Significance of the path structural coefficients

Structural paths	Path coefficient	T-statistics	Confirmed/Rejected
Causal conditions → Phenomenon	0.47	6.63	Confirmed
Phenomenon → Action strategy	0.22	2.96	Confirmed
Context conditions → Action strategy	0.42	3.86	Confirmed
Intervening factors → Action strategy	0.24	2.43	Confirmed
Action strategy → Outcomes	0.90	43.00	Confirmed

According to Tables 6 and 7, it can be concluded that the developed model in the qualitative part (paradigm model) has a credible validity and can be used as a reliable model for assessing sustainable technology in the urban transport sector. Finally, the paradigm model for assessing sustainable technology in Tehran's urban transport sector is in accordance with Figure 5.

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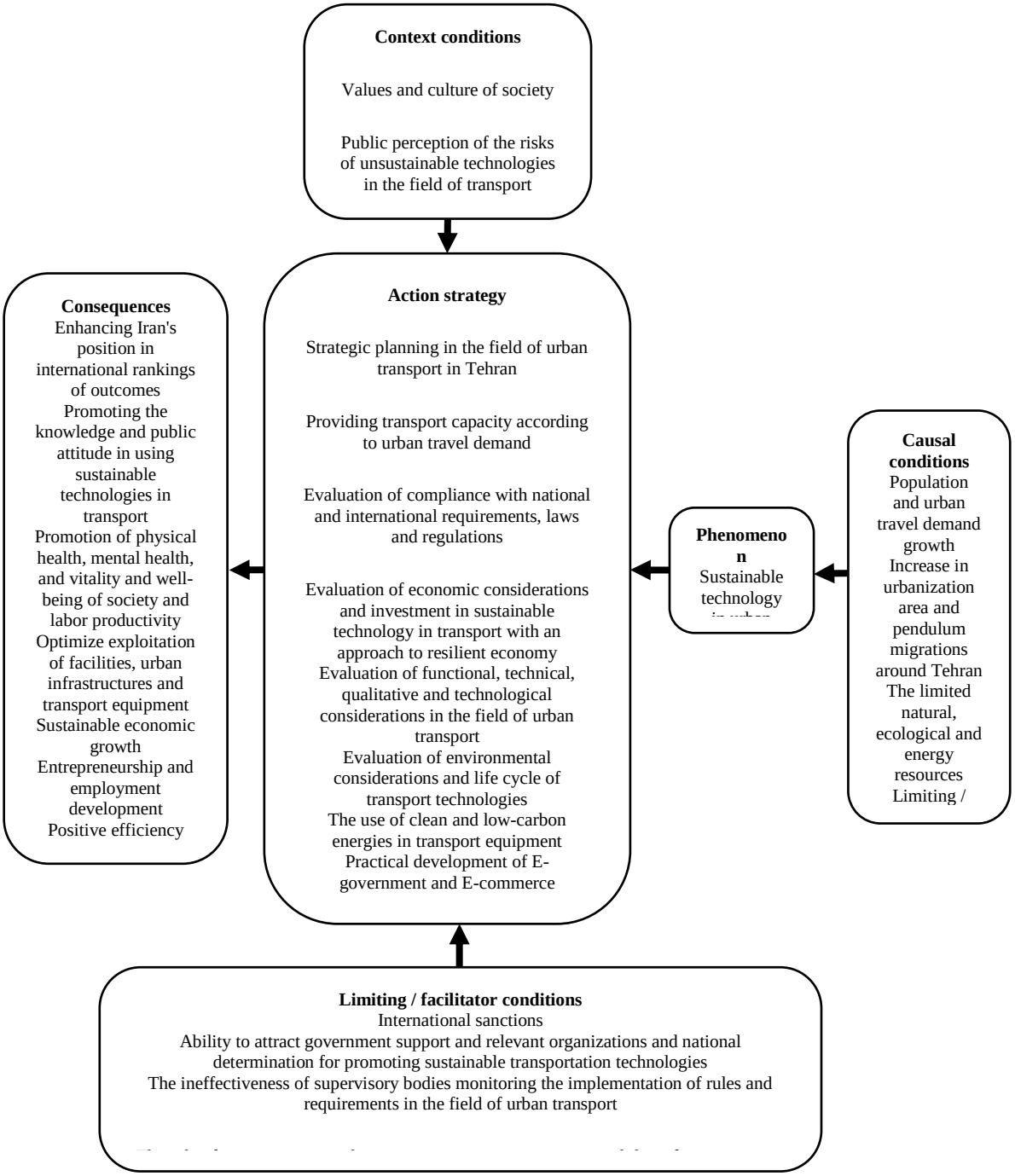


Fig4. Paradigm model for sustainable technology assessment in the field of urban transportation in Tehran

6. Conclusion and Discussion

In general, it can be said that the results of this study are similar to those of our previous research, including Ashby and Ferrer and the United Nations Environment Program, and are consistent. Considering the researchers' attitude to technology in their studies, the concept of the use of knowledge and experience to produce products and services in line with the developmental needs of humans and society and, on the other hand, along with the scientific orientations of this research,

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leads to the alignment of the results of the research with other studies.

