Perspectives of travel strategies in light of the new metro and bus networks in Riyadh City, Saudi Arabia

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In an effort to reduce traffic congestion and excess dependency on private vehicles in Riyadh City, authorities are considering introducing public transport infrastructure and enforcement policies. This study was conducted to evaluate whether the current Riyadh City transport policy measures are adequate to encourage public transport ridership and identify relevant transport policy measures to encourage a shift from use of private cars to public transport. A series of semi-structured interviews were conducted in Riyadh during June and July 2015. Seventeen study participants were selected to represent local stakeholders including transport experts and representatives of Riyadh City authorities. It was found that existing transport policy measures involve conventional approaches e.g. increasing road infrastructure to match growth in private vehicle ownership. There is, however, considerable support for reshaping the existing Travel Demand Management policies and measures along with introducing a public transport system. Improving infrastructure to enhance accessibility to and from transit stations, selecting appropriate Transit-Oriented Development sites, parking charges, separate carriages for families, and promoting the safety of public transport facilities are perceived as the most effective strategies.

Keywords: Riyadh City, transport policy measures, Riyadh public transport

1. Introduction

The significant growth of urban areas over the last four decades has caused enormous challenges such as denser use of space and motorisation (Global Mass Transit Report 2011; Aljoufie 2014). It is expected from past experience of development in different cities that travel demand will increase at a similar rate to city density (Javid et al. 2013). Sperling and Gordon (2009) state that the one billion cars driven currently on the earth are expected to double worldwide over the next two decades.

Despite the fact that the car is the preferred mode of transport for many reasons, the recent increase in car numbers has caused serious problems. Pollution, congestion and road accidents are major consequences of heavy traffic (World Health Organization 2004). Many studies comment that the annual increase in private car ownership is a threat to the human environment (Gärling and Schuitema 2007; Bamberg et al. 2011). Mathers and Loncar (2006) projected that deaths caused by traffic accidents would be the second highest cause of death for men by 2030. According to the World Health Organization (2013, 2009) annually road crashes cause more than 1.3 million deaths and many more individuals all over the world are permanently disabled.

Cities within the Kingdom of Saudi Arabia (KSA) in general and the capital city of Riyadh in particular, have witnessed a significant growth in urban development (Mubarak 2004). The latter has been accompanied with a high reliance on private cars, thus causing problems such as congestion costing the city almost $21 billion and other economic, social and environmental impacts (Ar Riyadh Development Authority (ADA) 2015). Moreover, fatal car accident rates are the highest in the world at an average of 4.4 deaths for every 1000 persons, resulting in losses of $3.6 billion each year (General Department of Traffic 2015; Global Mass Transit Report 2011). Pollution levels are over three times higher than the country's air quality limits (Alharbi, Shareef, and Husain

2015). According to Al-Fouzan (2012) and ADA (2014), the lack of effective public transport in Riyadh City is a result of very low car operating costs affordable to many of Riyadh's inhabitants, thus leading to excessive car use and congestion. The latter has also had an impact on public transport operation performance in the absence of bus lanes.

Against this background, authorities in Riyadh City have commissioned the construction of a public transport system comprising a network of six metro lines linked with a bus network in an effort to reduce car dependency and integrate the majority of the city's districts. The full project is expected to be operational by 2018 (ADA 2015).

The primary objective of this study is to investigate whether the existing Travel Demand Management (TDM) strategies are adequate to encourage public transport use in Riyadh City. The second objective is to identify the potential effectiveness, acceptability and applicability of a set of proposed transport policy measures that could influence people to use public transport. To fulfil these objectives, insights from local stakeholders, including transport experts and representatives of Riyadh City authorities, were elicited through semi-structured interviews.

2. Public transport and travel demand management: an overview

The introduction and implementation of TDM strategies and measures are seen as a challenge many cities face around the world, especially in developing countries (Javid et al. 2013). Beirão and Cabral (2007) found that competitive public transport systems and transport policy measures aimed to increase public transport usage are essential for sustainable public transport operation. The key concept of TDM is to influence people's travel behaviour to restrain private vehicle use and encourage the use of other transport means such as public transport and as a result improve environmental conditions, safety and revenue generation (Ison and Rye 2008; Grieco, Sammer, and Saleh 2012). Steg and

Tertoolen (1999) and Gärling and Schuitema (2007) identify four types of TDM measures that target different antecedents of travel demand, based on several postulations of how behavioural changes may be drawn out: (1) physical change measures, (2) legal policies, (3) economic policies, and (4) information and education measures.

TDM measures can also be classified into 'hard' and 'soft' policy measures (Richter, Friman, and Gärling 2009). Hard transport policy measures refer to the older branch of TDM strategies that include physical changes to improve a city's accessibility and pricing of car use (Grieco, Sammer, and Saleh 2012). On the other hand, soft TDM measures relate to altering car users' travel behaviour on a voluntary basis and motivating them to switch onto sustainable travel modes by, for example, implementing personalised travel plans and public transport marketing campaigns (Möser and Bamberg 2008; Richter, Friman, and Gärling 2009; Bamberg et al. 2011). Taylor (2007, 173) notes that 'soft transport policy measures generally offer more of the "carrot" whereas in "hard" TDM measures the stick is perceived as more dominant'.

Beirão and Cabral (2007) argue that in order to encourage a shift from private cars to public transport, it is important that the reasons behind patterns of travel behaviour are understood. The car is usually the most preferred method of transport, because of its convenience, speed, comfort and individual freedom (Redshaw 2012). These factors determine that public transport service should be adjusted to meet the requirements of travellers in order to become more attractive (Redman et al. 2013). Improved quality of service is one important factor that users of travel services demand (Prioni and Hensher 2000). The authors add that the relevant attributes relating to the service quality factor, as perceived by current and future transport users, should be clearly determined. A systematic review by Redman et al. (2013) found that public transport would attract car users if it offers over and above the basic level of attributes already offered by their cars,

such as level of accessibility, reliability and competitive cost. The study concludes that it is important for policymakers and public transport suppliers to understand the targeted car users' perceptions of the quality of attributes and underlying motivations, then plan how these can be best achieved by implementing public transport improvements.

Along this line, Ison (2000) concludes that travellers would prefer TDM strategies such as the reliability of public transport and low fares. Hensher, Stopher, and Bullock (2003) reported that travel time and level of fares have a major negative impact upon levels of consumer satisfaction. Also, Perone and Volinski (2003) found a 75% increase in public transport ridership as a result of offering free public transport tickets in Austin, Texas, USA. Results from an experimental simulation study by Eriksson et al. (2010) showed that attributes such as shorter journey times and more accessible public transport services led to more switching from car to public transport use. The study highlighted that trade-offs between pricing car use and improvement of public transport are needed to attract more public transport users. Finally, Loader and Stanley (2009) found that improved accessibility by extending public transport routes and service time in Melbourne, Australia led to high growth in public transport ridership.

Other attributes, such as availability of information for alternatives to car travel (Brög, Erl, and Mense 2002), frequency, comfort, and safety (Friman, Edvardsson, and Gärling 2001; Delbosc and Currie 2012) are also valued highly by travellers and regarded as important factors within their satisfaction ratings. For example, studies by Ison (2000) and Dell'Olio, Ibeas, and Cecin (2011) examined the effectiveness of the quality and efficiency of public transport services in increasing the number of users. Their analysis showed that increase of public transport frequency, cleanliness and comfort were the most effective and acceptable strategies among the current and not current users of public transport.

Hard transport policies such as congestion charging and road pricing result in public dissatisfaction, especially at their commencement, when they have been implemented across several countries worldwide (Börjesson et al. 2012). For example, the United Kingdom, the United States, Singapore, and Sweden have implemented pricing policies to improve mobility and reduce negative environmental impacts. In an effort to improve traffic efficiency and environmental quality in Stockholm, the national government in Sweden introduced a congestion charge trial in 2006 (Eliasson et al. 2009). An analysis of the monitoring reports during and after the completed charge trial revealed that the scheme decreased the number of cars entering the zone by 22%, resulting in a 6% increase in public transport ridership, improvement in congestion levels, more parking spaces and low pollution (Eliasson et al. 2009). Five years after the introduction of congestion charging in Stockholm, Börjesson et al. (2012) concluded that the substantial traffic reductions during the trial period were not at the same level over time. Increase in traffic could have been caused by the exemption of alternative fuel vehicles that was introduced in 2008. In London, measurable reductions in traffic and congestion after the introduction of the London Congestion Charge benefited public transport (Ison and Rye 2005; Banister 2008). Interestingly, a survey by Fiorio and Percoco (2007) in Trento, Italy, measured car users' willingness to switch to public transport and found that pricing car use had more influence on travellers than improving public transport speed.

