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Introducing public transport and relevant strategies in Riyadh City, Saudi Arabia: a stakeholders' perspective

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ABSTRACT

There is an increasing concern about the growth of car dependence and its associated negative impacts on cities, including economic and environmental factors, urban form and lifestyle. City authorities worldwide now pay increasing attention to sustainable transport systems by enhancing or introducing public transit services. An example is Riyadh City, Saudi Arabia, which has witnessed a significant growth in car ownership and population. Current efforts to reduce high dependence on private cars in Riyadh involve the development of a new public transport system. Against this background, this paper considers the wider impacts of the new public transport system in Riyadh City on urban form, economics, environment, social norms and culture. The analysis is based on in-depth interviews conducted with transport experts and officials of relevant authorities in Riyadh City. The study results highlight that the city's urban form would have the highest impact on the uptake of public transport. Moreover, stakeholders assumed that the provision of public transport services in Riyadh would improve mobility, decrease travel time, and create more employment opportunities, positively affecting Riyadh City's economy and the environment. Interviewees concluded that these potential interventions would affect social norms and culture positively in the long term.

1. Introduction

In the aftermath of World War II and as a result of economic development, cities over the world continue to grow; in 2008 the urban population has exceeded that of rural areas for the first time in human history (United Nations, 2009). Donovan and Munro (2013) expect the population in urban areas to double over the next 40 years. The patterns of development in cities are associated with the growth of urban transport and mobility allowing access for people and goods (Rode et al., 2017). Aljoufie (2014) argues that accelerated urban sprawl results in persistent challenges to a large number of urban areas across developed and developing countries. Also, Amin et al. (2013) maintain that in developing countries, cities have experienced a significant growth resulting in denser use of space and unaffordable challenges

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to their urban mobility systems such as congestion and air pollution. Travel demand is expected to increase at a similar rate with urbanisation (Javid, Okamura, Nakamura, Tanaka, & Wang, 2013). Between 1960 and 2010, the number of private cars worldwide increased from nearly 100 million to over 700 million (Davis, Diegel, & Boundy, 2014; Rode et al., 2017). Previous studies (Aljoufie, 2016; World Health Organization, 2013; Zhao, 2010) indicate that a rapidly increasing population, urban sprawl and the proliferation of cars result in higher traffic volumes and increased vehicular use, leading to congestion and other negative impacts such as air pollution, greenhouse gas emissions and economic losses. The World Energy Council (2011, p. 4) summarised that 'over the next four decades, the global transport sector will face unprecedented challenges related to demographics, urbanisation, pressure to minimise and dislocate emissions outside urban centres, congestion of aging transport infrastructure and growth in fuel demand'.

Hatwar and Gajghate (2014) argue that investment in public transport services is a compulsory quality leap for more liveable and accessible cities. Public transport plays a facilitating role in urban mobility (Banister, 2001). In Asian and some Western developed cities, public transport accounts for more than 51% of daily trips while in car-orientated cities such as in the United States or the Gulf region it accounts for less than 10% (UN UN Habitat, 2010). In Riyadh City for example, the current bus service shares less than 2% of 8 million daily trips (Al-Fouzan, 2012; Alqahtani, Al-Badi, & Mayhew, 2012).

Saudi Arabia along with other Gulf countries have experienced extreme wealth, significant population growth and increased car ownership since the oil boom in the 1970s, which led towards less sustainable travel patterns such as congestion and air pollution (Aljoufie, 2014). As a result, in 2012, the Riyadh City authorities introduced a new investment of $22.5 billion to develop a new public transport system including six metro lines integrated with a bus network. According to Ar Riyadh Development Authority (ADA) (2015) the system is expected to be in operation by the end of 2018. It is therefore necessary to consider the wider impacts of the new public transport system in Riyadh City on urban form, economics, environment, social norms and culture. This paper follows a qualitative approach to consider these types of impact in depth.

The structure of the paper is as follows. The next section is a literature review critically summarising worldwide experiences of the impacts of investment on public transport systems. Section 3 presents contextual background and information on how transport is governed in Riyadh City. Section 4 provides details on the interview approach and the fieldwork implementation. The study's results are presented in Section 5 and finally, Section 6 presents the whole study discussion and conclusion.

2. Impacts of investment on public transport systems

Most studies on the impacts of public transport systems on cities focused on heavy rail systems and the recent generation of rail systems built in US cities over the past half-century (Cervero & Kang, 2011). Weisbrod, Cutler, and Duncan (2014) revisit some of the advantages of investing in public transport, which include improved mobility, reduced congestion and carbon emissions, and air quality improvements. Public transport would also facilitate mixed land use, enable economic growth and increase property values and generate jobs (Litman, 2015).

Table 1. Examples of objectives of developing public transport systems.

