Journal of Civil Engineering, Science and Technology
Volume 14, Issue 2, September 2023, 104 – 116

ASSESSING THE PUBLIC AND EXPERTS' PERCEPTION TOWARDS THE PROPOSED CONGESTION PRICING SCHEME IN JORDAN

Ghadeer Al-Mawajdeh[1*], Khair Jadaan[2], Ghaleb Sweis[2]
[1]KBW Investments Company, Amman, Jordan
[2]Civil Engineering Department, University of Jordan, Amman, Jordan

Date received: 20/11/2022 Date accepted: 16/01/2023
*Corresponding author's email: Mawajdeh.ghadeer92@gmail.com
DOI: 10.33736/jcest.5153.2023

Abstract — This study aims to investigate the attitudes of both the public and the experts towards the Congestion Pricing (CP) scheme by considering the case of Amman City in Jordan. A combination of qualitative and quantitative methodologies was adopted. A predesigned survey with 600 respondents was the primary source of data in addition to semi-structured comprehensive interviews conducted with knowledgeable individuals experienced in the related fields including wholesalers. The analysis of the collected data was performed using the Statistical Package for Social Science SPSS IBM software together with the SPSS AMOS (Analysis of Moments Structural Equation Modeling Software) and Excel spreadsheets programs to carry out CFA, RII, descriptive statistics, and socio-economic index. The results showed that more than half of the respondents (58%) have never heard of CP. 47% of those who are aware of CP were in favor of implementing it. Greater support was given to the CP implementation during the Peak hours (55%) compared to their support of all-hour implementation (26%). The RII results revealed that CP can reduce road congestion (RII=69.8%), helps protect the environment (RII=70%), and limit recreation and shopping preferences (RII=64.7%) and this aspect could be better publicized as an effective means of maintaining social distance and reducing the risk of infection during Covid-19 pandemic. Moreover, people with greater socio-economic educational class tended to perceive a higher personal change in travel habits when CP is implemented. People's level of acceptance of the implementation of CP was found to be affected by several meaningful factors. The CFA revealed that a more significant factor was the "potential benefits and economic revenue of implementing CP". The main causes of traffic congestion in Amman, the capital of Jordan, were identified through interviews with experts from various concerned parties which included poor public transport system and parking management, increasing car ownership, and inadequate policies to control traffic congestion. The experts advised that the CP implementation should be linked with other related strategies and be evaluated periodically. They also suggested a minimum of 3.5 years' time framework in case of introducing the CP scheme. This period is needed for issuing new CP legislation and developing an acceptable level of public awareness of the system. Furthermore, the implementation of CP might not always seriously damage the wholesaler's own business or economic competitiveness. Based on the results of the study, recommendations for developing and implementing an effective CP system in Amman were outlined.

***Keywords*:** Congestion pricing, road traffic, awareness, management, Jordan

1.0 INTRODUCTION

Traffic congestion has become a familiar and risky problem worldwide. It causes numerous negative impacts that make it necessary to control and manage the use of vehicles, especially in urban areas. Traffic congestion may affect employers and corporate business activities in various ways. It limits worker availability and productivity by affecting employees' commutes which in turn leads to stress, frustration and negative work environment. It also impacts corporate activities such as shipping/receiving, logistics and distribution, client meetings, sales, operations and services. Relatedly, traffic congestion is usually addressed through a coordinated combination of several engineering techniques; generically referred to as 'Demand Management. The fact is that innovation in traffic management through Congestion Pricing (CP) is a sound way of successful and sustainable policies [1]. A recent study by [2] discovered the following common managerial insights: The dynamic pricing strategy represents the most direct and efficient way of managing demand by changing individual travel behaviors and trying to adjust the spatial and temporal distribution of demand, and it is widely used in a variety of transportation systems. However, the public's strong opposition to congestion pricing is the major impediment to widespread implementation.

Various countries in the world have implemented different forms/categories of CP schemes: Singapore in 1975 (Area Licensing Scheme (ALS) and Electronic Road Pricing (ERP)), Oslo in 1990 (Urban Road tolling), London in 2003 (London congestion charging scheme (LCCS)), Stockholm in 2002 (Stockholm congestion pricing (SCC)). A summary of the main CP schemes implemented in various countries of the world over the years together with their main feature is given in a study conducted by [3]. However, the choice among these forms should be made case by case and depends on many factors including (1) the main purpose of pricing, (2) the structure of the pricing scheme, and (3) the transport and geographic conditions under which CP is implemented. CP system can take many forms based on the objectives of the scheme and the area of each city by sending a price signal to link human choice and behavior to transportation choices.

The number of trips on Amman's road network is growing continuously at a high rate leading to traffic congestion with significant losses to the national economy. Traffic congestion on Amman's urban arterials is emerging as a major impediment to the achievement of economic goals. One possible solution is through building sufficient roads of sufficient size to cope with the demand. However, with no visible end to the demand yet in sight, and with high road construction costs, the cost of building new roads to cope with an unrestricted demand would be far too great. In addition, there is limited land available for building new roads or widening existing roads. So, it is vital to search for alternative solutions to alleviate traffic congestion with CP being one of the most effective measures that have been proven to be successful in many countries, and its benefits outweigh the associated implementation and operational costs.