In order to achieve desirable results in changing people's travel behaviour, careful consideration is required of issues around TDM strategies and their acceptability upon their implementation (for example, Eriksson, Garvill, and Nordlund 2008; Ison and Wall 2002; Steg 2007; Rye and Ison 2012). Gärling and Schuitema (2007) argue that hard policy measures such as increasing fuel tax would essentially contribute to solving travel problems in urban areas, but sometimes it would face public opposition and political

infeasibility. Banister (2008, 76) asserts 'public acceptability drives political acceptability, and it is only when there is sufficient public support for change, that action will take place'. Also, Gärling and Schuitema (2007) argue that the influence of pricing measures for making cars less attractive is affected by people's socioeconomic status.

Eriksson, Garvill, and Nordlund (2008) maintain that the low level of public acceptability of TDM strategies would affect the implementation and effectiveness of strategies. Steg and Schuitema (2007) and Eriksson, Garvill, and Nordlund (2008) highlighted the distinction between soft and hard measures' attributes for acceptability. Soft measures targeting efficiency such as improvements in public transport service are perceived to be effective, fair and acceptable. On the other hand, hard transport policy measures target curtailment such as pricing road use, thus have negative individual consequences and limit people's freedom of choice. Kottenhoff and Freij (2009) suggested that public transport improvements would increase the public acceptability of hard strategies such as placing a charge on the use of roads and cars. For example, in Lyon, France, public resistance forced the local authority to reduce the toll charge and limit the scheme zone (Schuitema, Steg, and Forward 2010). Jaensirisak, Wardman, and May (2005) argue that changing policy design features such as limiting charges in the central area or peak periods would influence public acceptability. A field experiment conducted in Stockholm by Schuitema, Steg, and Forward (2010) before and after implementing a trial period of congestion charges examined how the positive consequences of the scheme would affect people's beliefs. The study noticed an increase in the scheme acceptability among the respondents as a result of their experiences for reasonable increases in travel costs, reduced levels of congestion and decreased parking problems.

Overall, ‘carrot’ and ‘stick’ approaches that combine ‘hard’ and ‘soft’ TDM polices and measures are the way forward in reducing car use without facing strong public and political opposition (Gärling and Schuitema 2007; Thorpe, Hills, and Jaensirisak 2000). The report by the MIRO project showed that public transport improvements were the most popular transport policy measures, while the least popular was congestion charging (Schlag and Teubel 1997). The authors add that information provision is very important for people to accept TDM strategies; for example, by raising awareness of the planned strategies, cost, aims, and how these strategies would be implemented in practice. Against this background, a study by Rahman and Al-Ahmadi (2010) suggested that emphasising TDM strategies in Saudi Arabia for sustainable transport and understanding the unique socioeconomic and religious features are essential in order to select appropriate TDM strategies for the country. Therefore, this study builds upon this assertion and aims at better understanding of the potential for public transport as well as how TDM strategies may work in synergy in achieving higher acceptance levels of the upcoming public transport system in the city of Riyadh.

3. Methods

3.1 Background on study area

The geographical focus of this study is the city of Riyadh, the capital of Saudi Arabia. The population of the city grew from approximately 100,000 people in the early 1950s to 6,125,180 people in 2015 (ADA 2015). A total of 43.3% of the population are females, 37.3% are expatriates, and the population density is 2,379 inhabitants per square kilometre (ADA 2015). The 40-mile span of Riyadh includes 13 municipalities that accommodate 209 districts (Alqahtany 2014).

Riyadh is a car-dominated city. Between 1996 and 2008, private vehicle ownership has increased by 185.9% which accommodates about 85% of 8 million daily trips, whereas just 2% of the trips are undertaken by buses (Alqahtani, Al-Badi, and Mayhew 2012; Al-Fouzan 2012). The vast majority of Riyadh society have never used public transport and have built their way of life around their cars (Alqahtani, Al-Badi, and Mayhew 2012; Al-Dubikhi 2007). Al-Fouzan (2012) reports that, the lifestyle of Saudi families has been shaped by economic factors and urbanisation including higher family income and spreading of the cities. It is important to highlight that under the traffic and road regulations, women are banned from driving (Al-Dubikhi 2007). Also, individuals under the age of 18 years are not allowed to drive; this segment represents 50% of Riyadh's population and the majority of expatriates are not allowed to own cars. As a result, 70% of Riyadh's population are non-drivers (Al-Dubikhi 2007). All these three segments of the city's society heavily rely on privately owned hire cars with a chauffeur or taxis to meet their daily transport needs (Aldalbahi and Walker 2015).

The current public transport system in Riyadh City involves buses run by the Saudi Public Transport Company (SAPTCO) and privately owned 25-seat minibuses (Al-Fouzan 2012). SAPTCO started operation in 1979 with the aim to provide high-level bus services locally and across countries such as Jordan, Syria, Turkey and the Arab Gulf countries. Soon after its establishment, SAPTCO faced intense competition from privately owned minibus operators (AlGadhi 1994). Between 1982 and 1992, SAPTCOS's annual ridership and coverage decreased from 35 million passengers and 22 routes down to 6.1 million passengers and only 13 routes, respectively. Its market share in 1992 was 47% with the remaining proportion serviced by privately owned minibuses. Less than 9% of SAPTCO's users were women, while it is worth noting that private minibuses do not allow women on board (AlGadhi 1994; Al-Fouzan 2012). As a result,

the shortage in passenger numbers forced SAPTCO to decrease the number of intercity routes and limit the service to high-demand routes using private minibuses. As a consequence, many areas lost public transport service. Most importantly, subsidies of SAPTCO services were terminated in 1992, and the lack of coordination between SAPTCO and private minibus operators led to an overall decline of public transport in Riyadh, which has finally emerged as a travel option only for blue-collar non-Saudi workers (Al-Fouzan 2012). Currently, SAPTCO and some 30-year-old private minibuses provide irregular, limited coverage and poor-quality public transport services (Al-Fouzan 2012; Alqahtani, Al-Badi, and Mayhew 2012).

As shown in Figure 1, the Riyadh metro that is currently under development will be the backbone of the city's public transport with six lines at a total length of 178 km and 85 metro stations integrated with 1200 km bus networks. The entire project will be operational by 2018. The Riyadh public transport is fully financed by the Saudi Public Investment Fund (ADA 2015). The project operation and service improvement will be handled in cooperation between ADA and the High Commission of Public Transport.

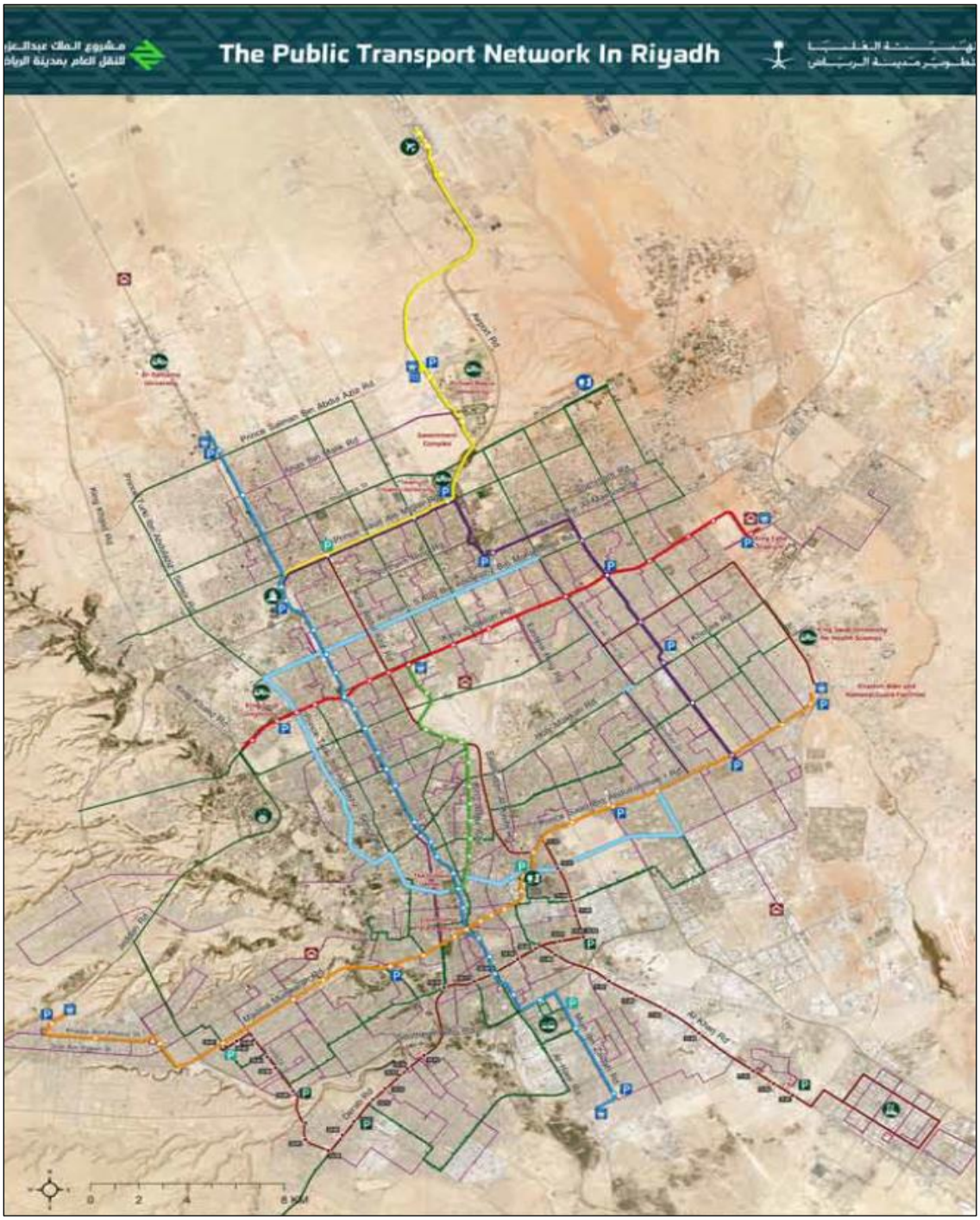

Figure 1. The public transport network in Riyadh City (Source: ADA 2015)