City	Reduce traffic congestion	Improve public transport	Serve the city centre better	Improve the environment	Stimulate development
UK					
Birmingham	✓	✓	✓		✓
Bristol	✓			✓	✓
Cleveland	✓			✓	
Hull	✓			✓	
Leeds	✓				✓
London Docklands	✓	✓			✓
Nottingham	✓		✓		✓
Continental Europe					
Athens	✓	✓		✓	
Copenhagen	✓	✓		✓	✓
Stockholm	✓	✓		✓	
USA					
Dallas	✓	✓			✓
Honolulu					
Kansas City					✓
Miami	✓		✓	✓	
Australia					
Brisbane					✓
Brisbane	✓	✓			✓
Sydney					✓
Asia					
Nagoya	✓	✓			
Dubai	✓		✓		✓
Abu Dhabi	✓		✓		✓

Source: Eccles, Alusi, Edmondson, and Zuzul (2012); Kaiser (2007); Mackett and Edwards (1998).

Urban form has been identified as a critical dimension of sustainable cities (Creutzig, 2014). Many studies confirm that in general, transport improvements influence urban form, and in particular public transport (Cervero & Kang, 2011; Creutzig, 2014). Cervero and Seskin (1995) argue that there is a simultaneous interaction and influence between public transport and urban form such as land use and density. For example, Washington DC has experienced substantial rail-induced land-use impacts around Metrorail stations where the density in the areas of the stations rose from 17 to 23% prior to and after the opening of the Metrorail, respectively. Over the last decade, land prices increased by 100% several years after Metrorail services began (Cervero & Seskin, 1995). Cervero and Kang (2011) argue that a range of impacts on city forms associated with new rail services, such as increased residential and commercial property values, density, and land use have also been found in studies of San Francisco's Bay Area Rapid Transit, Chicago's Midway Line, and in Seoul's new subway line. Staricco (2015) argues that transit-oriented development (TOD) has received attention worldwide over the last two decades and that it is an appropriate planning approach for Italian urban areas. He adds that TOD would support the sustainability of mobility patterns in the country and enhance desirable effects on both rail ridership and limiting urban sprawl. Table 1 presents a summary of reported outcomes from developing public transport systems across different cities. Mackett and Edwards (1998) argue that the most direct objective of developing these systems is to improve public transport, and that is usually linked to a social objective such as supporting mobility needs.

From an economic perspective, Aschauer and Campbell (1991) indicate that public transport concentrates economic activity and generates high productivity and economic growth. A recent study conducted by Weisbrod et al. (2014) assesses the economic impacts from investing in public transport in American communities. Their study maintains that in addition to city mobility and expansion of service, sustainable public transport can potentially affect the economy by lowering costs of travel and reducing vehicle ownership. Those switching from private car use experienced savings in terms of reduced travel costs and/or reduced journey times in the use of public transport, while there are reduced congestion costs for business and households, and enhanced city business growth. Pope (1994) conducted a survey of businessmen in Leeds and found that many of them supported a new public transport system in the city centre. The study found that they were more likely to move their shops to a revitalised business area supported by public transport. Litman (2015) argues that public transport would support city economy by providing more jobs and local business activity, increase productivity by improving access to education and jobs, and save expenditure associated with accidents and pollution.

The role of public transport in facilitating more sustainable urban environments has also been examined. Mackett and Edwards (1998) argue that if the most common reason for developing a public transport system is to reduce car use and traffic congestion, an improvement in the quality of the environment is also expected to be an outcome. The authors add that there is evidence of car use reduction in Lausanne, Manchester, Sheffield and Toulouse after developing new public transport systems. A study by Zavitsas, Kaparias, Bell, and Tomassini (2010) reveals that the concerns of cities with environmental and sustainability issues related to transport emissions and noise are increasing. Many authors comment that the annual increase in private car ownership is a threat to the human environment (Bamberg, Fujii, Friman, & Gärling, 2011; Gärling & Schuitema, 2007).

It is a challenge to overturn the influence of social norms and culture shaped by decades of car travel to promote public transit use (Brown et al., 2016). Better understanding of current and intended behaviour, selecting potential measures to promote uptake of public transport, and evaluation of results are essential steps to reshape social norms (Boschetti, Maurizi, & Cré, 2014). Beirão and Cabral (2007) raise the need to classify the main social or cultural barriers that prevent use of public transport as a major step towards removal of them. They add that people are unlikely to switch from current travel modes unless they perceive public transport as a viable alternative.

