

The need for sustainable local management to solve the reality of increasing traffic congestions in Iraq

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ABSTRACT

The need to find solutions based on sustainable methods for the transportation sector in Iraq has become an urgent necessity due to the ever-increasing volume of traffic congestion caused mainly by the increase in the number of vehicles and the total dependence on them for transportation in the absence of other alternatives. This increase in traffic congestion drains all of the fossil energy in addition to losses in time, health and comfort of users and those close to the roads. Also, it increases the costs in maintaining roads and vehicles, as well as the harmful effects on the environment. A number of literatures have been studied to explain the effects and causes of traffic congestion, especially in countries whose conditions are similar to Iraq. The roads and intersections in the city of Baghdad were monitored, and a number of experts were requested to discuss the causes. A sample questionnaire was conducted that included several levels and ages of Iraqi society to determine the sample's impression on a number of points affecting the local traffic congestion in Baghdad city. It was revealed through the questionnaire that there are four main causes for traffic congestion and there is a strong desire among Iraqis to own and drive vehicles, which led to a significant and continuous increase in their numbers, and this is one of the main causes of congestion.

Keywords: Delay, Maintenance, Sustainable Road management, Traffic congestion. Economy

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1. Introduction

Traffic congestion in most countries poses the biggest challenges to the health, environment, economy, comfort and safety of users in addition to wasting time [1, 2]. It seems clear that road congestion occurs when the roads are unable to accommodate the movement of vehicles normally (smoothly and comfortably), forcing it to reduce speed or stop and wait in some cases [3, 4]. There are many known general causes, but at the same time there are other local causes that must be considered in order to identify them and then find appropriate solutions to address them. All the general causes have been identified from the previous literature that affects the occurrence of congestion. As for local reasons, traffic congestion in the city of Baghdad was monitored, especially during the peak period, and experts were asked to indicate their information, as well as through a questionnaire. The effects of such congestions are clear on the Iraqi economy, which has been suffering for some time due to known circumstances [3, 4]. Such impacts have clear damages to roads, vehicles, health and the environment, and for this reason, it has become necessary to address these causes through sustainable and locally feasible methods [5, 6]. The absence of an management system and the weakness of the economy, which causes the weakness of the ability to find alternatives, financing projects and maintenance, has a significant role in non-control of traffic congestions in Iraq, especially in Baghdad. These conditions are usually accompanied by the deteriorating educational and cultural level and the emergence of the state of indifference, non-compliance and sense of responsibility towards others. It is clear that increasing the volume of vehicles after 2003 events has already exceeded the size of the development in the roads and infrastructure

in Iraq. It is therefore necessary to find sustainable and convenient ways in such difficult local conditions to solve this problem.