With regard to the above mentioned issues, it can be said that the main phenomenon and the key issue in the evaluation of sustainable technology in the urban transport sector of Tehran are the functions associated with the use of urban transportation technologies, which is due to population growth and, consequently, the increasing demand for urban travel, the expansion of marginalization and migrations around Tehran and limited natural, ecological and energy resources. Strategies such as strategic and prospective planning in the urban transport sector of Tehran, the capacity of transportation in proportion to the demand for urban travel, assessment of compliance with requirements, national and international regulations, assessment of the economic justification of sustainable technology in the field of transportation and the possibility of creating the necessary investment with the resistance economy approach, evaluation of functional, qualitative and technical considerations in the field of urban transport, assessment and monitoring of environmental impacts and analysis of the life cycle of transportation technologies, the use of clean and low carbon energy in transportation equipment, the establishment and development of e-government and e-commerce, the possibility of domestication and proliferation of technology, the establishment of a modernization of equipment after their life span, provision social justice in the use of sustainable transport technologies (utilization of all sectors of society), strengthening of scientific research and international cooperation in the field of modeling and empowerment in the field of transportation, decentralization of Tehran, and the homogeneous distribution of urban amenities, the design and development of infrastructure accordance with the principles of urban planning and management could be as the most important strategy to control the effects of unsustainable technologies in the field of urban transport of Tehran. The strategies are influenced by the values and culture of the society, the level of knowledge and the general public understanding of the risks of unsustainable technologies in the field of transportation, the urbanization culture and observance of laws and regulations in the field of transportation by the people and characteristics of Tehran in terms of climate, population, geography, politics, infrastructure and engineering. Furthermore, factors such as the impact of global sanctions, national resolve and government support, and the alignment of relevant organizations in the development and use of sustainable technologies in the field of urban transport, the effectiveness of monitoring and monitoring of the institutions implementing the laws and requirements in the field of urban transport. It is expected that the implementation of the mentioned strategies can lead to events and consequences such as: promotion of the status of Iran in international rankings, promotion of physical and mental health, vitality and welfare of the community and labor productivity, optimal utilization of urban facilities and infrastructure, and promotion of knowledge level and attitudes towards sustainable transport technologies, sustainable economic growth, entrepreneurship and employment, efficiency and positive performance in the field of urban transport and the urban environment are healthy and productive.

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In this section, the suggestions received from the implementation of the research and the results obtained are presented in two sections: Executive suggestions (applied) and Research suggestions (supplements).

A) Executive suggestions:

- Implementation of a pilot model and feasibility study of designing sustainable technology assessment software based on model components (after compiling a quantitative model)
- The need to assess the sustainability of new technologies as an attachment to their associated justification plans (in the phases of design, creation or transfer of technology)
- Developing a practical guide on how to use action strategies and how to influence them on sustainability in transportation technology, such as strategic planning in the field of transportation
- Due to the fact that one of the main conditions in the field of transport sustainability in Tehran is the attention to urban infrastructures and some of the current problems in the field of transportation are subject to inefficiency, a strategic and prospective approach to infrastructure improvement is emphasized.
- Given the cost dimension of technology sustainability in the field of transportation, the provision of affordable facilities, the sustainable development of localization, etc., is emphasized. In addition, the cost of using unsustainable technology will increase (for example, implementation of schemes such as fuel tax rates).
- Research suggestions
- Developing a quantitative model of sustainable technology assessment based on the model developed in this study in such a way that it is possible to measure functional indicators; for example, models of excellence models that include empowerments and outcomes.
- Implementation of research in the field of drawing up a nationally-developed model (other cities and provinces), as well as reviewing the model's generalization to other sustainable technologies.
- Conducting research on the reasons and obstacles to the non-availability of sustainable technology in the country.
- Provide the necessary framework for re-evaluating sustainable technology during use to measure their effectiveness in terms of model components (degree of realization of outcomes).

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