3. Contexual background

3.1. Study area

The Kingdom of Saudi Arabia is the largest country in the Arabian Peninsula with a population exceeding 31 million and a land area of more than 2.15 million km^2 (ADA, 2015). During the past four decades, the majority of Saudi Arabian cities have witnessed significant urban growth (Alotaibi & Potoglou, 2017) that follows closely the urbanisation of cities in North America, with decentralised jobs and homes which lead to commuting growth and increased car ownership (Aldalbahi & Walker, 2015). As shown in Figure 1, the geographical focus of this study is on the capital city of Saudi Arabia, Riyadh City. During the past
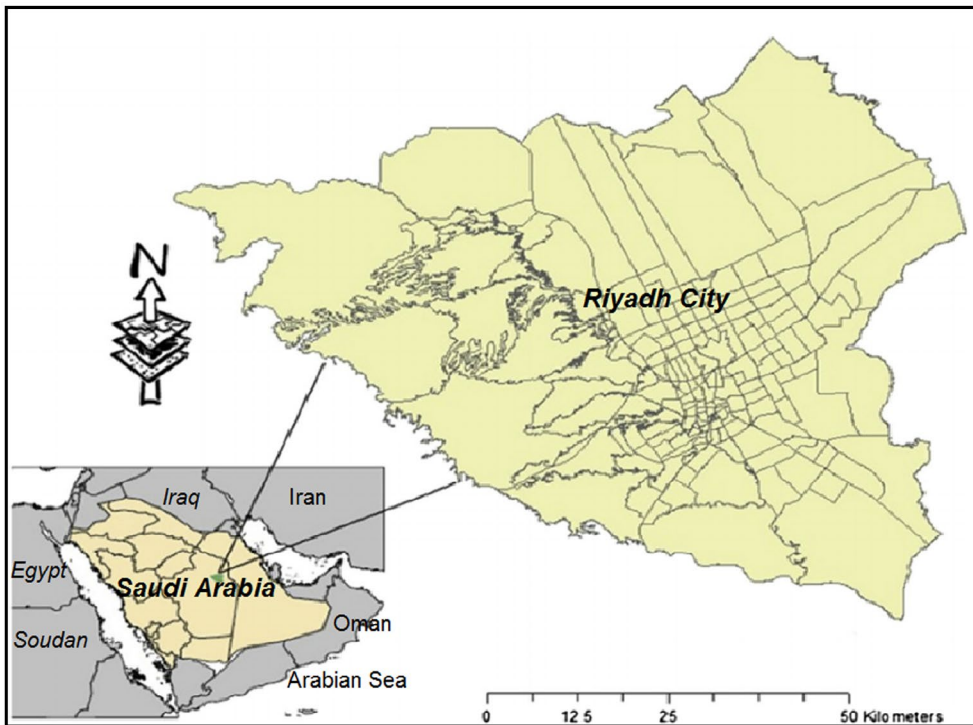
Figure 1. Map of the Kingdom of Saudi Arabia. Source: ADA (2013).

50 years, Riyadh City has developed from a walled town into a metropolis of almost six million people (Al-Hathloul, 2017).

In an effort to guide the urban development and growth of Riyadh City Doxiadis Associates, a Greek consulting firm, was commissioned in the late 1960s to develop the city's first Master plan, which was approved by the Council of Ministers in 1973 (Al-Hathloul, 2017). Riyadh has never had an effective public transport system, and consequently the Master plan considered the private automobile as the primary mode of travel within the city (Al-Ahmadi, See, Heppenstall, & Hogg, 2009; Al-Hathloul, 2017). However, most studies indicated that the Doxiadis plan was more of a technical document rather than a realistic programme (Alqahtany, 2014). The plan failed to address the expansion of the city due to unexpected population growth and increased urban areas (Mubarak, 2004). In the early 1980s the Ministry of Municipal and Rural Affairs (MOMRA) appointed another consulting firm, SCET International/SEDES of Paris, to update and revise the Doxiadis scheme (Al-Hathloul, 2017). SCET undertook a holistic evaluation of services to support the expanding city and developed a revised expansion and phasing plan. Following the expiry of the SCET scheme at the end of the 1990s, MOMRA developed a new strategy known as the Metropolitan Development Strategy for Ar Riyadh (MEDSTAR) to manage city development over the next 50 years (Al-Ahmadi et al., 2009). An implementation plan was introduced by MEDSTAR, which is the regulatory, structural, planning and executive framework for all authorities working in the city (ADA, 2015). MEDSTAR has identified six key transport strategies in Riyadh City, including the following:

- The need to develop effective public transport in the city;
- Progressive introduction of demand management measures including road pricing and congestion charging;
- The alignment of higher density residential and commercial development along major public transport spines;
- The development of the ring road system to take the pressure off congested central arterial roads;
- Improving traffic management practices; and
- Development of an integrated corridor management programme to upgrade major corridors in the city to ensure that they serve the proposed public transport network and qualify them for advanced traffic management schemes (ADA, 2009, p. 1).

These achievements are substantial and have involved good coordination between the ADA, the Ministry of Transport and others. As shown in Figure 2, following up the MEDSTAR strategies, a new Riyadh Public Transport Project (RPTP) was approved in an effort to reduce car dependency and integrate the majority of the city's districts (ADA, 2013). Nevertheless, Saudi Arabia has had limited experience in providing any kind of public transport, with the only case being the Saudi Public Transport Company (SAPTCO) in Riyadh, which ceased operation in 1992 (Al-Dubikhi, 2007; Alqahtani et al., 2012).

Riyadh City is wealthy and sprawling and its society is deeply affected by Islamic culture and many conventions regarding privacy (Aldalbahi & Walker, 2016). There are also socio-demographic issues such as high average household size (Abdul Salam, 2013), and the current prohibition on women driving in cities in Saudi Arabia (Al-Dubikhi, 2007). However, a decree has been recently issued allowing women to drive as of May 2018. All women and young children rely on male private drivers or taxis to meet their daily transport needs including travel for education, jobs, shopping or other leisure trips (Aldalbahi & Walker, 2015).