Traffic volumes on Amman's arterials are continuously and significantly increased over time causing negative social, economic, and environmental impacts. Strictly speaking, there is no organized framework for user charges in Jordan. Instead, road users pay tax as a condition of using roads and the road themselves are provided and maintained by government funds. The rates of taxes are not set with any pricing principle in mind and do not have any effect on reducing traffic problems including congestion. CP can, therefore, contribute to a significant reduction in the negative effects of travel produced by congestion by affecting the traveler's selection of trips. This study will undoubtedly help to improve predictions of travel demand of people who had a low, intermediate, and high socio-economic and educational status by considering CP impact.

This study aims to investigate the perception of both the public and the experts towards traffic congestion and Congestion Pricing (CP) considering the case of Jordan using a combination of qualitative and quantitative methodologies. In specific, the aim is to assess the level of awareness of CP among various road users and stakeholders and to determine the level of acceptability, support, and attitude of the scheme among various socio-demographic road users to the recommended scheme if implemented.

The main causes of traffic congestion in Amman, the capital of Jordan, were identified and recommendations for developing and implementing an effective CP system based on the outcome of the study are outlined.

2.0 LITERATURE REVIEW

There are various forms of charging for congestion. The main ones are discussed below [4].

(1) Facility-Based Charges:

Until now, this toll system is still the most common form of road pricing. Tolls can be levied either on all lanes of a facility or designated toll lanes as is done on High-Occupancy Toll Lane facilities (HOT). Tolls can also be levied at a single point on a facility or multiple points with the total amount paid being determined by distance traveled. Examples of this type are the Canadian 407 ETR which is ''108''kilometer toll highway that runs across the Greater Toronto Area and the new I-15 Express Lanes north of the City of Toronto opened to traffic in 2009. The highway has 193 entry and exit points, 40 interchanges, and nearly 300,000 drivers use it.

(2) Area-Based charges (Zonal):

This type places a boundary around a portion of the city and charges a fee for entering or driving within a congested area. This system works best to alleviate congestion and traffic in well-defined and very dense downtown cores. The charges are mainly adjusted to reflect the time of day and discourage traffic during peak travel periods. Based on its geography and traffic patterns, this area pricing system has been adopted in Singapore, London, Stockholm, Bergen, and Trondheim. These cities' experiences demonstrate that properly structured zone-based charging schemes can reduce urban congestion and increase public transportation

ridership [5].

(3) Cordon Charging Scheme:

Cordon's toll is a special form of area-based charging (Zone) in which fees are paid by motorists to cross a cordon in the inbound direction, in the outbound direction, or possibly in both directions. Some cordon tolls only apply during peak times. A 17-cordon scheme can encompass multiple cordons, and it can include radial screen lines to control orbital movements. All existing schemes are of single cordon type.

The Norwegian toll rings were the first cordons to be formed but unfortunately, their main purpose had been revenue generation rather than CP. The first cordon scheme designed to manage congestion is the Stockholm CP. The cordon surrounds the city center and has 18 control points [6]. Also, a cordon pricing scheme was introduced in central London in 2003.

(4) Distance-based charges:

This type of road pricing charges the road users mainly based on the distance driven and can offer a great level of choice and flexibility in how people pay for road use. Distance-based charges are the most comprehensive and flexible form of road pricing. This form typically uses a global positioning system (GPS) to track the distances traveled by road users. More specifically, the proposal made by the UK Commission for Integrated Transport (CFIT) replaced the existing vehicle registration fees and fuel taxes with a variable road user charge using GPS technology methods. Alternatively, annual or semi-annual odometer inspections are another, less-intrusive, way of monitoring distances traveled. This form can be augmented by charging road users according to their vehicle's size, weight, and subsequent damage to the road network and emissions. The system has been implemented in Germany and the Netherlands. Four US states have also implemented distance or weight-based charges for heavy goods vehicles but the charges are intended generally to recover the infrastructure costs imposed by heavy vehicles more willingly than to manage demand [7].

Among the many strategies that have been implemented in various countries to combat traffic congestion, road pricing and driver charging strategy is the one that has demonstrated a serious ability to make a lasting impression [4]. There are eight examples of congestion pricing systems that have been implemented or rejected, as well as the major and minor affecting elements that affect road users' general acceptance of congestion pricing [8].

CP has many social, environmental, and economic benefits which have been proven as reported by several studies through the implementation of the system in different countries of the world. A simple explanation of implementing CP is that it can keep smooth traffic flow; reduce travel times, accidents, and air pollution; and generate revenues for infrastructure investments [9]. Studies in Gothenburg, Sweden showed that implementing CP produced a 12% reduction in traffic when transit use was on the rise [10]. A detailed study indicated that public transportation service grew by 1,300 runs daily carrying an average of 19,100 additional passengers during eleven months and that CO2, PM10, and NH3 emissions decreased by 14%, 23%, and 47% respectively [11].

In the USA, a real–life example in Florida demonstrated the effects of the pricing mechanism. A 50 % discount on the toll was offered on the Midpoint and Cape Coral bridges for a short time before and after the rush hours resulting in an increase in traffic of as much as 20 % during the discount period before the morning rush hours, while corresponding drops in the rush hour itself occurred [12]. In Singapore, extensive improvements to public transport was achieved during the period of the ALS and since the ERP was introduced [13].

