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A CASE STUDY ON PERCEPTIONS OF PUBLIC TRANSPORTATION IN THE EASTERN PROVINCE OF SAUDI ARABIA

Summary. The Eastern Province of the Kingdom of Saudi Arabia (KSA) is home to almost 5,000,000 people and is a major contributor to Saudi Arabia's economic strength. The area has experienced population growth of about 3.5% per year and rapid urbanization over the past few decades. With this increase in population has come a significant escalation in automobile traffic, which, in turn, has contributed to poor air quality in the province. Two of the major cities in the area were listed on the World Health Organization's 2016 top 15 cities with the worst air pollution. Local studies have shown that vehicle traffic is a significant contributor to poor air quality and thus, eventually, climate change. Public transportation could alleviate some of the pollution. Unfortunately, overall past perceptions of public transportation and its negative connotations within the Saudi Arabian cultural setting have discouraged previous attempts to develop public transit services. Currently, KSA is progressing with metro works in the capital city of Riyadh and is considering what services to offer in the Eastern Province. This research involved surveying over 800 Eastern Province residents to determine whether they would use public transportation if it was offered, and what type of service they would expect. The response was positive and provided initial indications that public transportation is needed and would be utilized.

1. INTRODUCTION

The Eastern Province of the Kingdom of Saudi Arabia (KSA), with its larger cities of Dammam, the capital (pop. about 1,000,000), Al-Ahsa (1,136,000), Khobar (626,000), Qatif (559,000), Jubail City (436,000), Hafar Al-Batin (417,000), Dhahran (155,000) and many smaller cities and towns as well, is the third most populated region of Saudi Arabia. Saudi Arabia, and its Eastern Province, has experienced rapid population growth along with increased urbanization. The population of the Eastern Province has grown about 59% between 2000 and 2016 to 4,780,619. The Eastern Province is a major contributor to Saudi Arabia's overall economic strength. Some of the largest oil fields exist in this area. Dammam is a major seaport and Jubail City is an extensive industrial area. Commercial, educational and recreational development and employment opportunities attract immigrants within KSA as well, many from international countries. The immigrant population amounts to 25% of the total population of KSA, with many employed in unskilled labor [13, 17, 28].

With increasing economic, urban and population growth, traffic will continue to increase. Currently, the primary mode of transportation is via self-driven private automobiles. Some females in KSA can now drive independently, while others use drivers, who are usually a male relative or a male worker employed by the family. The increasing number of female drivers will most likely intensify traffic levels too. There is frequently gridlock on Eastern Province highways at peak travel times [13, 16].

Fig. 1. Map – Google Earth 2017

1.1. Automobile Traffic and Air Quality

Air quality in the Eastern Province is problematic. Specifically, two Eastern Province cities, Jubail (5th worst: 152 µg/m^3 of PM 2.5) and Dammam (tied for 13th worst: 121 µg/m3 of PM 2.5), are on the World Health Organization's 2016 list of cities with the highest levels of air pollution [35]. There is significant research linking high levels of automobile use and poor air quality. For KSA in general, transportation is responsible for 25% of its CO_2 emissions [32]. Tests performed in the Eastern Province in Dhahran found that traffic contributed 43-78% of the total extractable organic matter (EOM) of emission levels and that elevated levels of NO_x, NO and NO_2 were significantly linked to times when automobile traffic was at its worst [15, 26]. A study carried out at the center of Dammam found that residents were exposed to pollutants, based on an indicator of 40 kg/capita (NO_x) and 136 kg/capita (CO_2) and particulates higher than 31 kg/capita, which were twice as high (21%) as the ten percent standard set for sustainable communities [5]. Furthermore, as the population increases in the KSA, there will be a corresponding escalation in the use of automobiles and, therefore, carbon emissions. While the population in KSA increased by 41% between 2000 and 2013, the number of registered cars increased by 103% [23]. It was also found that a 1% increase in total oil consumption in KSA has the possibility of causing an 87% elevation in carbon emissions over time [3]. Moreover, higher incomes are related to increased CO_2 emissions, while reductions in income may not necessarily lead to a similar decrease in emissions [3]. Research has also shown that increased urbanization, more so than per capita income levels, is connected to carbon dioxide emission [29].

High levels of air pollution and particulate matter are shown to increase incidences of diseases and deaths, especially in developing countries. Numerous researchers have found links to asthma, respiratory problems, lung cancer, cardiovascular disease, stroke and premature death. They call for effective strategies to reduce air pollution in developing countries in general and the Middle East in particular [13, 16, 21, 33, 34, 35]. These strategies, among other suggestions, include adequate and inclusive public transportation systems.