3.2. Urban administration in Saudi Arabia

Several different government bodies are responsible for transport administration in Saudi Arabia. They include the Ministries (at national level) and national authorities.

3.2.1. Ministry of municipalities and rural affairs

The MOMRA has an important role in Saudi Arabia as the body responsible for physical development in urban and rural areas including providing the necessary roads and infrastructure (MOMRA, 2011). MOMRA has various departments and there are 243 municipalities in the country, each regulating its designated region while ensuring compliance with MOMRA's outline for the Kingdom's cities, rural areas, streets and construction designs. It also carries out studies relating to Saudi Arabia urban planning and development (MOMRA, 2011, p. 178).

3.2.2. Ar Riyadh Development Authority

Ar Riyadh Development Authority (ADA), the high commission's executive, technical and administrative arm, was established in 1983. Its duties include developing and improving Riyadh City's urban plan, economic activities, environment management and social and
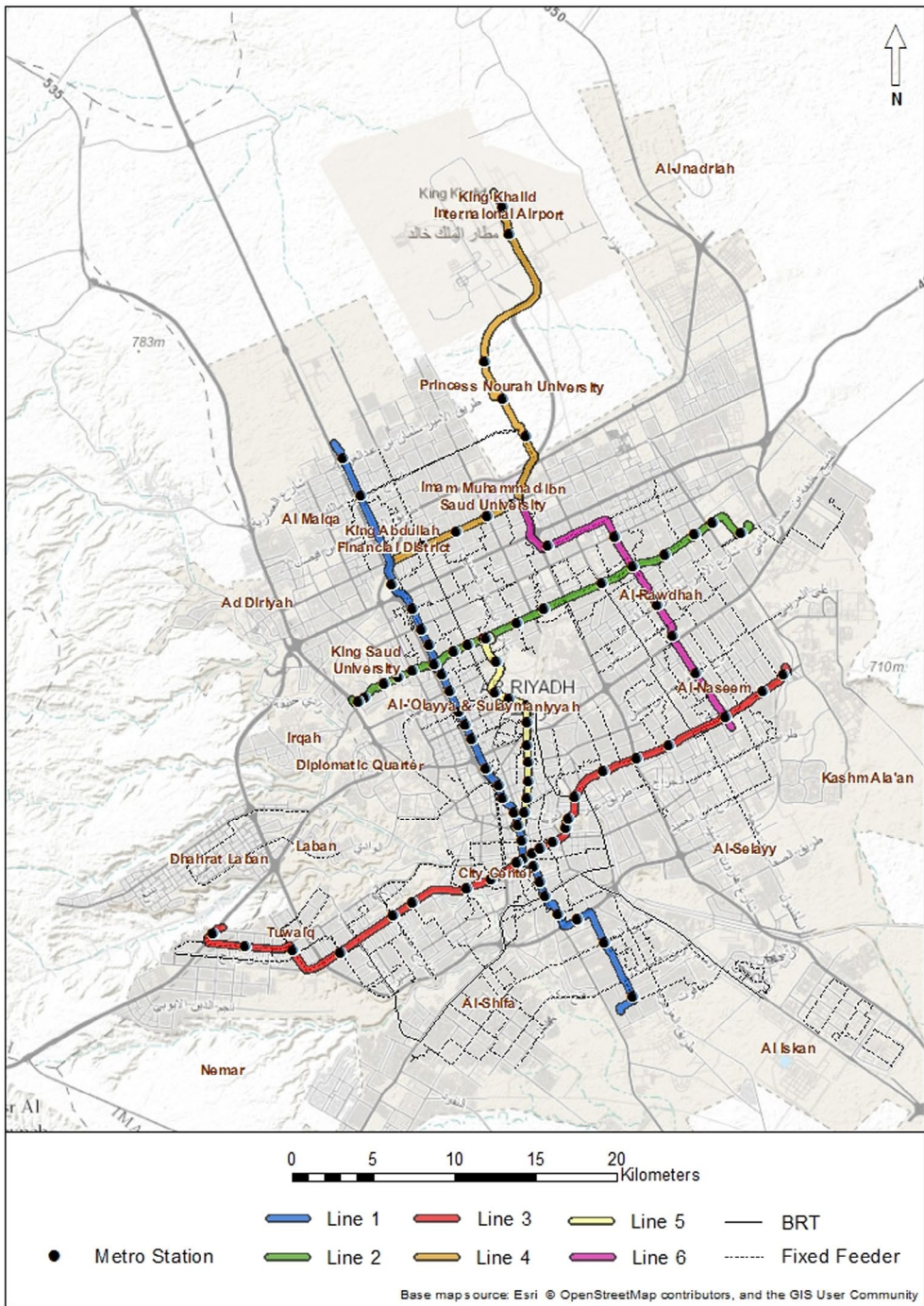
Figure 2. The planned new public transport system in Riyadh City. Source: ADA (2015).

cultural development. It provides the city with the necessary public services and utilities. ADA also carries out strategic urban studies, and organises and follows up on urban development programmes carried out by government bodies (ADA, 2015).