3.2 Recruitment of participants

As shown in Table 1, participants in this study were individuals engaged in public transport projects and sustainable development for Riyadh City across five authorities:

1) The Ar Riyadh Development Authority (ADA): ADA is the responsible authority for Riyadh City strategic urban planning, implementation of special interest development programmes, urban management and operation, conducting basic studies of the city, and implementation of construction projects for various destinations in the city (ADA 2015).
2) The High Commission of Public Transport (HCPT): The HCPT organisation was established in 2012 to regulate and supervise public passenger and transport services within cities and between cities in Saudi Arabia.
3) The General Administration for Traffic (GAT): The main authority responsible for application of traffic systems in cities across Saudi Arabia, traffic control, policing of accidents for all types of vehicles, annual reports of mobility in cities and car ownership, and issuing driving licences.
4) King Saud University (KSU): KSU is the main university in Riyadh City providing education, consultation services and research for other sectors in the country.
5) Tatweer Educational Transport Services Company (TTC): TTC is currently handling part of both male and female education transport services, and aims to develop and improve the educational transport sector, and enable integration with public transport.

Copies of the interview documents were distributed to participants prior to the interviews via email or in hardcopies. Seventeen face-to-face semi-structured interviews were

conducted in Riyadh City, during June and July 2015. The majority of interviewees were from ADA because it is the lead authority for regulating, planning, designing, and implementing public transport policies and infrastructure in Riyadh in collaboration with other authorities. On average, each interview lasted 45 minutes, and all interview conversations were recorded with the permission of the interviewees.

Table 1. Number and position of participants across Riyadh's authorities

Authority	Current position	Number
Ar Riyadh Development Authority	Director of Transport Planning	1
	Director of Design and Urban planning	1
	Consultant for the Ar Riyadh metro project	1
	Director of Transport Economics	1
	Director of the Transport Unit	1
	Advisor for Riyadh's public transport	1
	Director of the Design Department	1
	Engineers in the Transport and Planning Department	3
The High Commission of Public Transport	Director of the High Commission of Public Transport	1
The General Administration for Traffic	General Director in the Department of Traffic in Saudi Arabia	1
	Director of the Traffic Safety Department	1
Educational Transport Services Company	Chief Executive Officer	1
King Saud University	University academics engaged in transport research	3

3.3 Interview protocol

The interviews were organised into two sections. As shown in Table 2, the first section aimed to address the first research objective by eliciting expert views on the existing TDM strategies and the possibility of reshaping these to accommodate public transport. The participants were also asked to what extent they would support or oppose the introduction of public transport services and new transport policy measures in Riyadh City. They were asked to express their views about possible acceptance of public transport use among Riyadh's society and any expected barriers. Finally, they were asked to indicate what

priority should be given across five themes, namely, planning and physical changes, legal, economic, social and cultural, and information and technology, in reshaping the current TDM policies and measures to encourage public transport use in Riyadh City (see Figure 2 and question 5 in Table 2).

The second section was designed to address the second research objective, namely, to identify the potential effectiveness, acceptability and applicability of a set of proposed transport policy measures that could influence people to use public transport. Interviewees were asked to comment on the appropriateness of proposed transport policy measures of such TDM strategies in Riyadh City (Table 3). These transport policy measures were organised under the same five key themes as indicated in Figure 2. In this section, interviewees were asked about the potential effectiveness of these initiatives in changing travel behaviour, the expected level of acceptability by the general public and the level of applicability in local contexts. Tables 2 and 3 present a summary of the interview questions and their purposes.

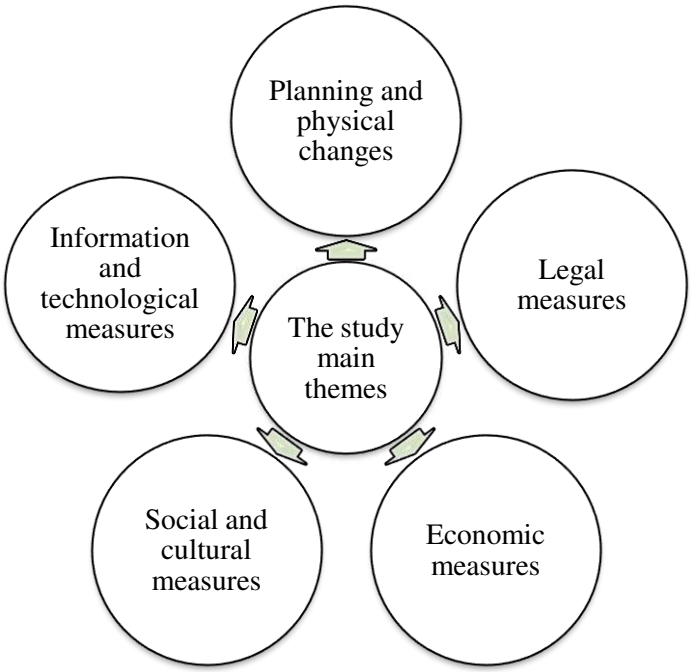

Figure 2. The study main themes

Table 2. Semi-structured interview protocol, section 1

Question	Purpose	Contents
Opening	Provide interviewee details for the study question, aims, objectives, and ask for permission to record the conversation	Cover letter/Introduction to the Interview
1	To investigate the current status of Riyadh transport policy measures and whether they are adequate to encourage public transport use	Do you think, on the whole, the current status of Riyadh TDM policies and measures are adequate for encouraging public transport ridership? And why?
2	Measure experts' opinions for the necessity of introducing public transport services in Riyadh City	In your view, to what extent do you agree or disagree with introducing public transport services in Riyadh City now? And why?
3	Measure the extent to which Riyadh society are ready to use public transport. Question whether there are barriers for such use	Is our society ready for a wide use of public transport? If no what are the barriers?
4	Measure experts' opinions for the necessity of implementing TDM policies and measures to change Riyadh residents' travel behaviour	How much do you favour implementing TDM policies and measures to change Riyadh residents' travel behaviour?
5	Measure the level of priority of the main themes for reshaping TDM strategies	What priority should be given to the planning and physical changes, legal, economic, social and cultural, and information and technology themes in reshaping TDM policies in Riyadh City?

Table 3. Semi-structured interview protocol, section 2

Question	Themes	Related transport policy measures of TDM policies and measures
6	Planning and physical changes	• Improvement of infrastructure for walking such as open space between buildings • Park and ride schemes • Transit stations/stops located centrally within acceptable walking distances • Limit supply of road space in key locations • More space to park in station car parks • Dedicated bus lanes • The luxury metro stations
7	Legal	• Banning car traffic in crowded areas • Operating and monitoring parking areas • Increase enforcement in urban areas • Updating the rules for issuing new driving licences • Limit supply of parking
8	Economic	• Taxing fuel • Taxing road • Parking pricing • Congestion charge in crowded areas • Lowering public transport cost • Reduce cost of tickets for family, students, special needs, and seniors

9	Social and education	• Awareness of the environmental impacts of using private car • Separate family carriages • Promote the safety of public transport facilities such as on board and stations • Comfort seats and cleanliness • Frequency of public transport service • On-board facilities and luxury services • Station facilities such as utilities offices • Encourage public school commuters • School programmes to encourage public transport use • Safe and pedestrian-friendly surroundings for all public transport stations
10	Information and Technology	• Public information campaigns • Compulsory environmental awareness training during driving education • On-board facilities such as Wi-Fi, TV Screens and newspapers • Mobile tickets app • Provide up-to-date information on public transport options, including timetables • Provide written directions for reaching sites by public transport to students, visitors, and staff • Provide personalised journey plans especially for employees

3.4 Data analysis

All the interviews were recorded and the obtained data were transcribed verbatim. During the transcription, the data were documented according to the study questions and themes. Thus, the study themes were considered as the main categories for analysis. All themes were located within the range between high priority and not at all a priority. In section two, the proposed examples of TDM measures related to each category were evaluated based on their importance for changing people's travel behaviour in Riyadh City. They were given a range between highly effective and not at all effective.