Price structures may be more redistributive and effective at reducing pollution and traffic, especially when toll profit is used to fund public transportation [14]. Setting up trial periods that would enable the public to comprehend the true impact of the measure and, thereby, temper their overly pessimistic initial perception, could help to partially alleviate their unpopularity, which stems from the fact that they are perceived as new taxes.

At the preliminary stages, the general community's response to road pricing structures has almost always been unfavorable. This response, though, varies over time and was discovered to be stronger after using the schemes in practice, to the point where a current scheme might receive support for even further extension [15]. The trucking industry and automotive vehicle associations have largely opposed road pricing, according to studies, however, this could change as urban congestion rise [16].

A recent study investigated the public perceptiveness of the road pricing strategy in an attempt to evaluate the

acceptability and consequently the potential implementation of such a strategy on Amman's urban road network [17]. Predesigned questionnaires were used to assess the level of acceptability of individual road users and public firms for introducing a road charging scheme on the use of congested roads. The results were encouraging and showed that almost half of the respondents support the implementation of such a scheme to combat traffic congestion. A study investigated the behavioral responses to road pricing among various affected groups in Jordan. Implementing road pricing as a traffic restraint measure was perceived by road users to have a significant effect on their travel habits and behavior [4].

Public acceptability and support are slightly affected by socio-demographic characteristics such as income, and education which agrees with what was reported by [18]. According to [19] low acceptability is a major barrier to the implementation of congestion charging schemes, particularly in democratic societies. Other research links socioeconomic variables to elements that may influence acceptability, like perceived effectiveness. The effectiveness and fairness of congestion charging are perceived to be uncertain, according to [20], who discovered that "gender, age, and education level have a significant effect on this perception.". Respondents in Melbourne were found to be more supportive of a CP than Brisbane and Amman due to its existing road pricing; CP and tolls [3]. The difference in congestion pricing's acceptability across cities even within the same culture such as in Australia. A comparison between Japanese and British data conducted by [21] revealed that trust in government is linked primarily to belief in absolute values, religious beliefs, and cultural values.

3.0 MATERIALS AND METHODS

In the current study, a combination of qualitative and quantitative approaches were adopted. A survey using a predesigned questionnaire was the primary source of the data through which the acceptability, level of support, awareness, favorability of the CP scheme, and socioeconomic index were analyzed. A total of six-hundred respondents participated in the survey through online and direct interviews. To ensure a broad and in-depth examination and comprehension of the problem, two direct interviews—one examining the attitudes and support of wholesalers and the other as confirmation were conducted. The interviews were also conducted to validate the statistical analysis results.

Simple and short questions not exceeding 20 words were used in the survey. The questionnaire focuses on some important factors believed to influence the public acceptance and agreeability of CP such as:

1) Potential benefits and economic revenue (e.g., congestion reduction, vehicle emission reduction, improve traffic operation and road infrastructure),

2) Economic unfairness of congestion pricing (e.g., unfairness to poorer people and negative impact on the economy), and

3) Expected personal travel behavior change (e.g., using public transport more, carpooling more, traveling to the city less frequently).

The questionnaire included an additional factor that measures the level of awareness of traffic congestion and CP and their support for implementing the CP system. Other general questions were related to the socio-demographic characteristics of the different groups of individuals, taking into account their characteristics (e.g., gender, monthly income, education level, employment, and Current Household Structure) were adopted. Furthermore, general questions were included to reflect the public opinion towards traffic congestion (e.g., the most congested day of the week, the highest congestion period) that can help in implementing the scheme. The category scale, dichotomous scale, Likert Scale, Numerical Scale, and Itemized Rating Scales were used in this study.

A Semi-Structured interview was conducted with five wholesalers in the industrial area of Sahab City South East of the capital of Amman to assess their attitude and support towards the pricing system. The structure of the interview comprises a brief introduction to the congestion charging system and other general questions (e.g. years in business, no. of employees). The interviews were guided by close-end questions while additional feedback in a form of face-to-face interviews were taken from some of the wholesalers' respondents. Structured comprehensive interviews were conducted with knowledgeable and experienced individuals from various concerned parties including Greater Amman Municipality (GAM), Jordan Traffic Institute (JTI), Ministry of Transport (MOT), and others to confirm the validity of the statistical analysis results identifying the response of the public and wholesalers towards implementing CP scheme in Amman. An open-ended answer was required under which key experts'

respondents were expected to provide in-depth comments, their conclusions, and recommendations. Due to limited time, interviews were carried out with a few wholesalers since most large wholesalers are located far away from the city of Amman.

Expert interviewees were asked many questions such as: (1) What are the main reasons for traffic congestion in Amman? (2) What kinds of measures and policy instruments have been applied to manage traffic congestion? (3) What in your opinion are the challenges of implementing congestion pricing (CP) in Jordan? (4) In case of implementing the CP system in Jordan, what would be your suggestion for the revenue allocation that produces an efficient transport system? and (5) How long the implementation of CP should last?

Wholesalers were asked to share their opinion about the following: (1) Traffic congestion causes financial losses to the firm, (2) CP can help reduce traffic congestion, (3) CP can help protect the environment by reducing vehicle emissions, (4) CP would reduce the deliveries time, (5) CP would negatively affect the number of customers and other questions are mentioned in next part.