3.2.3. Ministry of Transport

The Ministry of Transport (MOT) was established in 1953 to be responsible for building, maintaining and operating roads and bridges in and between major cities and villages. It also publishes statistical data relating to transport modes (Ministry of Transport, 2011) and conducts feasibility studies relating to road networks linking Saudi cities. The studies were prepared by private consultants but provided inadequate outcomes as they were based on assumptions due to insufficient data on population, land use, traffic volume and travel pattern studies (Ministry of Transport, 2011).

3.2.4. Public Transport Authority

The Public Transport Authority (PTA) is a new national authority established by a cabinet decree in October 2012. PTA is responsible for the design, construction and operation of all public transport systems in Saudi Arabia. It also aims to organise public transport services (train, metro and bus) for passengers within cities and between cities, supervising and providing them at a good level and appropriate cost, and encouraging investment in accordance with the objectives of economic and social development in the Kingdom.

3.2.5. The General Administration for Traffic

The General Administration for Traffic (GAT) is a national department linked to the Ministry of Interior. GAT is responsible for the operation, control and management of traffic in Saudi cities (GAT, 2016). The GAT is located in Riyadh and has regional offices in each capital of the 13 administrative regions in the country (Ministry of Interior, 2015).

GAT is in charge of preparing traffic plans and traffic management in case of accidents and operating traffic wardens (GAT, 2016) and the investigation and surveying of traffic accidents. The traffic engineering units in the traffic department are responsible for technical work relating to roads and vehicles. This unit's tasks include coordination with other governmental bodies in relation to traffic engineering; installing and maintaining traffic signs; and proposing and supervising the installation, operation, and maintenance of traffic lights (Ministry of Interior, 2015).

4. Data and methodology

4.1. Participants' characteristics

As shown in Table 2, seven main authorities that play a major role in sustainable development for Riyadh City, especially in mobility, have been targeted for sampling.

4.2. Data collection

The employment of interview methods for the purpose of collecting primary data helps researchers to gather reliable and valid data that is related to their research questions and objectives (Saunders, 2011). Furthermore, it enables the interviewer to steer the discussion in the most appropriate ways for collecting information from participants (Ghashat, 2012). Interviews help the researchers to gather more data, especially more complex data, and provide the interviewers with a comprehensive picture of the research area (Hall & Pain, 2006; Saunders, 2011).

Table 2. 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	4
Public Transport Authority	Director of Public Transport Authority	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
Ministry of Municipal and Rural Affairs	The General director of urban planning and consultant of the Ar Riyadh metro project	2
Riyadh Municipality	Director of studies and planning, and four engineers engaged on RPTP studies and design	5

In this study semi-structured interviews with stakeholders, including transport experts and representatives of Riyadh City authorities, have been employed. Generally, the interview method can be divided into three main categories: structured interviews, semi-structured interviews, and unstructured or in-depth interviews (Greener, 2008). The semi-structured interview has features of both structured and unstructured interviews, in which the researcher usually has a list of questions and themes that need to be covered during the interview. Researchers who follow the semi-structured interview method use both open and closed questions (Saunders, 2011). Semi-structured interviews depend upon a specific array of questions and endeavour to steer the discussion to continue, more loosely, on such questions (Nagy Hesse-Biber, Leavy, & Nagy Hesse-Biber, 2011).

Klenke (2008) states that semi-structured interviews are modelled more strongly on the unstructured than the structured interview which indicates that the subject theme directs the questions asked, though a more relaxed informal style is adopted between the interviewer and interviewee. Klenke (2016, p. 131) adds: 'This leaves the interviewer free to rephrase the questions and add further inquiries such as "Who?" "Where?" "When?" "Why?" and "How?" based on the interviewee's answers and conversation flow'. To this effect, Parker (2005, p. 53) states that an interview in qualitative research is always:

> semi-structured because it invariably carries the traces of power that holds things in place and it reveals an interviewee's, a co-researcher's creative ability to refuse and resist what the research wants to happen. The task of radical research, then, is to make the interview an encounter that reveals patterns of power and creative refusal of a set research agenda.

Based on the above details about semi-structured interviews, the study authors found this to be the most appropriate method that would address the study objectives by gaining appropriate responses from the targeted participants (see Table 3).

4.3. Interview protocol

All interviewees were contacted in person. Copies of the interview documents were distributed to participants prior to the interviews via email or in hardcopy. Thus, 25 face-to-face semi-structured interviews were carried out in summer 2015. As shown in Tables 4

Table 3. Advantages and disadvantages of semi-structured interviews.

Advantages	Disadvantages
Positive rapport between interviewer and interviewee	Dependent on skill of the interviewer (ability to formulate questions during the interview) and ability of respondent to articulated answers
Results in high reliability	Not very reliable
Addresses and clarifies complex issues	Time consuming and expensive
Reduces pre-judgement on part of the interviewer (i.e. researcher predetermining what will or will not be discussed due to few predetermined questions)	Depth of information difficult to analyse
	Generalisability limited
	Lack of validity

Source: Klenke (2016, p. 132)

Table 4. The interview questions.