NVivo 9 qualitative software was used to analyse the data. The aim of the analysis presented in the following section is to elicit whether there is any significant statistical difference in the responses of transport experts and representatives of Riyadh City authorities.

In order to more fully describe the study results, some studies such as Sandelowski (2001) and Cauwenberg et al. (2012), suggested quantitizing qualitative data to be

presented numerically in score or scale when respondents are discussing a certain factor. We adopted mapping of responses based on Simons et al. (2013), thus based on the study questions design and themes, in interpreting the study results, 'all interviewees, respondents or the study sample' means there was full agreement or similar belief among the entire sample. More than 75% agreement is called 'the majority', between 75% and 50% is called 'a lot of or many', 'some' is between 50% and 25%, and less than 25% is called 'few'. The meaning qualitative researchers seek depends, in part, on number, just as number depends on meaning.

4. Results

4.1 Section one: current status of travel in Riyadh City

The first section of the qualitative data was analysed based on the order of the questions presented in Table 2.

4.1.1 Existing transport policy measures in Riyadh City

All respondents thought that currently there are no direct transport policy measures to promote use of public transport because currently there is no effective public transport system. An ADA interviewee stated that: 'Current travel management policies involve just conventional transport strategies, e.g. increasing road infrastructure to match the growth of private vehicle ownership'. Another respondent from ADA felt that: 'The only current traffic system is for the regulation of traffic and parking on streets'. In general, interviewees felt that due to poor services provided by the existing buses of SAPTCO and private minibuses, the existing TDM measures have ignored public transport.

4.1.2 The necessity for introducing public transport in Riyadh City

Respondents were asked to present their views about public transport in Riyadh City with three options, namely: not necessary, a welcome change and high priority. There was a strong agreement across all interviewees indicating a high priority for introducing public transport. A lot of respondents said that the high reliance on the private car and absence of effective public transport in Riyadh City reduced mobility and increased the detrimental environmental impacts. They added that public transport is the best solution to alleviate the current trend of travel delays, pollution, fatal car accidents and improving the daily mobility of all segments of society. One interviewee from KSU argued: 'No city of the size of Riyadh with a population of nearly 6 million would be sustained with a road transport network alone. It has to be supplemented by public transport'.

4.1.3 Riyadh society's willingness to use public transport

The majority of respondents felt that Riyadh's society is partly ready for public transport use. And they illustrated that people who have no access to private cars would be more likely to use public transport, including expatriates, women, students, and the elderly. They asserted that the majority of expatriates have been accustomed to using public transport prior to coming to Riyadh. Therefore, interviewees thought expatriates would be more prepared to use public transport than others, especially at the commencement of public transport service. In Saudi Arabia, as women are not allowed to drive, and the rules are against women being alone with unrelated men, even a taxi driver, interviewees felt that women could be possible users of public transport. Other potential users are students of both genders, because some cannot drive, afford to buy a car or hire a driver. It was perceived that low fares and a reliable and accessible public transport system would be the best choice of transport mode for students. Nevertheless, some respondents stated that

there could be potential demand for many public transport trips in Riyadh City from those people who have no access to a car for economic or social reasons. Lastly, there was a thought that public transport would provide a new choice of mobility mode for the elderly who need to move around and for socialising and to be active in life.

4.1.4 Reshaping TDM strategies in Riyadh City

Respondents were then presented with a total of five options (very favourable, favourable, neutral, unfavourable, and very unfavourable) to rate how much they think reshaping the current transport policy measures will influence people's travel behaviour in Riyadh City. All interviewees felt reshaping the current TDM strategies would play a very important role in providing a successful public transport service in Riyadh City. For instance, one of the participants illustrated that: 'We need to do as it is applied in developed countries, they focus on choosing the best systems and encouraging measures to promote the use of these facilitates, such as higher fuel prices, and levying parking charges'. Another interviewee stated that, 'People may use public transport during a period of curiosity in the beginning of its introduction, but after that will be a decline in public transport ridership. So, in my opinion reshaping the current transport policy measures are indeed necessary.' The interviewee from ADA argued that, 'We try to make the public transport more attractive, but that is not enough.' He claimed, 'A stick and carrot approach is needed, where a carrot is a nice and easily accessible public transport service, while the stick is a sound strategy that has the effect of making private vehicles use not as easy and cheap as it is currently'. Generally, they thought that the city has been completely reliant on private cars for a long time, and a fundamental rethinking involving reshaping the current travel policies and implementing new transport policy measures is indeed required, along with introducing a public transport system.

4.1.5 Level of priority of the study themes for reshaping TDM strategies

As presented in Figure 3, the most popular responses are highest and high priority across all themes.

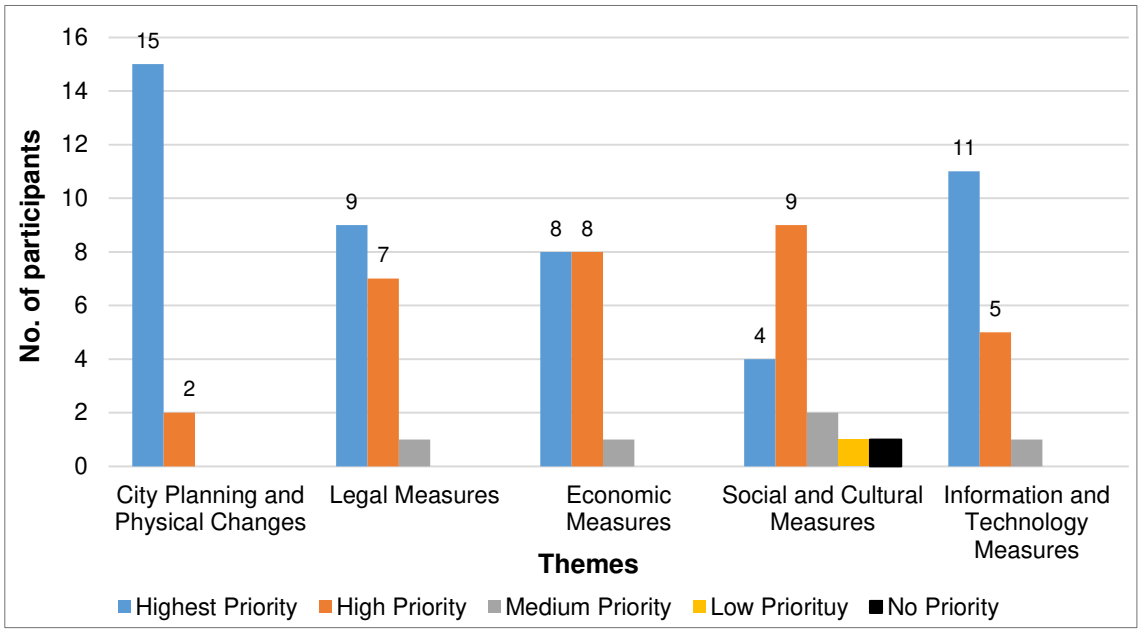

Figure 3. Priority of five themes in reshaping TDM strategies in Riyadh City

Planning and physical change theme: A lot of respondents rated city planning and physical changes as having the highest priority of all the five themes assessed. They thought that strategies related to the planning and physical change are visible and tangible, which would make people consider other travel alternatives. Some of them argued that in Riyadh City planning is seen as one of the hardest challenges for the successful operation of public transport. They stated that due to the bad conditions of the current buses, previous strategies have not taken public transport into consideration, which has caused the serious conditions of the city's planning today. They added that introducing public transport services requires reshaping the city's planning and population density to settle more along the public transport corridors. The Riyadh climate is generally dry, dusty and hot, so interviewees thought that the following are very important strategies to encourage use of public transport: introducing safe, shaded and attractive pedestrian paths, easy

public transport access, disabled access, air conditioning at all stations and bus stops, and easy integrations between public transport services pathways.

Legal theme: Interviewees felt that strategies related to the legal theme play a vital role as well. They sensed that along with introducing public transport, private car movement and ownership has to be restricted. They added transport policy measures to make cars less attractive such as speed management, illegal parking control, enforcements for driving without a driving licence, and obeying traffic regulations are needed in Riyadh City. Many respondents thought that effective legal transport policy measures would increase road safety and restrict the massive use of private cars in Riyadh.

Economic theme: The participants also felt that the economic aspect has to be considered. Many of the interviewees asserted that reform of transport charges in Riyadh City is needed. For example, increasing the cost of car operation and decreasing the cost of other transport alternatives such as metro and bus will make people re-think about the expensive use of the private car. Nevertheless, other regulations to affect the transport industry such as the decrease of subsidies for vehicle production and operations were recommended by many of the respondents.

Social and cultural theme: The unique aspects of Saudi society and culture, such as the high income of households and privacy requirements, would be a barrier for public transport use. A respondent from GAT indicated: 'The Riyadh society have got a bad image from the current bus service conditions'. He added: 'This image has to be changed using more public campaigns and advertisements for the new public transport system'. Some of the interviewees also admitted that society has to know more about the new service implemented in Riyadh, and that people could be informed via public campaigns

and new school sessions to teach pupils the main benefits of public transport, signs and usage. According to the majority of respondents, large families, the need for privacy and gender segregation are other factors which would influence choice of transport mode. Some interviewees also suggested that the following are important strategies in public transport: separate compartments for women with their children, or men and their wives, or individuals alone, and a higher than usual screen for windows for family compartments.