2. Literature review

Transportation affects most life sides [7, 8] especially economic growth particularly in developing countries [9-12]. Roads are the main facility for transportation in Iraq which increases the demand on roads [13-15]. An increase in vehicles on the roads at certain times of the day creates inefficiencies on the road and traffic management infrastructures that deal with capacity. This counts as crowding, as researchers have studied over the years [16]. Vencataya et al (2018) studied the effect of economic growth on traffic congestion, which negatively affects health, safety and showed their impacts on various aspects of society and economy [17]. Takyi et al (2013) studied the effect of population and economic growth and increasing family income on traffic congestion due to the increase in the number of vehicles, which causes delays and negatively affects workers' productivity [18]. Agyapong and Ojo (2018) studied the causes of traffic congestion and their harmful effects on the economy in Ghana [19]. Condurat et al (2017) demonstrated the impact of the growing use of vehicles and roads on the environment and health through the increase in emissions and pollutants in addition to fuel and energy consumption in the northeastern region of Romania. These emissions and pollutants increase with the increase in traffic congestion [20]. Hao and Wang (2018) have studied the impacts of emissions of vehicles in United State at different speed (through acceleration and deceleration) [21]. Kesuma et al (2020) studied the impact of traffic congestion of the risk caused by heavy vehicles on the environment [22]. Muneera and K Karuppanagounder (2018) studied the impact of fuel consumption, emission pollution of vehicles in traffic congestion on the economy [23]. Afrin and Yodo (2020) studied different stages of traffic congestion and the causes behind it. Also the impact of time delay, economy and pollution had been discussed [24] indicated that the increase in economic growth and the increase in population in Nigeria have led to an increase in traffic congestion, also due to the increase in accidents on the roads and the ease of obtaining driving licenses for young people of 15 years [25]. Shamsher and Abdullah (2013) indicated that among the main causes of traffic jams in Bangladesh is the lack of adequate parking spaces for vehicles, and this is what forces vehicles to stop on the side of the road in addition to the limited availability of buses and poor road infrastructure [26]. Revenio C. J. and Almalinda M. J. (2016) recommended conducting an analytical study of traffic congestions for the city of Muscat in the Sultanate of Oman. Also they indicated that among the causes of traffic congestion is the failure to address all intersections on the roads and the increase in accidents due to reckless driving and that such congestions lead to the occurrence of psychological stress and pressures, problems and chronic diseases such as diseases of the lungs, pressure and others [27]. Koźlak, and Wach (2018) explained that the increase in economic growth in Poland had led to an increase in the number of vehicles in relation to the population, which increased the volume of traffic jams [28]. Albalate and Fageda (2019) studied the case of traffic congestion in Spain and indicated the need to adopt sustainable methods for a transport policy, create parking spaces for vehicles, and the need to find a traffic management system because the options are not necessarily feasible, especially as their cost is high and that studies and analyzes are required before making a decision [29]. He et al (2016) Show that traffic congestion in China - Beijing can be divided into heavy, mild, smooth and very smooth and there are peak periods in the morning and evening time [30]. Mohsin et al (2021) indicated that adopting sustainable practices has to meet the local circumstance represented within the behavior, culture and economy of the population community similarly because the geographical location and climate of such environment [31].

3. Research methodology

At the beginning of the research, previous literatures were reviewed with the addition to obtain available information about the causes and impacts of such traffic congestions. Such information was added with the available local data to determine a bigger image of causes and impacts of such congestions. In the second stage, the development of vehicles and roads in Iraq was explained with the beginning of the last century. In the last stage, roads and intersections were monitored at peak time to monitor the development of traffic congestion in the city of Baghdad, and some experts were asked to explain the reasons, and a questionnaire was made for a sample that includes several segments and ages of the community to indicate the local causes of these congestions. About 100 questionnaire forms were distributed and 78 forms were returned and analyzed. The questionnaire results were subjected to descriptive statistics by SPSS 14.0.