The analysis of the collected data was carried out using SPSS. Confirmatory Factor Analysis (CFA), Relative Importance Index (RII), and descriptive statistics. The Relative Importance Index (RII) was utilized to estimate the relative agreeability of people to the CP. The RII index is a weighted item analysis, not a people analysis, and it will help rank the measured indicators in terms of relative contribution to agreement/disagreement with the charged congestion tax [22]. RII is a statistical method for determining the order of various factors [23]. Confirmatory Factor Analysis is a modeling technique that can come to terms with the relationships between the observed and latent variables. A factor is a variable in CFA that affects more than one observed indicator and influences the correlations between the observed measures. A factor analysis model's goal is to determine the number and type of factors that account for variation and covariation among observed measures [24]. CFA in the SPSS program was used to explore the factorability of the measured items of people's opinions on the CP to help us summarize them into a smaller number of simple, meaningful, and interpretable factors which will be used as a predictor-independent variable for the level of people's support to the CP.

Means and standard deviations were used to describe continuous and metric variables. In addition, frequencies and percentages were used to describe categorical variables like the gender and age of the respondents.

Furthermore, the Non-linear Factor Analysis suite in the analytical program was used to explore the dimensionality of the people's measured manifest 38 indicators of socio-demographic factors (Namely: level of education, household income, car ownership, employment type, and employment organization) to approximate their socio-economic index. This socio-economic index factor was computed from the SPSS analytical and AMOS programs. The SPSS AMOS (Analysis of moment software) is a rigorous structural equation modeling program that will help to identify and confirm the socioeconomic index. To compute the composite socio-economic index score we obtained the factor weights of the measured variables then we interact them with their raw measured variables and the yielded products are then added up yielding a continuous socioeconomic index score which will be used as a control independent variable in the subsequent analysis.

Because of limited time and resources, an appropriate approach for determining the sample size is adopted using the following formula:

$$no= (t)\ 2*(p)\ (q)/\ (d)\ 2=384 \quad (1)$$

A total of 600 respondents participated in the survey online.

4.0 RESULTS AND DISCUSSIONS

Socio-Economic Weighted Index was computed using the structural equation modeling, the mean socioeconomic index for the sample was equal to 51.3 points out of a hundred maximum points, SD= 18.7 points. Table 1 shows the categorized values based on three equal ranges that 43.6% of people in the sample had low socioeconomic and educational status, another 31.8 % of the respondents had intermediate socio-economic and educational status, and the rest of them, 24.1%, had high socioeconomic and educational class.

Table 1 Socio-Economic Classes

Socio-Economic:	Frequency	Percentage
Low	260	43.3
Medium	191	31.8
High	149	24.8

Personal change in travel correlated with people's measured socioeconomic index score, r=0.11, p<0.010, denoting that people with greater socioeconomic educational class tend to perceive a higher personal change in travel habits. Public acceptability and support are slightly affected by socio-demographic characteristics such as income, and education.

A CP awareness scale between 1= Never heard of it to 5= very well aware was used to explain the findings. The overall mean awareness for the sample was 1.84 indicating a low level of public awareness of CP. It is evident from the distribution of the responses that the majority of people (58.3%) had never heard of CP. Only 12.8% were either aware or very well aware. Regarding their awareness of CP in other countries, Table 2 shows that only 22.2% of the respondents reported that they are aware while the vast majority of the respondents (77.8%) were not aware of CP in countries other than Jordan.

Table 2 Respondent Awareness &Attitudes Toward Congestion Pricing. N=600

Are you aware of the congestion pricing systems of other countries	Frequency	Mean (SD)/ Percentage
No	467	77.8
Yes	133	22.2

In an attempt to evaluate the possible impact of implementing the CP system, the respondents were asked to rate on a Likert-like scale (1= no extent, 5= great extent) the extent they perceive that the CP would help them save fuel. The yielded results shown in Table 3 reveal that 7.5% of them believe that CP will lead to no fuel saving, while 12.7% advised that a great extent of fuel reduction could occur. However, the majority of respondents (43%) advised that CP would lead to some extent of fuel reduction.

Table 3 Respondent Citizens' Attitudes Towards Congestion Pricing. N=600

How much fuel do you think congestion pricing will help you save?	Frequency	Percentage
To no extent	45	7.5
To some extent	258	43
To more extent	221	36.8
To great extent	76	12.7

The relative importance index (RII) was used to judge the respondents' attitudes toward the various issues and impacts of the CP. The results are shown in Table 4. It can be seen that the most important issue as perceived by the public was that CP gains revenue for traffic operation and road infrastructure (RII = 82.3%) followed by the belief that it is unfair to the poor (RII = 76.7%). However, the CP's importance in reducing traffic congestion and helping to protect the environment was perceived equally with an RII of 70%.

Perceived benefits and economic revenue of implementing CP were found to have the highest contribution to people's support of the system based on the CFA results denoting that implementing a CP in Amman seems to be more appropriate to emphasize the effectiveness of alleviating traffic congestion, protecting the environment and using revenues gained from CP to improve traffic operation (e.g. public transport system) and road infrastructure based on the majority of respondents.