1.2. Climate change

The Arabian Gulf in general and Saudi Arabia in particular have experienced significant climate change in the past few decades. Current ambient temperatures have increased by 4ºC over the average temperatures in 1960. Warmer days and nights last longer into the winter season, decreasing the number of cold days in the year, while precipitation has also decreased in the same period [4]. These changes are believed to be influenced, in part, by human activities in the area. Based on various studies, CO_2

emissions are the primary cause as they represent an 80% CO_2-equivalent of overall emissions and, for the past decade, have been increasing by 8% per year [4, 6, 7, 10, 22]. If there is no mitigation in CO_2 as well as other emissions locally and worldwide, the Eastern Province may become dangerously hot and difficult for human habitation by the end of this century [19, 22]. A study of KSA citizen attitudes toward climate change reveals that most believe that there climate change has occurred. Of the people surveyed, 98% agreed that climate change is occurring, 81% believed that it was the most severe problem in KSA. Furthermore, 92% believed that human activity is the cause and that lack of energy conservation is also responsible for this. About a third felt that the government should be more involved in climate change mitigation programs [4, 14, 27].

1.3. Social Dimensions

Sustainable public transport systems also must consider that any public transportation solution has to equitably accommodate all users. In the Eastern Province, the relatively high economic status of KSA citizens, as well as the poor quality of what limited public transportation is available, encourages heavy car usage. One study found that even if public transit were provided, wealthier families would still prefer to drive [24]. Where there is heavy use of private cars and lack of public transportation, people who cannot afford vehicles become segregated and tend to be excluded from economic opportunities, which further limits their access to equal prosperity [8, 9, 20, 34]. Moreover, the impression that public transport is meant only for those who cannot afford private vehicles, for example, for wageworkers, what affects the significance of any available means of public transportation [20, 30]. To avoid these problems, there must be carefully designed transit systems that include development input from all economic levels, genders and ages. With this information, the systems can provide access to cultural and economic opportunities that are otherwise financially out of reach for those without vehicles [34]. Public transit in the Eastern Province could offer increased mobility and access to work, school and services that might not otherwise be available to some populations.

1.4. Public Transportation

The availability of public transportation in KSA is increasing, but public transportation in the Eastern Province is currently inadequate and overall negative attitudes toward public transit systems are prevalent. Saudi Arabia is updating its transit systems in the capital city of Riyadh, Jeddah, Mecca and Medina, and has proposals for two metro lines in Dammam, with authorities considering what services to provide [18]. A study of transport offerings found that about 2% of KSA city dwellers use public transportation and the perception is that these are male, lower-income expatriate laborers. Well over 85% of urban residents use private transportation. Some companies and educational institutions provide buses to transport their employees, but very limited government or privately sponsored public transportation presently exists. What is available is described as inadequate and of poor quality [2].

KSA culture also dictates certain limitations to public transportation use. Privacy concerns for KSA women often restrict their use of public transportation. Although the trend is changing, women typically require a male guardian (husband or immediate male relative) to accompany them when they travel, and interactions with males who are not immediate relatives are to be avoided, when possible. Most women travel by private car or car pools driven by relatives or hired drivers. Since hired drivers are foreign and trusted family retainers, women may travel in the back seat as with a chauffeur. Other forms of travel such as public taxis or online ride calling companies like Uber and Careem do provide culturally acceptable travel, but not all families allow their women to use these services. Due to undesirable perceptions and lack of cultural acceptance, many men and women historically appeared to feel that public transportation was not a viable or safe option for travel within KSA cities [1, 2].

1.5. Acceptance and Effects of Public Transportation in other GCC Countries

In nearby Gulf Cooperating Countries (GCC), public transportation has expanded and is increasing in acceptance. The United Arab Emirates (UAE) public transportation operated in Dubai has enlarged its ridership from 6% in 2006 to 13% in 2013, with the expectation to increase to 20% by 2020. The metro system that started in 2009 is credited with the increase in public transportation use. The UAE estimates that the country has reduced the per capita road sector energy consumption by 17.5% between 2000 and 2013 [23, 25]. Data on recent travel with the use of the Dubai metro showed that expatriate workers were the primary consumers of the service. In 2015, Bahrain started bus-based mass transportation and there has been a steady increase in the daily number of users from 46,500 in early 2015 to 72,500 in late 2016 [11, 12, 23]. Both of these countries have more relaxed cultural boundaries than Saudi Arabia, visibly demonstrated by their acceptance of female drivers and independent female travel.