Parts	Purpose	Contents
Opening	Provide interviewee details of the study objectives and ask for permission to record the conversation	Cover letter/introduction to the interview
1	To investigate the current status of Riyadh in terms of issues related to city form, economic, environment and social norms and culture	In the current time, do you think Riyadh City has issues in terms of city form, economic, environment and social norms and culture? And why?
2	Measure stakeholders' 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	To consider the wider impacts of the new public transport system in Riyadh City on urban form, economics, environment, social norms and culture	What are the assumed impacts of introducing public transport and related interventions in Riyadh on city form, environment, economic, social norms and culture? Please feel free to add other comments

Table 5. City main aspect.

City main aspect	Rank	A	B	C	D	E
1. City form	☐	☐	☐	☐	☐	☐
2. City economic	☐	☐	☐	☐	☐	☐
3. City environment	☐	☐	☐	☐	☐	☐
4. Social norms and culture	☐	☐	☐	☐	☐	☐

Notes: (A) Highly impacted, (B) Very impacted, (C) Somewhat impacted, (D) Slightly impacted (E) Not at all impacted.

and 5, all the interviewees were asked the same questions with open time for any related comments interviewee would like to add. This paper focuses on part 3 identified in Table 4 and the analysis of other parts has been published in another paper by the same authors.

The highest proportion of interviewees was from ADA because it is the responsible authority for design, implementing public transport infrastructure, and operation in the future, in collaboration with other authorities such as PTA. After providing the interviewee with details of the study main objective, permission was sought to record the conversation. The interviews focused on selected aspects of the city as shown in Figure 3. Thus, interviewees were requested to indicate to what extent they believe these aspects would be impacted as a result of introducing public transport and related interventions into Riyadh City.

Figure 3. The city aspects.

4.4. *Data analysis*

The collected data were transcribed and documented according to the city aspects as shown in Figure 3. NVivo 9 qualitative software was used to analyse the data based on Grounded Theory. 'Grounded theory is a method of analysing qualitative data which is grounded in the data without preconceived theories and is characterised by intensively analysing data, often sentence by sentence, or phrase by phrase' (Simons et al., 2013, p. 3).

The description of the study results followed the suggestions of Sandelowski (2001) and Cauwenberg et al. (2012) for quantifying qualitative data to be presented numerically in score or scale. Therefore, based on the design of the study questions and for interpretation of the study results, 'the study respondents agreed', 'general belief' or 'the majority' indicates a 75% or more agreement or similar belief among all interviewees. 'A lot of', or 'many' refers to between 75 and 50% of respondents, 'some' is between 50 and 25%, and 'few' indicates less than 25% of respondents.

5. Results

Interviewees cited evidence in the MEDSTAR project, and the Riyadh Comprehensive Public Transport Plan by Canadian from the Intelligence Buildings Infrastructure (IBI) group in 2002 and 2006 respectively, which identify a public transport system being necessary for Riyadh City. The majority of interviewees thought there was a necessity for a public transport system and related interventions to improve mobility and the quality of urban life. Generally, interviewees felt that the majority of city aspects are already formed and that the assumed impacts of introducing public transport and related interventions in Riyadh would take at least 10 years to become obvious.
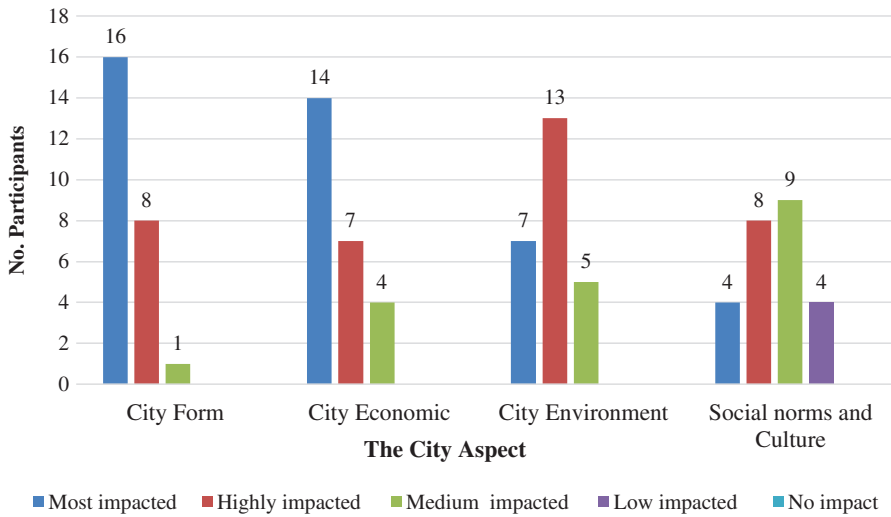
Figure 4. The assumed impact of implementing public transport and related interventions.

5.1. Urban form

As shown in Figure 4, city form was assumed to be subject to the highest impact in contrast to the remaining city aspects. One interviewee from ADA mentioned that 'Reshaping the city form is part of the reason for introducing public transport in Riyadh City; we cannot continue expanding the city and relying on private cars for use. It has impacts on expansion of infrastructures, cost, city life of citizens, time lost in car traffic, the decreasing quality of air, as well as difficulty for pedestrians'. Generally, interviewees felt that the mode of travel plays a vital role in the city planning in which the current planning is compatible with private cars. It was thought that there would be changes in travel demand and population density and more activities around public transport corridors and stations.