Table 4 The Relative Importance Index RII (%) of People's Perceptions of the CP

Indicators	RII (%)
Gains revenue for traffic operation and road infrastructure	82.3
Congestion pricing is unfair to the poor	76.7
Helps protect the environment	70.0
Reduces road congestion	69.8
It affects access to workplaces adversely	67.7
It results in changes in travel time to avoid charges	66.4
It limits recreation and shopping preferences	64.7
It could raise carpooling	64.1
It adversely affects the economy and travel ability	59.2
It enhances the use of public transport	56.7

In the same context, when asked to rate their level of support of a congestion tax during all hours on a support rating Likert-like scale (1= Not supportive at all, 5= very supportive) as shown in Table 4 the mean support level to all-hour CP was equal to 2.6 out of 5 on the Likert-like scale, denoting that people's collective opinion was generally between not supportive to undecided, the grouped distribution of their responses showed that the majority of them,73.7%, were unsupportive to all hour CP.

The respondents too were asked to rate their support to CP during only peak hours, and the mean collective support was equal to 3.31 out of 5 points, indicating a reasonable level of support with 55% support as shown in Table 5. A paired-samples t-test was performed and showed that people had significantly greater support to CP during the peak hours compared to their support of all hour CP, $t=13.70$, $p<0.001$, denoting they generally were significantly more inclined to support a peak-hours CP on average.

Table 5 Respondents' Level of Support to Congestion Pricing. N=600

Level of support to congestion pricing during All Hours, mean Likert (1-5 points)	**Frequency**	**2.61 (1.2)**
Not supportive	442	73.7
Supportive	158	26.3
Level of support to congestion pricing during Peak Hours, mean Likert (1-5 points)		**3.31 (1.2)**
Not supportive	269	44.8
Supportive	331	55.2

Evaluating the favorability of CP implementation in Amman produced the results shown in Table 6 where only 47.7% of the respondents were in favor of implementation.

Table 6 Favorability of Congestion Pricing. N=600

Are you in favor of congestion pricing implementation	Frequency	Percentage
No	317	52.9
Yes	283	47.7

A targeted transport problem, such as system effectiveness, for example, can be different in different cities based on many socio-economic and other factors. Because of this, the results of the data analysis carried out in this study were compared with those of similar studies executed in other cities of the world. Two Australian cities of Melbourne and Brisbane, with socio-economic characteristics different from Amman, were selected as the case study for this purpose.

A recent study carried out in these cities by [25], revealed that implementing the CP scheme seems to be more appropriate to emphasize the effectiveness of protecting the environment (by reducing vehicle emissions) rather than reducing congestion. This may be explained by the excellent public transport systems of high ridership in

both cities that effectively manage traffic operations. However, based on the results of this study, implementing CP in Amman city is considered appropriate to emphasize the effectiveness of both reducing congestion and protecting the environment, as the city is lately suffering from significant traffic congestion and an insufficient public transport system. Redistribution of CP revenue is often considered a successful key factor for public acceptance of CP. However, the Australian study of [25] mentioned above showed that revenue redistribution has little impact on respondents' acceptance of CP while the results of our study revealed that it has a great impact on respondents' level of support and acceptance in Amman.

The respondents in both Australian cities were not concerned with congestion pricing's unfairness to the poor. Contrarily in this study, the unfairness of the CP was highly correlated, but negative to an all-hour CP, p=0.025, on average for an additional one unit in people's perception of the unfairness of CP the odds of an agreement to all-hour CP declines by factor equal to (1-0.885) x100= 11.5% times.

Behavioral adaptation (personal travel change) influences the acceptability of CP in Melbourne, Brisbane as well as in Amman. More specifically, the stronger respondents believe that the CP would decrease their travel to the city for shopping or recreation, the less supportive of respondents to it. Similarly, the benefits of implementing the CP in the mentioned cities such as a decrease in fuel consumption for private vehicle users, and a decrease in bus fare for transit users have a significant and positive influence on respondents' level of support in all mentioned cities.

The analysis also shows that the acceptability of CP does not vary significantly across different income groups in both Australian cities. In contrast, in this study a Multivariate Binary Logistic Regression Analysis of the combined and individual association between people's demographic, attitude, and travel characteristics with their odds of supportive opinion to Peak hours CP shows that there was a statistically significant association between people's monthly income and socio-demographic and economic factors (e.g. Income, education, household structure) with their support to the peak-hour CP.

In summary, public acceptability and support are slightly affected by socio-demographic characteristics such as income, and education which agree with what was reported by [18]. Respondents in Melbourne were found to be more supportive of a CP than Brisbane and Amman due to its existing road pricing, CP and tolls. Variations in analysis keep notable evidence of the variation in congestion pricing's support and attitudes (Multivariate is more precise) plus the difference in congestion pricing's acceptability across cities even within the same culture such as in Australia. A comparison between Japanese and British data conducted by [21] revealed that trust in government is linked primarily to belief in absolute values, religious beliefs plus cultural values.

5.0 CONFIRMATORY INTERVIEWS

Experts from various concerned parties including GAM, JTI, MOT, and others were interviewed to explore their opinion and attitudes toward the causes of traffic congestion, the potential application of the CP system in Jordan, and their comments on the results of the survey responses.