Information and technological theme: Almost all the study sample expected reshaping strategies related to information and technology would play a great role in changing people's travel behaviour in Riyadh. One respondent from ADA stated that 'The Saudi society is a young society; the majority of its population is less than 20 years old and has the ability to adapt to modern issues; hence, these systems are likely to be accepted when implemented'. Some interviewees stated that it is very important to provide all members of society with information about public transport services, with a high standard of communicating with the society such as daily timetables and journey planners. They added that an Internet website concerning plans and daily changes of public transport including ticket prices, or any changes in programmed journeys should be available.

4.2 Section two: the potential effectiveness, acceptability and applicability of a set of proposed TDM strategies

The second section of the interview provided interviewees with potential TDM strategies on the same themes as in Figure 3. Respondents were asked a series of questions (see Table 3) about the transport policy measures:

4.2.1 Planning and physical changes strategies

All study participants perceived that park and ride schemes outside the city centre, transit stops located centrally within acceptable walking distances, and dedicated bus lanes as most effective and highly effective strategies. Some interviewees suggested that allowing for high-rise building along with public transport corridors and selecting appropriate Transit-Oriented Development (TOD) sites are very important to increase the density and promote public transport use. In addition, the majority of interviewees thought that the availability of luxury metro stations would not be a strategy that is more effective, especially for those regular commuters. They indicated that luxury metro stations would be welcomed but did not think it would encourage public transport use as frequency and low cost would do. Limiting the supply of road space in key locations in the city was seen as complicating mobility and having low acceptability that would lead to low effectiveness as well.

4.2.2 Legal policies and measures

Interviewees felt that banning car traffic in congested areas is an effective transport policy measure in many cities, but would not be acceptable and applicable to implement in Riyadh City. They majority of participants maintained that banning car traffic would need more complicated physical changes in the planning of Riyadh City centres, attributed to the multiplicity of congestion places and lack of coverage of public transport services. The majority of respondents thought that operating and monitoring parking areas and parking control would be highly effective, acceptable and applicable strategies. According to some interviewees, transport policy measures including updating the rules of issuing new driving licences, and reducing speed limits and increasing enforcement in urban areas were perceived as having a medium effectiveness and acceptability.

4.2.3 Economic strategies

All respondents felt that lowering public transport cost, and subsiding the cost of tickets for students, families and the elderly would be highly effective strategies. The majority of interviewees perceived parking charges as the most effective strategy in this theme. Congestion charges, taxing fuel, and taxing roads were found to be effective economic strategies as well, but would be less acceptable by the general public. Some of the interviewees felt that people would consider fuel taxing unfair as the country is one of the biggest oil producers, or think public transport had brought negative changes to them and oppose the strategies. One of the respondents suggested that, 'Allocating certain amounts of fuel to each vehicle monthly at a lower price, and in the event of reaching this quantity before the end of the month fuel price will be doubled, would be effective strategy'.

4.2.4 Social and cultural strategies

The majority of interviewees believed that frequent services with a good safety of public transport would be the most effective strategies to encourage public transport ridership. A lot of interviewees felt that the provision of separate family carriages, school programmes, and encouraging school commuters would be highly effective strategies. High frequency of public transport, comfortable seats, cleanliness and the provision of safe and pedestrian-friendly surroundings for all public transport and station facilities such as utilities offices were thought to be highly effective strategies by the majority of the study participants. On the other hand, many of the interviewees perceived that on-board facilities, luxury services, and awareness of the environmental impacts of having private cars as strategies would not play a great role in terms of encouraging public transport use. They attributed these conclusions to the expected main motivation of public transport use, which is improving people's mobility and saving time.

4.2.5 Information and technology strategies

In general, strategies related to information and technology to promote public transport use are very effective, acceptable and applicable compared to strategies for other themes. For example, all respondents expected high effectiveness of transport policy measures, including mobile tickets apps, providing up-to-date information on public transport options, and public information campaigns. According to some participants, on-board media, such as Wi-Fi and TV screens, were felt to be effective as well. Providing personalised journey plans especially for employees, written directions for reaching sites by public transport to students, visitors and staff were ranked as the lowest effective strategies in this theme.

5. Discussion

The present study reports a series of semi-structured interviews to evaluate existing and future TDM strategies in Riyadh City, Saudi Arabia to encourage a shift from private car to public transport. The study findings strongly emphasise the city's needs for a competitive public transport system. This finding is in line with the Global Mass Transit Report (2011) and Alqahtany (2014) who state that neglecting public transport in Riyadh City for no obvious reasons affects the city aspects negatively, especially planning. Thus, from interviewees' perspectives, sustainable public transport system operation would be a key element for solving the existing major travel issues for this large metropolitan city by providing another alternative to the private car. Improving the city mobility, economic and environmental benefits, together with an improved quality of urban life are more benefits hoped to be achieved by sustainable operation of public transport in Riyadh City. These results agree with the ADA report (2015), and the results of other studies, for example, a previous study by Tran and Kleiner (2005) and recent studies by Weisbrod,

Cutler, and Duncan (2014) and Litman (2015) who highlight direct and indirect urban area benefits of investment in public transport, such as improved mobility, recentralised city activity, increased productivity and reduced emissions.

The study findings highlight the absence of existing direct transport policy measures that may encourage or motivate Riyadh's residents to use public transport due to the ineffective current public transport system. Throughout the interviews, it was felt that the potential for public transport success in Riyadh might be at risk given the low operational costs of private car use, including abundant free parking areas and low fuel prices. The latter may indicate that Riyadh residents perceive public transport as a mode to serve lower class Saudi citizens and the foreign labouring classes. The Global Mass Transit Report (2011) states that high income, lack of city planning, low car operational cost, culture and climate are certain barriers that would prevent the increase of public ridership among Riyadh society. Thus, to reduce the effects of these barriers and attract more car users, there was more emphasis among study participants for reshaping the existing TDM strategies and implementing new appropriate transport policy measures along with introducing a public transport system in Riyadh City by 2018. These results confirmed Rahman and Al-Ahmadi's (2010) study that concluded there is a potential need for understanding the Saudi unique socioeconomic and religious features when authorities consider new transit systems and transport policy measures in the future

The study findings also declared that some segments of the Saudi society would be more likely to use public transport, including the elderly, students, expatriates and women. Interviewees claimed that these groups may have not be able to drive because of economic reasons or obeying Saudi law, given that under traffic and road regulations women, people under the age of 18 years and many foreign labourers are prohibited from driving (Al-Dubikhi 2007; Al-Atawi 2015).

In regards to addressing the TDM strategies related to the study themes, the study results showed a high priority for reshaping strategies related to city planning and physical change to improve the access to public transport services. This finding is consistent with Loader and Stanley (2009), Redman et al. (2013) and Banister (2008) who found that improving city accessibility is an important factor in attracting more public transport users. Alqahtany (2014) found that transport policies and traffic infrastructure were not carried out in Riyadh City in a sustainable manner as a result of ignoring public transport, and the high reliance on private cars. Moreover, in line with Gärling and Schuitema (2007), throughout the interview results it became clear that the following proposed transport policy measures were scaled as acceptable and highly effective strategies: park and ride schemes outside the city centre, improving infrastructure for walking, transit stops located centrally within acceptable walking distances, and dedicated bus lanes. On the other hand, Balcombe et al. (2004) argue that there is no more evidence for reduction in car use in cities centres as a result of introducing park and ride schemes. Basso et al. (2011) found a dedicated bus lanes policy is the best for improving mobility and achieving social welfare compared to transit subsidisation or congestion pricing. In contrast with the suggestion of Kenworthy (2006) to limit the supply of road space to curb automobile dependence, our study found minimal road capacity as complicating mobility and having low acceptability that would lead to low effectiveness as well.

As suggested by respondents themselves, allowing for high-rise building along public transport corridors and selecting appropriate TOD sites at Riyadh City and connecting them with the main public transport lines would be required to increase the density and promote active public transport. This is in line with the study of Cervero and

Murakami (2008) who refer to TOD as one of most sustainable forms for decreasing private car travel and promoting transit riding.

Legal transport policy measures are imperative in reducing private car use and ownership, such as illegal parking control, monitoring parking, and limiting the supply of parking. These findings are consistent with the study by Javid et al. (2013) in Auckland City, in which the authors report that parking management reduced the rate of private car trips by 8–18%. In addition, according to iCommute (2012), private parking often comprises 50% or more of a city centre's parking stock, and even complete control of all parking fails to control through traffic, often comprising one-third or more of all traffic entering a city centre. Furthermore, in this study, other legal measures including speed management, enforcements for driving without a driving licence, and obeying traffic regulations were found as the most effective, acceptable and applicable legal strategies to be implemented in Riyadh City. A recent study from Bliss and Breen (2012), confirms these findings, as they report that such legal strategies hoped to change social norms towards sustainability and increase road safety. On the other hand, in line with the study of Schlag and Teubel (1997), prohibiting car traffic in city centres and congested locations was found to be fairly effective but less acceptable compared with other legal measures.