1.6. Goals of this study

For the reasons cited above, a public transportation system would benefit the Eastern Province. International studies as well as internal KSA environmental assessment mention the importance of public transportation systems for environmental improvement [3, 16, 35]. The potential reduction in traffic would alleviate gridlock as well as improve air quality. It could increase travel options, beyond private cars, to work, school and shopping that currently have limited public transportation availability. Assessment of the attitudes toward public transportation was required to determine whether implementation of a system would be accepted by male riders and female patrons including permission to use the system by their male guardians. Another aspect was to discover when and where people would travel so that it could inform preliminary planning of a comprehensive system.

2. METHODOLOGY

2.1. Outline of the questionnaire

A survey was designed and distributed to assess the interest in a public transportation system in the Al Khobar/Dammam area of the Eastern Province and residents' willingness and readiness to use public transportation. The goal of the survey was to collect as much feedback from the public in these locations as possible. The survey was conducted in person and consisted of two parts: basic demographic questions and public transportation use questions. In all, 834 surveys were collected.

2.2. Survey respondents' characteristics

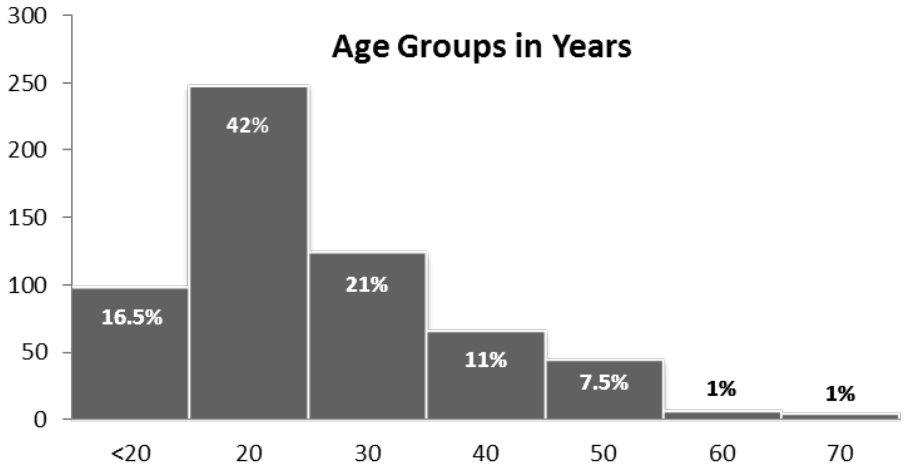

Fig. 2. Respondents' age information

Questions about age and gender show that about 43% of the respondents were male, 57% were female and the majority of the respondents, 79%, were younger than forty years of age, with a median age of 28 years. This young age range reflects the median age of the population in Saudi Arabia, which is about 25 years [17]. Fig. 2 illustrates the age groups of the participants who took part in the survey.