The interviewed persons were first asked to identify the main reasons for traffic congestion in Amman and their responses may be summarized as follows:

1) Absence of adequate Mass Transit System. More specifically poor vehicle conditions, poor infrastructure, and insufficient maintenance of the public transport system. Also, lack of the infrastructure of public transport services from the departure centers and stop stations on the routes

2) Absence of parking management system

3) Increase in traffic passing through Amman, especially during summer

4) Increasing car ownership from 58 persons/car in 1986 to 6 persons /car in 2017 with a significant percentage of old vehicles suffer from lack of necessary maintenance. Also, most of the daily trips are done by private cars. Street networks were not able to cope with the rates of increased numbers of vehicles, particularly at intersections

5) Main hospitals and commercial and governmental activities are located in the central part of Amman

6) Poor and unclear vision and policies for urban/regional and land use planning

7) Lack of funding

8) Insufficient experienced specialized traffic personnel

9) Limited modal share (No walking or bicycling)

10) Techniques to control traffic are poor police. In addition, not have enough expertise in traffic management

The interviewed persons also summarized the measures and policy instruments that have been applied to manage traffic congestion in Amman as follows:

1) Infrastructure Investment (Bridges and Tunnels)

2) Increasing the road capacity including new interchanges

3) Traffic signal control to ease traffic movement in congested intersections

4) Traffic control using aircraft

5) Residential commercial plots

6) Restructuring and improving the public transport network (BRT Project and Urban Transport Project: Irbid, Zarqa, Madaba, and Salt

7) Providing more supply, controlling demand, and caring about mobility

8) Walking and cycling programs

9) ICT based route

The interviewed persons highlighted the main challenges of implementing a CP system in Jordan as follows:

1) Legislation challenges

2) Economic and political challenges

3) Side effects of the proposed CP system and people's affordability

4) Lack of awareness

5) The poor conditions of the existing public transport

6) Few available alternative routes

In addition, the interviewees mentioned that the success of implementing the CP policy depends on the willingness of the citizens to substitute travel by private car for travel by public transport, and this is obvious when 55% support implementing CP. However, the interviewed experts mentioned that CP must be linked to several policies to be an applicable, successful, and effective strategy such as improved public transport, good parking management, and time management in different services.

Regarding the implementation time frame, a study conducted by [25], showed details of the suggested time framework that can be followed in case of introducing the CP scheme. The introduction timeline comprises four phases namely: Feasibility study, functional design, technical design, and communication plan. It is believed that the time required for planning from the feasibility study to the operating system is about 3.5 years with a similar time for implementation.

The interviewee showed different views regarding the time required for introducing the CP scheme. However, it seems that at least a 3.5 years' time framework may be adopted. Those who objected to this time frame were convinced by the long time required for issuing a new CP legislation and developing an acceptable level of public awareness of the system's concept, importance, and benefits.

The interviewed experts stated that all revenue that would be collected from the CP must be spent on improving alternative transport options and that the revenue may be distributed to the following areas:

- Improve public transport (Bus network improvements)
- Road & bridge maintenance and upgrades
- Road safety
- Walking & cycling programs
- Go directly to people by funding and supporting humanitarian areas as King Hussain Cancer Center.

While price levels might be changed, it is of utmost importance that the implemented CP scheme be evaluated periodically every say five years using an agreed assessment criterion., but implementation should last until noticed improvements and effective strategies in the transport system occur leading to positive driving culture changes to appear (e.g. behavioral/personal changes, increase in acceptability and support of CP.

Wholesalers Interviews

Similar interviews by the experts were conducted with five wholesalers in the private sector, specifically, in Sahab industrial city to find out their opinion and attitudes towards traffic congestion, its impacts, and the potential application of the CP system in Jordan. At the end of the matter, all of them agreed and support implementing CP only during peak periods and not throughout the whole day.

The feedback from the interviews with the participants may be summarized as follows:

(A) In 2016 about 20% losses in the total ordered deliveries occurred were considered high, and reported that traffic congestion was not the only cause for these losses. To deal with this situation the company resorted to use small vans to enter congested areas. Moreover, they started using a tracking system to choose the least congested route.

(B) Traffic congestion negatively affects the employee's attitude and productivity when stuck in a traffic jam. To solve this problem, they have a fair work system based on the served areas (by organizing work among each other with employee living in a very congested area would not work the day after.

As a result of the above measures the reported losses dropped to only 5% in 2018. However, the company supports implementing this scheme only during peak periods.

(C) Implementing CP may make them raise the prices which will negatively affect the number of customers; meetings will be set regardless of implementation, working at home is not valid because the nature of work needs availability at the company.

(D) They suffer from traffic congestion, especially during the fasting month of Ramadan and the time of 2-5 p.m.

(E) Implementing CP will reduce the time consumed in a traffic jam as a result the number of deliveries would increase.

Knowing what factors encourage or discourage public acceptance can help in designing and implementing more effective congestion pricing scenarios [26]. The main management and planning considerations for the recommended CP System may be summarized as follows:

- Strategic and management plans need to be taken and carefully followed to avoid transfer of traffic

problems elsewhere such as to another time of day or another location. In addition, technological issues to implementing a pricing system must be considered (e.g., GPS, GSM, and ANPR).