The majority of interviewees agreed for that to gain clear desirable impacts of the planned system, appropriate strategies related to city planning have to be implemented. Such measures included allowing for high-rise buildings, improved linkages between public transport services and residential and industrial areas, TOD sites connected with a high-frequency public transport service, parking monitoring, and improvement of infrastructure for walking. It was felt these strategies would play a major role in changing the current city form positively. One interviewee from ADA felt a reshaping of the current city form would be necessary 'since it is the first project in Riyadh City; it will change urban development around the main public transport stations and around transit-oriented areas, which amount to 13 areas inside Riyadh City'. Another participant hoped that 'the successful operation of public transport in Riyadh City would slow down the current city sprawl'. One of the interviewees argued, 'due to economic growth, the low cost of travelling long distances by car, and no natural borders for Riyadh City, [has caused the city to] expand many times'. Generally, there was a belief among the majority of interviewees that the size of the proposed project in providing six lines of metro and bus networks and other transport services in Riyadh City would definitely change urban development, especially around public transport stations, corridors, and TOD areas.

5.2. City economy

Many participants argued that the capital investment of $22 billion in the city for building a new public transport system is a significant economic value added to the city's economy. One interviewee from ADA indicated that the project was expected to reduce unemployment by offering 15,000 jobs for Saudi society in public transport or in the surrounding areas, such as hotels, offices and shops.

They added that investing in public transport and related interventions undoubtedly will expand services and improve city mobility. The majority of interview participants stated that currently Riyadh roads are over congested and this adversely affects businesses and households' mobility, so they hoped that public transport would provide direct travel cost savings for those people who switch to use public transport services, leading to a shift in consumer spending. Some of the participants mentioned that public transport hopes to improve accessibility of the whole city which will aid travellers and improve productivity of city business.

Another interviewee stated that public transport would save the household budget, for example, nowadays each family would do more than four morning trips to different destinations. He added that in this case the family opt to pay more for costs associated with cars and hire drivers or arrange taxis. So, there is a general hope among the study participants that public transport would help reduce travelling costs when family members walk or need just one car to drive all family members to the nearest station following which they can reach their destinations by public transport.

5.3. City environment

The majority of interviewees felt that the Riyadh City environment would be positively impacted and that was one of the main objects of the project. For example, one of the participants stated that currently 17 million litres of fuel burn daily in Riyadh City as a result of reliance on private cars, so public transport will definitely help to reduce this amount and that would positively impact the city environment. Some of the interviewees felt that successful operation of public transport in Riyadh City would resolve the city's current environmental problems. One of the participants maintained that public transport is expected to bring about a 15% reduction in car traffic demand, which in the current time has exceeded 8 million vehicle trips, generating thousands of tonnes of solid waste.

5.4. Social norms and culture

Generally, it was felt that both social norms and the Saudi culture will be impacted by introducing public transport services related interventions, but it will take time for behaviour to become modified in comparison to other themes. Interviewees felt that there would be more social interaction along with the introduction of public transport services since daily journeys are a part of social life and culture. They added that the shift from private cars to public transport would result in a qualitative move and closeness in society. One of Riyadh Municipality interviewees thought that, 'Introducing a public transport system in Riyadh City would be one of the programmes to change social norms in a positive way'. The majority of interviewees thought that offering a reliable public transport service would make

people more aware of time and promote respect of public places. Another interviewee from Riyadh Municipality stated, 'More strict strategies are planned to be implemented along with introducing a public transport system in Riyadh City. For example, there will be safety measures and tools to restrict anti-social acts and protect staff, passengers and property of public transport'. The interviewee felt that these measures would encourage public transport use and at the same time play a vital role in the social life of communities. He added that 'there would be a penalty for using the public transport service without paying for a ticket and for any vandalism on all public transport facilities'.

6. Discussion and conclusion

The current study used semi-structured interviews to consider the wider impacts of the new public transport system in Riyadh City on urban form, economics, environment, social norms and culture. In line with the conclusions of Mackett and Edwards (1998) who expected that planned new public transport systems would have a similar effect to those in operation, the study findings show that the planned public transport system in Riyadh would make a positive contribution on all city aspects within different scales of time. City form would be more highly impacted than the economy, but in terms of timescale the economic influence of investment in public transport has already appeared since the RPTP work started. A medium impact is expected on the city environment while impacts on social norms and culture would take a long time to become obvious.

The study findings show that the current Riyadh City form is highly dominated by private transport infrastructure, and there is a disconnection between land use and other travel alternatives such as walking and cycling. As the RPTP is the biggest project in the country and the first travel alternative, study participants believe it will reshape city form. In line with this view, Amin et al. (2013) state that sustainable mobility shapes the urban form. TOD sites, park and ride schemes, metro stations and bus stops, and physical change measures to re-establish connections with public transport services would bring about dramatic changes in the current city form. Sustainable operation of Riyadh public transport and activating related interventions would decrease the rate of current city expansion and increase density. Cervero and Murakami (2008) maintain that physically TOD's features refer to three dimensions; density in accommodating enough population living within acceptable walking distances from public transport services; diversity in land uses and housing types; and design that embodies physical features encouraging walking, biking, and public transport ridership as well as social engagement.