In agreement with a previous studies by Gärling and Schuitema (2007), Ison (2000) and Hensher, Stopher, and Bullock (2003), the economic theme is seen by authorities' representatives as a very important factor which would influence transport mode choice in Riyadh City. Thus, levying car parking fees, low public transport fares, special offers such as issuing daily, monthly and annual tickets were seen as highly effective strategies by the majority of the study sample. They perceived that accessible, and reliable public transport with low fares would be the chosen mode of mobility among

students. Lastly, they added that the elderly are in need of public transport to move around and for socialising and to be active in life.

Al-Fouzan (2012) concluded that authorities in the UK and USA are more aware of the influence of car parking requirements, in addition to other transport policy measures, to encourage sustainable transport alternatives. Another study by Ison and Wall (2002) found workplace parking charges as effective transport policy measures, but at the same time it has the lowest acceptability compared with other pricing measures such as taxing roads and fuel. Balcombe et al. (2004) maintain that parking polices not always effective but there are many examples of the effects of restricting parking places or applying charges for changing people's travel behaviour towards public transport.

Litman (2011) and Ison and Rye (2005) argue that the London congestion charge has reduced traffic and congestion significantly, and Small (2004) states that congestion charging creates a virtuous cycle in shifting private car users to public transport. Interviewees perceived that congestion charges might increase the burden of driving their cars, and give them a sense that public transport has brought about negative changes for the city. Moreover, in the current study road pricing and taxation, or increasing fuel prices were seen as effective strategies, but might be not accepted by the public in Riyadh City. This result agreed with the work of Ison (2000) who found that 80% of the key stakeholder groups in the UK feel urban road pricing publicly unacceptable. With regard to increasing fuel prices, studies in Italy by Gallo (2011) and Tehran by Khalilikhah, Habibian, and Heaslip (2016) yielded the same results when remarkable increases in fuel prices led to little decrease in car use and serious dissatisfaction for the people.

With respect to the social and culture theme measures, similar to findings by Alqahtani, Al-Badi, and Mayhew (2012), our participants claimed that Saudi society has no experience of using modern public transport, a bad image of the current bus service

conditions, high income of households, and possesses unique characteristics from religion and tribes. It was thought that these would exercise a major effect on travel behavior and transport mode choice in Riyadh City. Interviewees felt that there is a need to change people's awareness, approaches, beliefs, values and personal norms in relation to car use in Riyadh City. For instance, in line with the conclusions of Gärling and Schuitema (2007) and Stead and Banister (2001) the study findings indicated that providing information about negative aspects of car use through education and public campaigns, holding new sessions to teach pupils the main benefits of public transport, signs, and usage were found to be effective strategies in this study. Moreover, participants thought that integrating public transport services with school transport services to transport high school pupils would entice them to use public transport in the future.

This study found that high frequency of public transport, comfortable seats, and cleanliness would be highly effective strategies to attract more public transport users. The results agreed with Dell'Olio, Ibeas, and Cecin (2011), Ison (2000) and Balcombe et al. (2004) who also found these strategies as the most effective and acceptable to attract the current and the future public transport users. Security measures, personal safety, and pedestrian-friendly surroundings for all public transport premises were also thought to be highly effective strategies by the majority of the study participants. This is in line with surveys in cities throughout Europe that state that developing safety and security measures across public transport facilities has raised passenger confidence to increase public transport use (Gaggi, Fluhrer, and Janitzek 2013). Ison and Wall (2002) found that improved public transport and carrots such as safe walking and cycling routes are the most acceptable. A study by Delbosc and Currie (2012) argued that even though the perception of the influence of safety measures on public transport ridership seems small, it affects more than household car ownership.

The strict gender segregation is an important aspect in Saudi society which is fully enforced by the country's rules and religious life (Alhazmi and Nyland 2015; Ezzi, Teal, and Izzo 2014). Therefore, from this study finding, it became clear that allocating buses for female students, gender separation at bus stops and waiting areas in transit stations, and separate carriages for families were perceived as effective strategies to promote public transport ridership in Riyadh City. Dunckel-Graglia and Brook (2013) describe separating women's carriages in public transport as a good idea to ensure their safety and modify their travel behaviour towards increased use of public transport.

In terms of information and technology strategies, participants perceived that information and technology services are effective, acceptable and applicable and should be available to promote public transport. Implementing a clear and accurate passenger information strategy using the appropriate media for each person is very important to ease the access to the public transport services (Institute for Transport Studies 2010). The study participants felt that the employment of new technical features such as a Smart ticketing system would reduce barriers to the use of public transport. Other effective information and technical strategies include mobile tickets app, providing up-to-date information on public transport options, including timetables, on-board facilities, such as Wi-Fi, TV screens, and newspapers.

The following Table 4 summarises the study findings in terms of effectiveness and acceptability of the TDM strategies proposed in the study. It contrasts what is reported in the literature review with the findings from the interviews. The 'expected' reaction in Riyadh is denoted by the sign in brackets of [✓] for positive effectiveness and acceptability by the general public and [X] for negative.

Table 4: Riyadh findings compared to general findings from elsewhere in the world

TDM Domain	Strategy	Effective	Acceptable	References
Planning and physical changes	Improve infrastructure for walking	[✓]✓	[✓]✓	(Gärling and Schuitema 2007; Meek, Ison, and Enoch 2008)
	Park and ride schemes	[✓]✓	[✓]✓	
	Transit stations/stops within acceptable walking distance	[✓]✓	[✓]✓	
	Limit supply of road space	[✓]✓	[X] X	(Kenworthy 2006)
	More space to park in station car parks	[✓]✓	[✓]✓	(Rietveld 2000)
	Dedicated bus lanes	[✓]✓	[✓]✓	(Basso et al. 2011)
	Luxury metro stations	[X]	[✓]	
Legal policies	Banning car traffic in crowded areas	[✓]✓	[X] X	(Loukopoulos, Gärling, and Vilhelmson 2005; Ison 2000)
	Operating and monitoring parking areas	[✓]✓	[X]✓	
	Increase enforcement in urban areas	[✓]✓	[X]✓	(Gärling and Schuitema 2007)
	Updating the rules for issuing new driving licences	[✓]✓	[✓]✓	(Chapman 2007)
	Operating and monitoring parking	[✓]✓	[✓]✓	(Gärling and Schuitema 2007)
Economic policies	Parking charge	[✓]✓	[✓]X	(Ison and Wall 2002)
	Increase fuel price	[✓]✓	[X] X	(Gallo 2011; Khalilikhah, Habibian, and Heaslip 2016)
	Road or congestion pricing	[X]✓	[X] X	(Dieplinger and Fürst 2014; Small 2004)
	Decreasing cost of public transport	[✓]✓	[✓]✓	(Gärling and Schuitema 2007)
Social and cultural measures	Awareness of the environmental impacts	[X]✓	[✓]✓	(Chapman 2007; Howarth and Ryley 2012)
	Separate family carriages	[✓]✓	[✓]✓	(Alhazmi and Nyland 2015; Ezzi, Teal, and Izzo 2014)
	Promote the safety of public transport	[✓]✓	[✓]✓	(Delbosc and Currie 2012)
	Comfortable seats and cleanliness	[✓]✓	[✓]✓	(Ison 2000; Beirão and Cabral 2007)
	Frequency of public transport service	[✓]✓	[✓]✓	
	On-board facilities and luxury services	[✓]✓	[✓]✓	(Ahern and Tapley 2008)
	Station facilities such as utilities offices	[✓]✓	[✓]✓	
	Encourage public school commuters	[✓]✓	[✓]✓	(Bamberg et al. 2011; Möser and Bamberg 2008)

	School programmes	[✓]✓	[✓]✓	(Gärling and Schuitema 2007; Möser and Bamberg 2008)
	Security and personal safety	[✓]✓	[✓]✓	(Delbosc and Currie 2012; Hamilton 2007)
Information and technological measures	Public information campaigns	[✓]✓	[✓]✓	(Institute for Transport Studies 2010; Matsumoto and Hidaka 2015)
	On-board facilities such as Wi-Fi	[✓]✓	[✓]✓	
	Mobile tickets app	[✓]✓	[✓]✓	
	Provide up-to-date information on public transport options	[✓]✓	[✓]✓	(Balcombe et al. 2004)
	Provide written directions for reaching sites by public transport	[✓]✓	[✓]✓	
	Provide personalised journey plans	[✓]✓	[✓]✓	

Additionally, the strength of the present study arises from being the first ever study to look into the potential demand for public transport in the Riyadh City, Saudi area. This study takes a holistic view in the sense that it employs a qualitative approach to engage key stakeholders targeted from authorities in Riyadh City engaged in transport such as ADA and the High Commission of Public Transport.