4. The growth in vehicles and roads in Iraq

Iraq was under Ottoman rule for long periods until the First World War and when British forces entered from the south and occupied Iraq, the main means of transportation was by relying on animals where the old alleys are still narrow to this day. In the thirties of the last century, vehicles began to enter Iraq, and most of them were remnants of the First World War, and after the end of the Second World War, vehicles left over from the war began to enter, and the streets began to expand to accommodate these vehicles and their numbers and roads began to grow. The clear development of the reality of roads in Iraq took place in the eighties of the last century during the war with Iran, which required a network of highways to connect Iraqi cities, and a number of intersections were improved, especially in Baghdad, through the establishment of a number of tunnels and bridges by some foreign companies. During the period of the previous regime, the number of cars was limited because the government at that time imposed large sums, fees and taxes on vehicles, and only the symbols of the regime, senior officials and officers could own luxury cars while for the rest of society, owning a regular car was a difficult goal to reach. Because of the difficult conditions represented by economic sanctions, the blockade and the collapse of the local currency after the events of the Kuwait Liberation War, many maintenance programs for road networks inside and outside cities were neglected, as many parts of roads and bridges were exposed to war and projectile damage. Also, some have abandoned the use of vehicles due to the high maintenance costs and the lack of good fuel availability. After the events of 2003, things turned upside down, as there were no controls, fees or taxes on vehicles, their prices decreased greatly, and this explains why many used vehicles entered after such events and the situation continued until this moment that Iraq became the largest importer in the region for used vehicles. It is worth noting here that the first used vehicles that the Iraqis had previously wanted to acquire and drive were those that they were deprived of and that were used by the leaders of the former regime. Now, fewer new vehicles are being imported as well, but due to the lack of conditions of strength, durability and safety in import controls, many weak and useless vehicles entered the country because of their small size and low cost, which led to a lot of chaos in the traffic system and accidents in a large way, especially since most of those driving them are young people. These vehicles go side by side with the rest of the vehicles and trucks. Although cities in Iraq were previously connected at the beginning of the last century by a network of trains linking the south with the center and then with the north to Turkey and even Berlin in Europe, but it was neglected, as well as the rest of the other means of transport, such as water and air transport, and thus transportation in Iraq was limited to relying on vehicles and roads. The great dependence on vehicles and roads for transportation in the absence of other alternatives and the large increase in the number of vehicles that occurred after the events of 2003 (estimated at around 900-1300%) due to economic growth which is accompanied by the absence of maintenance and development works for the roads and the intersections and lack of regulations make them unable to pass such increase volume of vehicles in addition to a number of other obstacles that create the case of growing traffic congestion.

5. Results and discussions

It has been evident in the streets of Baghdad the presence of traffic congestion with different degrees of severity and in different places. This intensity increases at peak times, which are usually around eight to nine o'clock in the morning and around two to five o'clock in the afternoon, especially in the city center areas, where state departments and institutions are concentrated Hospitals, as well as a number of colleges and university institutes. Congestion also occurs in commercial areas and wholesale centers. It is noticeable during this period that the number of taxis, minibuses, small vehicles, motorcycles and cargo vehicles increases as well as pedestrians. The second peak period starts at six o'clock until ten in the evening in the areas where private clinics for doctors are stationed, as well as in the places surrounding shopping centers and some restaurants. In this period, the number of private and luxury vehicles increases. Discussions were held with members of the sample, especially experts, about the possible causes and impacts of the traffic congestion in the city of Baghdad. Also, through the questionnaire, the results indicated below were reached, and the results of the sample analysis and the questionnaire are presented below.

5.1. Possible causes of traffic congestion

There are a number of general causes known to the occurrence of traffic congestion, some of which are indicated in the literature, and others are special or local causes related to the nature of the city, the way of life, economic, social and cultural conditions of such city. The possible causes of traffic congestion are

explained below:

- a) The increase in population density, as the increase in commercial, industrial and other activities leads to an increase in the movement of vehicles, pedestrians, employees and others, and increases congestion due to the saturation of roads and sidewalks.
- b) Deficiencies in infrastructure, as shown below:
 - Lack of other alternatives in the transportation process, such as the metro and trains.
 - Bridges, tunnels and traffic signals are not available at all intersections, in addition to the absence of an integrated network of highways and the lack of suitable parking spaces for vehicles.
 - The inability to distribute the administrative, educational, health and service institutions and departments, markets and transport services, as the concentration of these institutions and services in a specific place (near the center) greatly increases congestion, especially at peak times.
 - Absences of management systems, as controlling the transport process in general and traffic in particular needs a management system that organizes laws, instructions and everything necessary to maintain the flow of roads. It works to regulate and facilitate the movement of vehicles and pedestrians together without causing accidents. This requires punishment of transgressors and reckless, imposing fines and fees on them, and putting in place controls that work to regulate traffic and remove obstacles in the event of accidents or any emergency changes that may occur. It also works on monitoring roads using cameras to study traffic, find solutions to congestion or frequent accidents, and follow-up maintenance programs to maintain the smooth flow of vehicles and make studies for the future needs of transport.
 - Weak economy and this leads to the inability to spend, develop and make improvements of the transportation process or reduce congestion such as rehabilitating and maintaining roads and improving intersections through building bridges and tunnels. The weak purchasing power leads many to own weak vehicles to use them as taxi vehicles that do not carry any safety standards.
 - Also, the deterioration of the economy and the increase in unemployment are pushing many to use the sidewalks and streets to display and sell goods.
- c) Impaired planning and coordination. This is common in countries that lack plans, where roads are subjected to many restrictions due to the existence of the process of constructing a building, repairing sidewalks, sewage problems, and so on.
- d) Weakness in sense and realization and this is what is illustrated by not compliance with traffic laws, regulations, signals and lights. There are several examples for both pedestrians and vehicle drivers, for example, crossing pedestrians for the road as well as the parking of sudden vehicles on the road random and non-civilized. There are a lot of practices in the way by pedestrians and drivers are incorrect due to poor cultural and social awareness in the absence of legal proceedings to punish violators.
- e) Difficult weather conditions, where some conditions such as snowfall or heavy rain work to force vehicle drivers to move slowly and sometimes to stop due to the inability of the roads to pass the movement of vehicles as they are normally (especially when the water drainage system is not eligible for the rainy season).
- f) Weakness of the security aspect and the occurrence of violations and the emergence of acts and terrorist bombings require finding checkpoints on the roads for control and restoration of security and this is one of the important causes of congestion.

5.2. Traffic congestions impacts

There are a number of impacts of traffic congestion, which were obtained from the literature, as well as from what is available from local detection, as detailed below.

- a) Delay: It is one of the most prominent and clear influences that cannot be evaluated due to the difference in estimates among those affected by it, whether they are, for example, students, employees and so on, but time may have great importance, and in some cases it is impossible to estimate the damage resulting from the delay.
- b) Economic losses: These impacts are the most damaging at all, which arise from traffic congestion, and these losses can be classified due to:
 - High costs, and this results from the high production and shipping costs.
 - Increased consumption and such increases are due to the excessive consumption of fuel, vehicles and roads, which calls for shorter maintenance periods.

- Costs resulting from handling problems resulting from traffic congestion, such as pollution and others.
- c) Health and psychological damage. It is clear that congestion leads to discomfort. The exposure to long periods of delay and congestion affects the psyche of users and may lead to violence in some cases, and this may cause chronic diseases such as blood pressure and diabetes. On the other hand, high exposure to emissions from vehicles leads to lung and respiratory diseases.
- d) Environmental impacts and these harmful effects are varied as shown below:
- Some of them are related to gaseous or thermal emissions of vehicles and their impacts on the atmosphere.
 - Some impacts relate to environmental damage caused by parts of engines, vehicles, and oils that have been replaced and left in vehicle repair and maintenance sites, as congestion speeds up the consumption of these parts.
 - Also, the congestion calls for more maintenance work for road layers, and this increases the harmful effects of the environment due to the nature of such materials in addition to the size of the equipment used.

5.3. Analysis of the questioner results

The sample questionnaire consisted of two parts:

1- Part 1 deals with analyze of sample properties

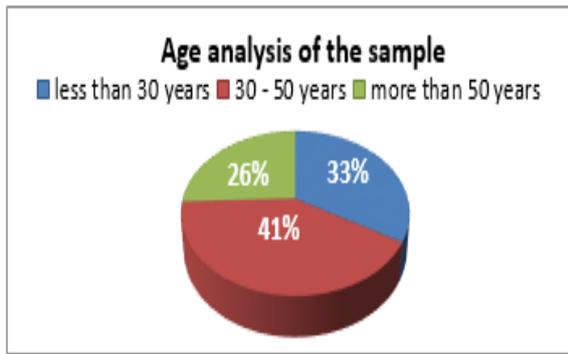
- a) Age analysis - Figure 1(a) shows the analysis of the ages of the sample, while Figure 1(b) shows the analysis of the desire for each age group to own and drive vehicles in the usual state, as well as if alternatives are available for transportation. It is evident from Figure 1(b) that older people have less desire to own and drive vehicles than younger age groups, especially if alternatives are available.
- b) Educational level – Figure 6(c) shows the sample individuals' percent that possess an institute or college degree, and more.
- c) Specialization – Figure 7(d) shows the specialization of the sample, whereas, the number of experts with more than 15 years of experience in traffic systems is 8. While the number of engineers who have more than 10 years of experience in the field of transportation is 12 (The total number is 78).
- d) Owning vehicles – Figure 1(e) shows the approximate percentages of those who own one or more vehicles. In Figure 1(f) shows more details of owning such vehicles.
- e) Opposing vehicle ownership - Figure 1(g) shows the approximate percentage that opposes owning any vehicle for various reasons, including economic and others.
- f) Owning vehicles before and after 2003 - Figure 1(h) shows the percentage of those who owned one or more vehicles before and after the events of 2003 and it is clear that 71% of the sample owned one or more vehicles after such events due to the availability of purchasing power and the low cost of ownership.

2- Part 2 deals with statistical analysis of the answers received from the questionnaire where five -likert scale from 1 to five was adopted within the second part of the questionnaire where 1 stands for (strongly disagree) and five stands for (strongly agree). 100 questionnaire forms were distributed and 78 forms were returned and analyzed. Descriptive statistics were used in subjecting Results which were performed using SPSS 14.0. Summary Statistics utilized in data analyzing table including: Mean of score (MS), Standard Deviation (SD), and Relative Sufficiency RS%, and primarily assessment degree (A.D.) as explained in Table (1).

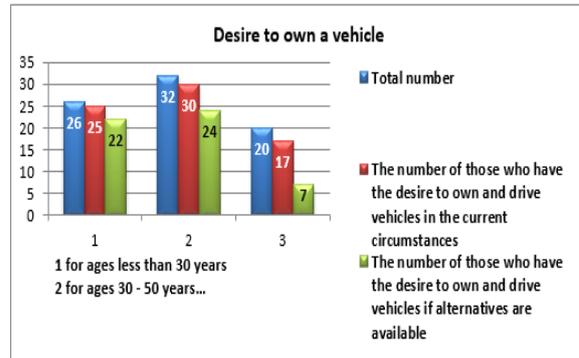
Table1. Scoring Scales of the studied Questionnaire's items with Assessment Degrees

Scores	Scales	Interval	A.D. (*)
Strongly disagree	1	20 -	TL
Disagree	2	36 -	L
Neutral	3	52 -	M
Agree	4	68 -	H
Strongly agree	5	84 - 100	TH

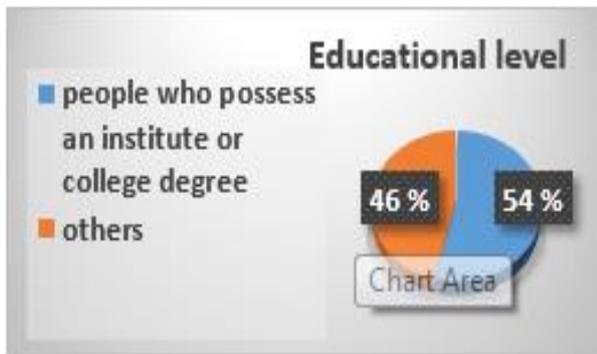
(*) TL: too Low; L: Low; M: Moderate; H: High; TH: too High



a. Age analysis of the sample



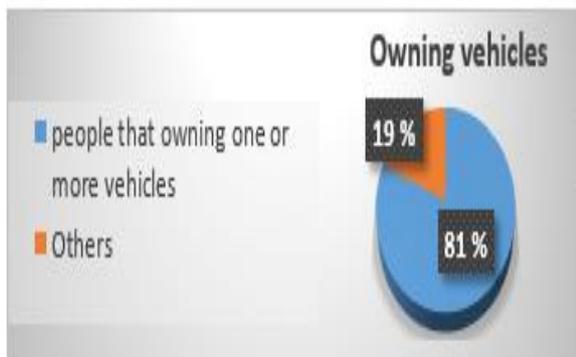
b. Desire in age group to own/drive vehicles