Interview results show a widespread support for allowing high-rise buildings along public transport lines and surrounding areas. These are seen as necessary strategies to improve city sprawl, increase density, recentralise city activity, improve access to public transport services, and increase ridership. A recent study from Pojani and Stead (2015) confirms these findings as they found that success of non-motorised travel modes and public transport practically and financially required high density and mixed land use.

In economic terms, introducing public transport would lead to direct and indirect economic benefits broadening economic growth in Riyadh City. In the study results, the impact of spending on the project capital investment and operations cost will support the city economy through creating jobs and stimulating the economy. Moreover, public transport would lead to mixing land use and improving properties value. These results are in line with the

study by Aschauer and Campbell (1991) in the last decade and a recent study by Weisbrod et al. (2014) which states that investing in public transport supports the city economy in several ways, such as improving employment status and centralising the economic activities. As it is stated by Al-Mosaind (2001) and confirmed by the majority of participants, households' spending for daily mobility in Riyadh increased dramatically as a result of the spreading of the city, increases in average household size, and the unique social characteristics and culture. Thus, the study results revealed a general hope among the majority of interviewees that the introduction of public transport would reduce households' spend when they modify their travel behaviour by switching to use the nearest public transport station instead of private cars. Moreover, public transport would improve city accessibility, save costs and time for passengers and at the same time it would reduce congestion costs and improve automobile mobility, saving time and costs for peak period automobile travellers.

Nevertheless, the study results maintain that the sustainable operation of Riyadh public transport would improve city mobility on the whole and provide access for jobs and education; reduction of accidents will save lives and damage to roads and associated expenditure; and reduce emissions. All these results are in line with recent studies by Weisbrod et al. (2014) and Litman (2015) which classify the benefits of investing in public transport in urban areas to direct and indirect benefits.

From a viewpoint of environmental impact, the study results show that the traffic demand has exceed 8 million vehicle trips in Riyadh City, generating thousands of tonnes of solid waste. The city weather is dusty, dry and very hot in the summer. The city air quality shows elevated levels of pollution including Co_2 emissions and Particulate Matter (Alharbi, Shareef, & Husain, 2015). The study results show that Riyadh public transport is expected to reduce motorised travel by 10% to 15% and this reduction would increase with time when people become familiar with the service. Thus, sustainable operation of public transport in Riyadh City is hoped to minimise environmental pollution by reducing motorised travel. Riyadh public transport has been designed using solar energy and other environmental friendly power such as electric metro and ultra-low emission technologies for buses. The majority of the study sample argued that a sustainable national plan is needed to improve the city air quality and noise. It is important to raise awareness of environmental considerations in education and the workplace. Developing environment–friendly practices such as integrated and safe pedestrian networks in most important parts of the city will discourage the use of private cars and encourage people to walk.

There is less expectation that social norms and culture, which are regularly stated to be barriers of public transport ridership in Saudi Arabia, will be affected in the short-term as a result of introducing a public transport service in Riyadh City. The social norms and culture in Riyadh City are derived mainly from Islamic religion. This aspect must be taken into account and respected in all services and interventions maintaining the desired privacy and accommodating the belief that an unrelated man is not allowed to be alone with a woman (Doumato, 2003). Moreover, Riyadh society is highly reliant on private cars and has not been accustomed to any other kind of transport mode. The study findings show that changing social norms and culture towards public transport ridership in Riyadh City will need persuasive, soft measures directed at households and individuals. The shift from private car to public transport will result in a qualitative move and closeness in society. Providing a service which is comparable in time and comfort to using private cars is perhaps the major

challenge to persuade the general population to shift to public transport in Riyadh City (Aldalbahi & Walker, 2015).

Arguably, hard measures such as building infrastructure and pricing policies are not sufficient to change people's perception towards private cars and public transport (Zhang, Schmöcker, Fujii, & Yang, 2015). With reference to soft measures, the study means the quality of public transport service such as security, safety, comfort, convenience, and reliability would play major roles in influencing travel mode choice in Riyadh City. Litman (2015) argues that the quality of public transport such as providing a comfortable and convenient service would attract more public transport users, even if the trip takes somewhat more time compared to driving. Moreover, the study findings show that a sustainable public transport operation with a high quality of service such as reliability, security and safety would encourage ridership, as well as increase women's participation in employment and other activities. Moreover, general public campaigns and school lessons teaching general people and students the benefits of public transport services, how they can pay for tickets and information about prices, and how they would behave on board, would be essential strategies for social norms and culture to promote use of the public transport service. According to Aldalbahi and Walker (2015) changing Saudi attitude and then travel behaviour is a gradual process and will take a long time to be achieved. People will only change their behaviour if they have the opportunity, ability and motivation to do so (Boschetti et al., 2014).

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