Regarding the limitations, due to the cultural context of the society all interviewees in this study were males. There is a lack of secondary data about the reality of the current transport policy measures of the city of Riyadh with respect to sustainability. Moreover, there is no prior information about the public transport operational criteria such as the ticket prices and the service frequencies.

Finally, a subsequent part of this study will involve a quantitative survey of the general public from a sample of Riyadh's residents. The survey aims to investigate the general public's perspectives regarding the potential uptake of public transport services in Riyadh City. The survey will also explore the general public's attitudes towards public transport and the proposed set of TDM strategies to encourage public transport ridership, and investigate residents' transport behaviour adopting a stated preference experiment.

6. Conclusion

In summary, the study indicated an absence of direct transport policy measures and regulations that may encourage or motivate Riyadh's residents to use public transport in Riyadh City, or travel policies to encourage public transport ridership, and an urgent need for TDM policies and measures in Riyadh City. Moreover, it was found that many sectors of society are in real need for effective public transport facilities, such as high school students, university students, elderly, and women. Modern attractive public transport facilities in terms of a high-quality service, ease of reach, and reduced fares for families, students and elderly people are the key elements for the success of these facilities within the society. Moreover, availability of information regarding these facilities' timing, service plans, changes, and route planning through modern mobile communication devices are very important for its success.

It is also perceived that selecting appropriate TOD sites, improving infrastructure to enhance the accessibility to and from transit stations, and park and ride schemes were the most effective strategies. Economically, increasing fuel prices was also considered to be effective, but might lead people to sense that public transport has brought about negative changes for their city. Social and cultural strategies are deemed to be very important for changing people's travel behaviour, and separate carriages for families and the safety of public transport facilities on board and in stations were seen as the most effective strategies to encourage public transport ridership in Riyadh City. There is a general feeling that strategies related to information and technology to promote public transport use are very effective, acceptable and applicable to be implemented in Riyadh City.

References

ADA. 2014. "Investment Climate in Ar Riyadh." In *Ar Riyadh Urban Strategies Development*. Riyadh: ArRiyadh Development Authority.

ADA. 2015. "Investment Climate Report." In *A Comprehensive Strategic Plan for the City of Riyadh*. Riyadh: ArRiyadh Development Authority.

Ahern, A. A., and N. Tapley. 2008. "The Use of Stated Preference Techniques to Model Modal Choices on Interurban Trips in Ireland." *Transportation Research Part A: Policy and Practice* 42 (1): 15-27.

Al-Atawi, A. M. 2015. "Sustainable Transportation in Saudi Arabia: Reducing Barriers and Choosing Values." *International Journal of Transportation* 3 (2): 81-88.

Al-Dubikhi, S. A. 2007. *Exploring the Potential for Successful Public Transport in Riyadh*. University of Melbourne, Melbourne, Australia.

Al-Fouzan, S. A. 2012. "Using Car Parking Requirements to Promote Sustainable Transport Development in the Kingdom of Saudi Arabia." *Cities* 29 (3): 201-211.

Aldalbahi, M., and G. Walker. 2015. "Attitudes and Policy Implications of Urban Growth Boundary and Traffic Congestion Reduction in Riyadh, Saudi Arabia." In *International Conference Data Mining*. Bali (Indonesia).

AlGadhi, S. A. 1994. "Evaluation of performance of Riyadh urban public transportation services." *Transportation research record*: 10-10.

Alharbi, B., M. M. Shareef, and T. Husain. 2015. "Study of chemical characteristics of particulate matter concentrations in Riyadh, Saudi Arabia." *Atmospheric Pollution Research* 6 (1): 88-98.

Alhazmi, A., and B. Nyland. 2015. "Contextualization of Saudi International Students' Experience in Facing the Challenge of Moving to Mixed Gender Environments." *American International Journal of Contemporary Research* 5 (2): 87-97.

Aljoufie, M. 2014. "Spatial analysis of the potential demand for public transport in the city of Jeddah, Saudi Arabia." 1: 113-123.

Alqahtani, M., A. Al-Badi, and P. Mayhew. 2012. "The enablers and disablers of e-commerce: consumers' perspectives." *EJISDC* 54 (1): 1-25.

Alqahtany, A. 2014. *The development of a consensus-based framework for a sustainable urban planning of the city of Riyadh*. Cardiff School of Engineering, Cardiff University, Cardiff.

Balcombe, R., R. Mackett, N. Paulley, J. Preston, J. Shires, H. Titheridge, M. Wardman, and P. White. 2004. "The demand for public transport: a practical guide." In *TRL Report* Crowthorne, UK.

Bamberg, S., S. Fujii, M. Friman, and T. Gärling. 2011. "Behaviour theory and soft transport policy measures." *Transport Policy* 18 (1): 228-235.

Banister, D. 2008. "The sustainable mobility paradigm." *Transport Policy* 15 (2): 73-80.

Basso, L. J., C. A. Guevara, A. Gschwender, and M. Fuster. 2011. "Congestion pricing, transit subsidies and dedicated bus lanes: Efficient and practical solutions to congestion." *Transport Policy* 18 (5): 676-684.

Beirão, G., and J. Cabral. 2007. "Understanding attitudes towards public transport and private car: A qualitative study." *Transport Policy* 14 (6): 478-489.

Bliss, T., and J. Breen. 2012. "Meeting the management challenges of the Decade of Action for Road Safety." *IATSS Research* 35 (2): 48-55.

Börjesson, M., J. Eliasson, M. B. Hugosson, and K. Brundell-Freij. 2012. "The Stockholm congestion charges—5 years on. Effects, acceptability and lessons learnt." *Transport Policy* 20: 1-12.

Brög, W., E. Erl, and N. Mense. 2002. Individualised marketing changing travel behaviour for a better environment. Paper presented at the OECD Workshop: Environmentally Sustainable Transport.

Cauwenberg, J. V., V. V. Holle, D. Simons, R. Deridder, P. Clarys, L. Goubert, J. Nasar, J. Salmon, I. D. Bourdeaudhuij, and B. Deforche. 2012. "Environmental factors influencing older adults' walking for transportation: a study using walk-along interviews." *International Journal of Behavioral Nutrition and Physical Activity* 9 (85): 1-11.

Cervero, R., and J. Murakami. 2008. "R+P as Transit-Oriented Development." In *Rail + Property Development: A Model of Sustainable Transit Finance and Urbanism*. Berkeley, US: MTR Corporation, 21-30.

Chapman, L. 2007. "Transport and climate change: a review." *Journal of Transport Geography* 15 (5): 354-367.

Delbosc, A., and G. Currie. 2012. "Modelling the causes and impacts of personal safety perceptions on public transport ridership." *Transport Policy* 24: 302-309.

Dell'Olio, L., A. Ibeas, and P. Cecin. 2011. "The quality of service desired by public transport users." *Transport Policy* 18 (1): 217-227.

Dieplinger, M., and E. Fürst. 2014. "The acceptability of road pricing: Evidence from two studies in Vienna and four other European cities." *Transport Policy* 36: 10-18.

Dunckel-Graglia, A., and S. S. Brook. 2013. "Women-Only Transportation: How 'Pink' Public Transportation Changes Public Perception of Women's Mobility." *Journal of Public Transportation* 16 (2): 85-105.

Eliasson, J., L. Hultkrantz, L. Nerhagen, and L. S. Rosqvist. 2009. "The Stockholm congestion–charging trial 2006: Overview of effects." *Transportation Research Part A: Policy and Practice* 43 (3): 240-250.

Eriksson, L., M. Friman, D. Ettema, S. Fujii, and T. Gärling. 2010. "Experimental simulation of car users' switching to public transport." *Transportation Letters* 2 (3): 145-155.

Eriksson, L., J. Garvill, and A. M. Nordlund. 2008. "Acceptability of single and combined transport policy measures: The importance of environmental and policy specific beliefs." *Transportation Research Part A: Policy and Practice* 42 (8): 1117-1128.

Ezzi, S., E. Teal, and G. Izzo. 2014. "The influence of Islamic values on connected generation students in Saudi Arabia." *Journal of International Business and Cultural Studies* 9: 1-19.

Fiorio, C. V., and M. Percoco. 2007. "Would you stick to using your car even if charged? Evidence from Trento, Italy." *Transport reviews* 27 (5): 605-620.

Friman, M., B. Edvardsson, and T. Gärling. 2001. "Frequency of negative critical incidents and satisfaction with public transport services. I." *Journal of Retailing and Consumer Services* 8 (2): 95-104.

Gaggi, S., T. Fluhrer, and T. Janitzek. 2013. *Innovation in urban mobility - policy making and planning.* Bulgaria: The European Commission.

Gallo, M. 2011. "A fuel surcharge policy for reducing road traffic greenhouse gas emissions." *Transport Policy* 18 (2): 413-424.

Gärling, T., and G. Schuitema. 2007. "Travel demand management targeting reduced private car use: Effectiveness, public acceptability and political feasibility." *Journal of Social Issues* 63 (1): 139-153.