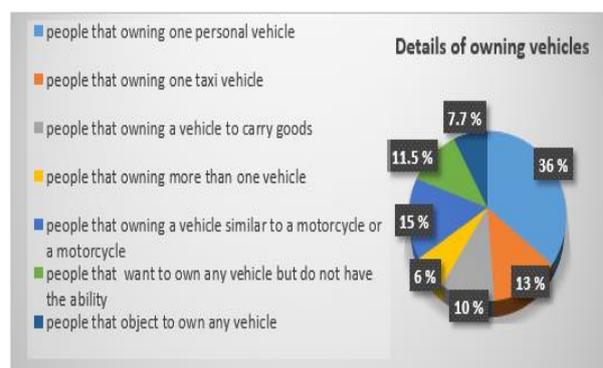
c. Educational level



d. specialization of the sample



e. sample's owners of vehicles



f. sample's ownership of the vehicles



g. percentage of opposing vehicles



h. vehicles before after the events of 2003

Figure 1. Analysis of questionnaire results

Where Relative Sufficiency (RS %) is calculated by equation (1):

$$R. S. \% = \frac{\text{Mean of Score}}{\text{no. of Scoring Scales}} * 100\% \quad (1)$$

The analysis of the questionnaire results is shown below:

- a) Reasons to own and drive vehicles. Table 2 shows the reasons for owning and driving vehicles through the impression of respondents arranged according to their weights.
- b) The nature of the transportation process in Baghdad using vehicles. Table 3 shows the impression of respondents of the transportation process in Baghdad using vehicles, arranged by weights.
- c) The size and type of vehicles used in cities Table 4 shows the impression of respondents on the increase in the number of vehicles with an increase in the number of unqualified vehicles.
- d) Arranging causes of traffic congestion. Table 5 shows the order of the causes of traffic congestion, in descending order, according to the impression of the respondents
- e) The difficulty of crossing intersections Table 6 shows the impression of respondents for crossing intersections by pedestrians and vehicles.
- f) Quality of roads. Table 7 shows the impression of respondents for roads in Baghdad through driving of vehicles.
- g) Evaluation of the transport process in general. Table 8 shows the respondents' impression of the overall conditions of the transport process.

Table 2. Reasons for owning and driving vehicles

Rank	Items	MS	SD	RS %	AD
1	Necessary to move with a lack of other transportation means	4.34	0.94	86.5	TH
2	Necessary as a desired appearance from a social point of view (part of a person's personality)	4.30	1.01	85.5	TH
3	Necessary for emergency conditions	4.07	1.19	78.8	H
4	Necessary as a means of work and financial gain	3.51	1.36	70.3	H
5	Essential for enjoyment, outings and use on holidays	3.36	1.40	67.2	M
6	Unnecessary with heavy traffic	3.22	1.39	64.4	M
7	It is a financial burden and requires a maintenance budget	3.18	1.39	63.6	M

Table 3. Nature of the transportation process in Baghdad using vehicles

Rank	Items	MS	SD	RS %	AD
1	Difficult especially at peak times due to severe traffic congestion	4.38	0.91	89	TH
2	Difficult with consuming time and effort due to traffic congestion	3.81	1.20	76.2	H
3	It may be considered normal, with some traffic congestion near the city center	3.32	1.39	66.5	M
4	Driving can be considered fun when visiting friends and shopping, especially on holidays	3.12	1.40	62.3	M