- It is necessary to involve the public at an early stage to increase their awareness of congestion and CP as a solution. It is also necessary to allocate a customer service center so that people can enquire on system functionality and payment histories.

- A trial period is key to public support and successful long-term implementation which allows them to see the benefits of this scheme to their daily lives. So, they may sway their opinion in favor of the road pricing scheme. A 6-month trial period is suggested for implementing the CP scheme in Amman/Jordan and the revenue raised should be used in efficiently for the public.

- Charges for different periods are needed to be announced and published. According to the yielded results from the data survey: One Jordan Dinar/trip is considered a fair price for the top perceived congested days of the week, which are Sundays and Thursdays, and may be applied for the hours between 07:30 am to 08:30 am, 1:30 pm to 4:30 pm, and 5:00 pm to 5:30 pm. In comparison to [19], the proposed pricing strategy is 1 JD for the hours of 06:00 am to 9:00 am, and 3:00 pm to 06:00 pm but 0.5 JD for the hours of 06:00 pm to 09:00 pm.

- Exemptions and reduced charges are recommended to be applied to specific groups such as people with disabilities or low income, residents living within or very close to the congestion zone/priced road, emergency vehicles, and carpooling.

- CP signs are necessary to be held on roads approaching, within, and leaving the charge zone. In addition, cameras operating in the zone needs to be placed at strategic points.

- CP remains a political minefield and there is a need to win political and public support. The different use of revenues affect political and public acceptance. For example, a significant portion of the raised revenue could be allocated to improve public transport and traffic operations and road maintenance.

- Following the implementation of the rapid transit bus in Jordan, this path could be an effective path to use as a congestion pricing road, doubling the performance of the rapid transit bus.

- It is recommended to carry out a feasibility study in order to identify the most applicable, appropriate, and effective CP scheme to be implemented in Amman, with the challenges and barriers that it might face, and set guidelines to overcome these barriers. A study conducted by [3] highlights the most frequent questions necessary to be followed either for Amman or any country that needs to implement the CP system.

6.0 CONCLUSIONS

This study investigates the attitudes of both the general public, including selected firms, and the experts of Jordan towards Congestion Pricing (CP) using a combination of qualitative and quantitative methodologies. The results of the data analysis revealed that the majority of people (58.3%) had never heard of CP and that the majority (77.8%) were not aware of CP in countries other than Jordan, this result corresponds with a study conducted by [19]. The most important issue as perceived by the public was that CP gains revenue for traffic operation and road infrastructure (RII = 82.3%) followed by the belief that it is unfair to the poor (RII = 76.7%). The results indicated a reasonable level of support with 55% of the respondents supporting the CP implementation only during peak hours while only (26.3%) of them support its implementation during all hours of the day.

The identified main causes of traffic congestion in Amman, the capital of Jordan included the absence of an adequate Mass Transit System and parking management system, increased car ownership and through traffic especially during summer, poor and unclear vision and policies for urban/regional and land use for planning and lack of funding.

Measures that are considered to mitigate congestion were reported to include Infrastructure Investment (Bridges and Tunnels), increasing the road capacity by including new interchanges, traffic signal control to ease traffic movement on congested intersections, traffic control using aircraft and restructuring and improving the public

transport network.

For the wholesalers, they consider congestion the main contributor to about 20% losses in the total ordered deliveries occurred in 2016. They also consider traffic congestion to negatively affect the employee's attitude and productivity when getting stuck in a traffic jam, and this result agreed with [25] and [27]. Implementing CP may make them raise the prices but will reduce the time trapped in a traffic jam as a result of the increasing number of deliveries. Implementation of CP might not damage the wholesaler's own business or harm their economic competitiveness. They are likely to benefit from the introduction of a CP system. Moreover, companies already have strategies to cope with the congestion problem (e.g. tracking system, fairness work system) since their main goal concentrates on achieving customer satisfaction according to the interviewed wholesalers.

Based on the results of this study, implementing CP in Amman city in Jordan is considered appropriate to emphasize the effectiveness of both reducing congestion and protecting the environment, as the city is lately suffering from significant traffic congestion and an insufficient public transport system, those benefits were highlighted by [9], [25], [28]. The CP system is complex thus influencing its public acceptance and support. However, there is no such a system as perfect and selecting the best scheme is regarded as a trial-and-error process. Introducing a successful CP must be directly linked to several aspects such as improving public transport, parking management, and time management of various services. It is important to mention that after implementing the rapid transit bus in Jordan, this path could be an effective path to use as a congestion pricing road so it can double the outcome of the rapid transit bus and solve a great portion of the congestion traffic problem.

The findings reported in this study also shed light on some related issues that were beyond the scope of this work and are recommended for future research in any country that has the intention to implement the CP, such as evaluating the initial investment of the CP and operating cost that would help in identifying the proposed charge, measuring and gaining politician's support of the CP, carrying out a study to accurately identify the most congested day and highest congested hours to determine the impact of Congestion Pricing on Housing Prices, and noteworthy to mention it is to repeat the study after 5 years with a larger sample size to investigate the people's perception in acceptability, support, and attitudes towards the CP system.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgement

The authors wish to acknowledge the respondents for supporting this work.