General Department of Traffic. 2015. *Statistics*. https://www.moi.gov.sa/wps/wcm/connect/ [Accessed: 20.2.2016].

Global Mass Transit Report. 2011. *Policy Review. Public transport in Saudi Arabia: Embracing comprehensive mobility.* . http://www.globalmasstransit.net/archive.php?id=6463 [Accessed: 22.11.2015].
Grieco, M., G. Sammer, and W. Saleh. 2012. *Travel demand management and road user pricing: success, failure and feasibility*: Ashgate Publishing, Ltd.
Hamilton, B. A. 2007. "Personal security in public transport travel–Problems issues and solution." *Land Transport New Zealand Research Report*.
Hensher, D. A., P. Stopher, and P. Bullock. 2003. "Service quality—developing a service quality index in the provision of commercial bus contracts." *Transportation Research Part A: Policy and Practice* 37 (6): 499-517.
Howarth, C., and T. Ryley. 2012. "A behavioural perspective on the relationship between transport and climate change." *Transport and Climate Change. Bingley: Emerald*: 261-286.
iCommute. 2012. *Integrating Transportation Demand Management Into the Planning and Development Process*. iCommute. http://www.icommutesd.com/documents/tdmstudy_may2012_webversion_000.pdf [Accessed: 22.12.2015].
Institute for Transport Studies. 2010. *Innovative information systems for public transport*. University of Natural Resources and Applied Life Sciences (BOKU), Vienna: The CIVITAS cleaner and better transport in cities.
Ison, S. 2000. "Local authority and academic attitudes to urban road pricing: a UK perspective." *Transport Policy* 7 (4): 269-277.
Ison, S., and T. Rye. 2005. "Implementing road user charging: the lessons learnt from Hong Kong, Cambridge and Central London." *Transport reviews* 25 (4): 451-465.
Ison, S., and T. Rye, eds. 2008. *The Implementation and Effectiveness of Transport Demand Management Measures An International Perspective*. Hampshire, England: Ashgate publishing limited.
Ison, S., and S. Wall. 2002. "Attitudes to traffic-related issues in urban areas of the UK and the role of workplace parking charges." *Journal of Transport Geography* 10 (1): 21-28.
Jaensirisak, S., M. Wardman, and A. May. 2005. "Explaining variations in public acceptability of road pricing schemes." *Journal of Transport Economics and Policy*: 127-153.
Javid, M. A., T. Okamura, F. Nakamura, S. Tanaka, and R. Wang. 2013. Public Attitudes towards Travel Demand Management Strategies (TDM) in Lahore, Pakistan: Importance of Lifestyles, Social and Travel Related Beliefs. Paper read at 13th World Conference on Transport Research, 15-18 July 2013, at Rio de Janeiro, Brazil.
Kenworthy, J. R. 2006. "The eco-city: ten key transport and planning dimensions for sustainable city development." *Environment and urbanization* 18 (1): 67-85.
Khalilikhah, M., M. Habibian, and K. Heaslip. 2016. "Acceptability of increasing petrol price as a TDM pricing policy: A case study in Tehran." *Transport Policy* 45: 136-144.
Kottenhoff, K., and K. B. Freij. 2009. "The role of public transport for feasibility and acceptability of congestion charging–the case of Stockholm." *Transportation Research Part A: Policy and Practice* 43 (3): 297-305.
Litman, T. 2011. London Congestion Pricing Implications for Other Cities. In *Efficiency. Equity. Clarity*. London: Victoria Transport Policy Institute.

Litman. 2015. "Evaluating public transit benefits and costs." *Victoria Transport Policy Institute* 65: 1-141.
Loader, C., and J. Stanley. 2009. "Growing bus patronage and addressing transport disadvantage—the Melbourne experience." *Transport Policy* 16 (3): 106-114.
Loukopoulos, P., T. Gärling, and B. Vilhelmson. 2005. "Mapping the potential consequences of car-use reduction in urban areas." *Journal of Transport Geography* 13 (2): 135-150.
Mathers, C. D., and D. Loncar. 2006. "Projections of global mortality and burden of disease from 2002 to 2030." *PLoS Med* 3 (11): e442.
Matsumoto, T., and K. Hidaka. 2015. "Evaluation the effect of mobile information services for public transportation through the empirical research on commuter trains." *Technology in Society* 43: 144-158.
Meek, S., S. Ison, and M. Enoch. 2008. "Role of bus-based park and ride in the UK: a temporal and evaluative review." *Transport reviews* 28 (6): 781-803.
Möser, G., and S. Bamberg. 2008. "The effectiveness of soft transport policy measures: A critical assessment and meta-analysis of empirical evidence." *Journal of Environmental Psychology* 28 (1): 10-26.
Mubarak, F. A. 2004. "Urban growth boundary policy and residential suburbanization: Riyadh, Saudi Arabia." *Habitat International* 28 (4): 567-591.
Perone, J. S., and J. M. Volinski. 2003. "Fare, free, or something in between?".
Prioni, P., and D. A. Hensher. 2000. "Measuring service quality in scheduled bus services." *Journal of Public Transportation* 3 (2).
Rahman, S. M., and H. M. Al-Ahmadi. 2010. "Evaluation of transportation demand management (TDM) strategies and its prospect in Saudi Arabia." *Jordan Journal of Civil Engineering (JJCE)* 4: 1.
Redman, L., M. Friman, T. Gärling, and T. Hartig. 2013. "Quality attributes of public transport that attract car users: A research review." *Transport Policy* 25: 119-127.
Redshaw, S. 2012. *In the company of cars: Driving as a social and cultural practice*: Ashgate Publishing, Ltd.
Richter, J., M. Friman, and T. Gärling. 2009. "Soft transport policy measures 1: Results of implementations."
Rietveld, P. 2000. "The accessibility of railway stations: the role of the bicycle in The Netherlands." *Transportation Research Part D: Transport and Environment* 5 (1): 71-75.
Rye, T., and S. Ison. 2012. *The Implementation and Effectiveness of Transport Demand Management Measures: An International Perspective*. Hampshire, England: Ashgate Publishing, Ltd.
Sandelowski, M. 2001. "Focus on Research Methods Real Qualitative Researchers Do Not Count: The Use of Numbers in Qualitative Research." *Research in Nursing & Health* 24: 230-240.
Schlag, B., and U. Teubel. 1997. "Public acceptability of transport pricing." *IATSS Research* 21: 134-142.
Schuitema, G., L. Steg, and S. Forward. 2010. "Explaining differences in acceptability before and acceptance after the implementation of a congestion charge in Stockholm." *Transportation Research Part A: Policy and Practice* 44 (2): 99-109.
Simons, D., P. Clarys, I. Bourdeaudhuij, B. Geus, C. Vandelanotte, and B. Defoeche. 2013. "Factors influencing mode of transport in older adolescents: qualitative study." *BMC Public Health* 13 (323): 1-10.

Small, K. A. 2004. "Road Pricing and Public Transport." In *Road Pricing: Theory and Evidence*, edited by G. Santos. University of Cambridge, Cambridge, UK: Elsevier.

Sperling, D., and D. Gordon. 2009. *Two Billion Cars Transforming a Culture.* Oxford University: Oxford University Press.

Stead, D., and D. Banister. 2001. "Influencing mobility outside transport policy." *Innovation: The European Journal of Social Science Research* 14 (4): 315-330.

Steg, L. 2007. "Sustainable Transportation: A Psychological Perspective." *IATSS Research* 31 (2): 58-66.

Steg, L., and G. Schuitema. 2007. "Behavioural responses to transport pricing: a theoretical analysis." *Threats to the quality of urban life from car traffic: Problems, causes, and solutions*: 347-366.

Steg, L., and G. Tertoolen. 1999. "Sustainable Transport Policy: The Contribution from Behavioural Scientists." *Public Money and Management* 19 (1): 63-69.

Taylor, M. A. 2007. "Voluntary travel behavior change programs in Australia: The carrot rather than the stick in travel demand management." *International Journal of Sustainable Transportation* 1 (3): 173-192.

Thorpe, N., P. Hills, and S. Jaensirisak. 2000. "Public attitudes to TDM measures: a comparative study." *Transport Policy* 7 (4): 243-257.

Tran, T., and B. H. Kleiner. 2005. "Managing for excellence in public transportation." *Management Research News* 28 (11/12): 154-163.

Weisbrod, G., D. Cutler, and C. Duncan. 2014. *Economic Impact of Public Transportation Investment.* Washington, USA: The American Public Transportation Association.

World Health Organization. 2004. *World Report on Road Traffic injury prevention*. Geneva: World Health Organization.

World Health Organization. 2009. "Global Status Report on Road Safety: Time for action." In *Time for action*. Geneva: World Health Organization.

World Health Orginization. 2013. "Global status report on road safety 2013 Supporting a decade of action." In *The Decade of Action for Road Safety 2011-2020*. Luxembourg: World Health Orginization.