Table 4. The effect of increasing volume and different quality of vehicles

Rank	Items	MS	SD	RS %	AD
1	The volume of vehicles is growing rapidly with the increasing number of different vehicles and there is an urgent need to find appropriate solutions	4.39	0.93	87.5	TH
2	The problem is concentrated in the presence of different vehicles in terms of size and strength, and some of them do not meet the requirements of strength and safety	4.32	0.97	86.2	TH
3	The size of the vehicles is large and there is no problem with the type of vehicles	3.44	1.31	68.7	H
4	The size is normal and there is no problem with the vehicles' type	3.21	1.35	64.1	M

Table 5. Descending order of traffic congestion causes according to the respondents' impression

Rank	Items	MS	SD	RS%	AD
1	Traffic volume exceeds the roads capacity	4.46	0.89	91.2	TH
2	Intersections problems due to lack of underpasses or overpasses	4.41	0.91	90.7	TH
3	Lack of alternatives	4.38	0.92	89.3	TH
4	Absence of a planning role in the transport process within cities and studying the growth and expansion of the transport process	4.36	0.93	87.2	TH
5	Absence of effective management that adopts monitoring traffic congestion, organizing traffic in safe manner, and holding violators accountable through the enforcement of laws and regulations	4.31	0.95	86.4	TH
6	Some roads and intersections require regular maintenance	4.29	0.98	85.9	TH
7	The concentration of some institutions, official departments, colleges and services in the center and weakness in distribution	4.26	1.01	85.5	TH
8	Failure to comply with traffic laws, regulations, and to disrespect the traffic man by some drivers of vehicles, especially motorcycles	4.18	1.07	83.6	H
9	Presence of many checkpoints due to security problems	4.03	1.17	80.5	H
10	Presence of many violations on the road from street vendors due to poor financial condition and by some officials and institutions with the absence of legal authority and weakness in imposing order	3.96	1.22	78.9	H
11	Parking vehicles on roads sides due to lack of parking spaces for vehicles, which reduces the possibility of roads to pass vehicles	3.88	1.25	77.7	H
12	Random stops for some vehicles for several reasons: careless, Random pedestrians cross roads, some vehicles and motorcycles pass in the opposite direction	3.79	1.25	75.9	H
13	Traffic congestions due to stops resulting from accidents or breakdowns in vehicles due to the lack of commitment in terms of durability and safety for vehicles	3.47	1.34	69.5	H

Table 6. The difficulty of crossing intersections

Rank	Items	MS	SD	RS %	AD
1	Severe congestion at intersections due to unavailability of bridges and tunnels to pass the large numbers of vehicles and pedestrians.	4.38	0.89	89.3	TH
2	Severe congestion at intersections due to some non-compliance with traffic regulations and because of power cuts to traffic signals	3.49	1.29	69.6	H
3	Movement is almost normal at intersections, with some congestion	2.95	1.39	59.0	M

Table 7. Quality of roads

Rank	Items	MS	SD	RS %	AD
1	Some methods require constant follow-up and maintenance because problems arise from time to time	4.31	0.97	86.3	TH
2	Some roads need to be rehabilitated due to insufficient maintenance work especially in some areas	3.76	1.18	75.1	H
3	Road conditions can be considered normal	2.87	1.37	57.4	M

Table 8. Evaluation of the transport process in general

Rank	Items	MS	SD	RS %	AD
1	Need to review and provide alternatives	4.35	0.79	86.9	TH
2	It needs development	4.23	0.92	84.6	TH
3	Natural and does not need to be developed	2.95	1.42	59.0	M

6. Conclusions

1. Enhancement of economy in Iraq significantly increases the traffic congestion.
2. Poor control increases traffic congestion requires. Effective control involves traffic monitoring especially during peak hours.
3. Absence or low traffic consciousness in the society increases the congestion.

4. Special causes such as uncontrolled security operations, improper locations of checkpoints, and improper timing for truck movement increases the congestion.
5. Addressing traffic congestion causes require applying all available capabilities to eliminate harmful effects of these congestions in terms of preserving time, economy, health and the environment.

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Conflict of interest

Declaration of competing interest

The authors declare that they have no any known financial or non-financial competing interests in any material discussed in this paper.

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