References

[1] Levinson, D., Marion, B., Owen, A., & Cui, M. (2017). The City is flatter: Changing patterns of job and labor access. Cities, 60, 124–138.

[2] Qin, X., Ke, J., Wang, X., Tang, Y., & Yang, H. (2022). Demand management for smart transportation: A review. Multimodal Transportation, 1(4), 100038.

[3] Al- Mawajdeh, G. (2018). Urban Traffic Demand Management through Congestion Pricing (CP). University of Jordan, Amman, Jordan.

[4] Jadaan, K., Abudayyeh, D., & Msallam, M. (2013). Behavioural Responses to Road Pricing in Jordan. Engineering Science and Technology: An International Journal (ESTIJ), 3(3), 505–509.

[5] De Palma, A., & Lindsey, R. (2011). Traffic congestion pricing methodologies and technologies. Transportation Research Part C: Emerging Technologies, 19(6), 1377–1399.

[6] Santos, G. (2005). Urban congestion charging: a comparison between London and Singapore. Transport Reviews, 25(5), 511–534.

[7] Conway, A., & Walton, C. M. (2009). Policy options for truck user charging. Transportation research record, 2115(1), 75–83.

[8] Selmoune, A., Cheng, Q., Wang, L., & Liu, Z. (2020). Influencing factors in congestion pricing acceptability: a literature review. Journal of Advanced Transportation, 2020.

[9] Short, J. R. (2018). Are traffic-clogged US cities ready for congestion pricing? UMBC Faculty Collection.

[10] Börjesson, M., & Kristoffersson, I. (2015). The Gothenburg congestion charge. Effects, design and politics. Transportation Research Part A: Policy and Practice, 75, 134–146.

[11] Percoco, M. (2013). Is road pricing effective in abating pollution? Evidence from Milan. Transportation Research Part D: Transport and Environment, 25, 112–118.
[12] Federal Highway Administration (FHWA). (2017). Congestion Pricing A Primer.
[13] Wilson, S. (2018). Review of international road pricing initiatives, previous reports and technologies for demand management purposes, Ministry of Transport.
[14] Fageda, X., Flores-Fillol, R., & Theilen, B. (2022). Price versus quantity measures to deal with pollution and congestion in urban areas: A political economy approach. Journal of Environmental Economics and Management, 115, 102719.
[15] Tretvik, T. (2003). Urban road pricing in Norway: Public acceptability and travel behaviour. In Acceptability of transport pricing strategies (pp. 77–92). Emerald Group Publishing Limited.
[16] Regan, A. (2000). What Can a Trucker Do? ACCESS Magazine, 1(17), 20–25.
[17] Msallam, M. (2016). Public perceiveness and potential implementation of road pricing in jordan. https://doi.org/10.5281/zenodo.54671
[18] Hamilton, C. J. (2011). Popular Acceptance of Congestion Charging. Transport Policy, 18(6), 836–847.
[19] Shatanawi, M., Abdelkhalek, F., & Mészáros, F. (2020). Urban congestion charging acceptability: An international comparative study. Sustainability, 12(12), 5044.
[20] Wang, Y., Wang, Y., Xie, L., & Zhou, H. (2018). Impact of Perceived Uncertainty on Public Acceptability of Congestion Charging: An Empirical Study in China. Sustainability, 11, 129. https://doi.org/10.3390/su11010129
[21] Schmöcker, J.-D., Pettersson, P., & Fujii, S. (2012). Comparative Analysis of Proximal and Distal Determinants for the Acceptance of Coercive Charging Policies in the UK and Japan. International Journal of Sustainable Transportation, 6, 156–173. https://doi.org/10.1080/15568318.2011.570856
[22] Holt, G. (2013). Asking questions, analysing answers: Relative importance revisited. Construction Innovation, 14. https://doi.org/10.1108/CI-06-2012-0035
[23] Hossen, M. M., Kang, S., & Kim, J. (2015). Construction schedule delay risk assessment by using combined AHP-RII methodology for an international NPP project. Nuclear Engineering and Technology, 24. https://doi.org/10.1016/j.net.2014.12.019
[24] Brown, T. ., & Moore, M. . (2012). Confirmatory Factor Analysis, Handbook of Structural Equation Modeling, 361–379.
[25] Zheng, Z., Liu, Z., Liu, C., & Shiwakoti, N. (2014). Understanding public response to a congestion charge: A random-effects ordered logit approach. Transportation Research Part A Policy and Practice, 70. https://doi.org/10.1016/j.tra.2014.10.016
[26] Abulibdeh, A. (2022). Planning for congestion pricing policies in the middle east: public acceptability and revenue distribution. Transportation Letters, 14(3), 282–297.
[27] Börjesson, M., Eliasson, J., & Hamilton, C. (2016). Why experience changes attitudes to congestion pricing: The case of Gothenburg. Transportation Research Part A: Policy and Practice, 85, 1–16. https://doi.org/https://doi.org/10.1016/j.tra.2015.12.002
[28] Vanoutrive, T., & Zijlstra, T. (2018). Who has the right to travel during peak hours? On congestion pricing and 'desirable' travellers. Transport Policy, 63, 98–107. https://doi.org/https://doi.org/10.1016/j.tranpol.2017.12.020