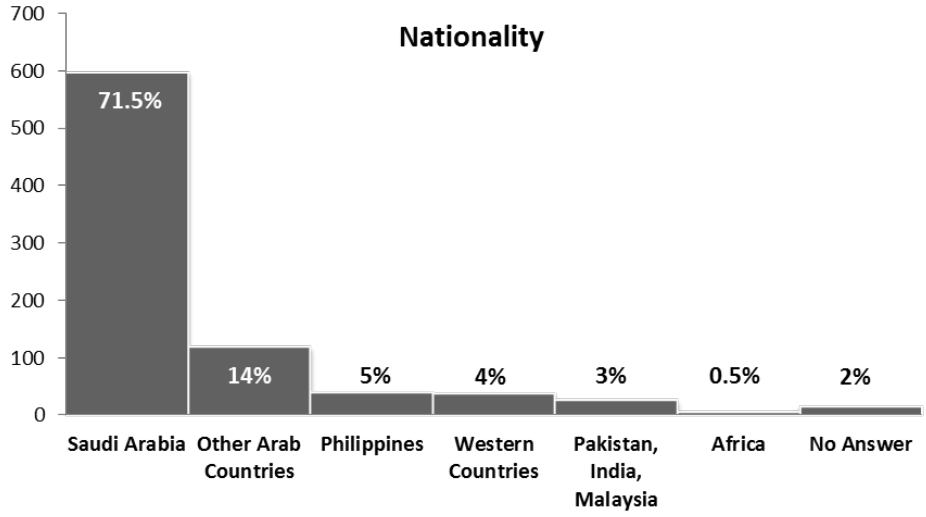

Fig. 3. Nationality groups

Respondents were also asked to disclose their nationality. This could be relevant since many residents in the Eastern Province are expatriates from international locations, are less likely to have private vehicles and could be primary users of a transit system. As shown in Fig. 3, almost 72% of the respondents were Saudi Arabia Nationals and another 14% were from other Arab countries. The remainder represented people from the Philippines, Asia and Africa; respondents from Western countries including Canada, Great Britain, Australia, New Zealand, Europe and the United States were grouped together into one category.

3. SURVEY RESULTS

3.1. Use

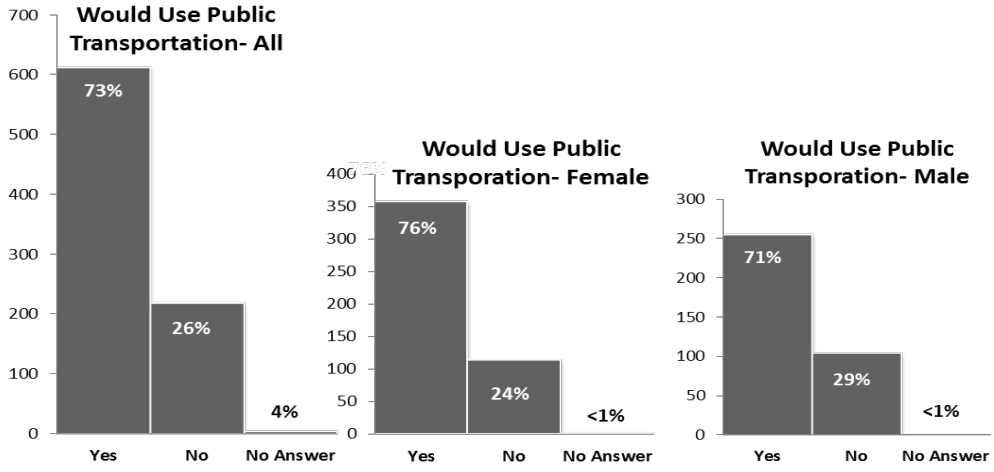

Fig. 4. Gender differences in answers

Of all the people surveyed, a little more than 73% stated that they would use public transportation if it was available. When male and female respondents were analyzed separately, there was very little variation from this percentage: women answers were nearly 76% positive and men answers were almost 71% positive. Fig. 4 illustrates these responses. Analysis of KSA nationals in comparison to international residents revealed results for each set similar to the entire group, as did separation by age ranges. The majority of all respondents stated that they would use public transportation if it was available.

Male survey takers were asked whether they would allow their female relatives to ride on public transportation. This was an important question to ask since male guardians would need to agree to women traveling on public transit systems for the system to be viable. Most, 68%, responded that they would allow female relatives to use public transportation. Here too, analysis of KSA nationals, international residents and separate age groups demonstrated little variation from these results. Among younger males (<40), 74% stated that they would allow females to use transportation.

3.2. Service Availability

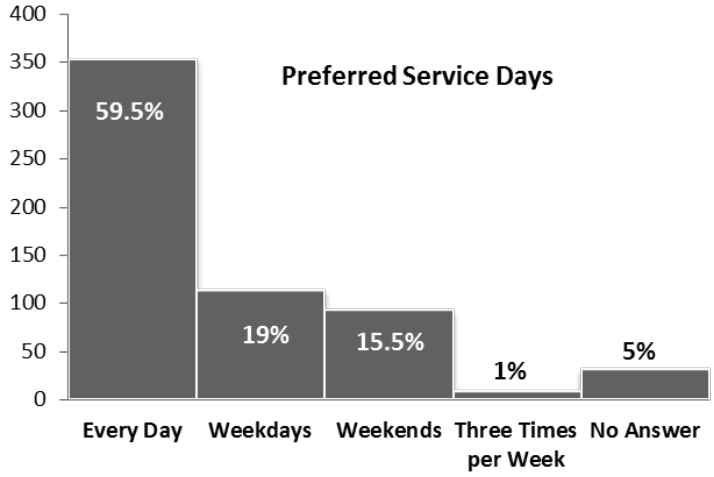

Fig. 5. Preferred service days

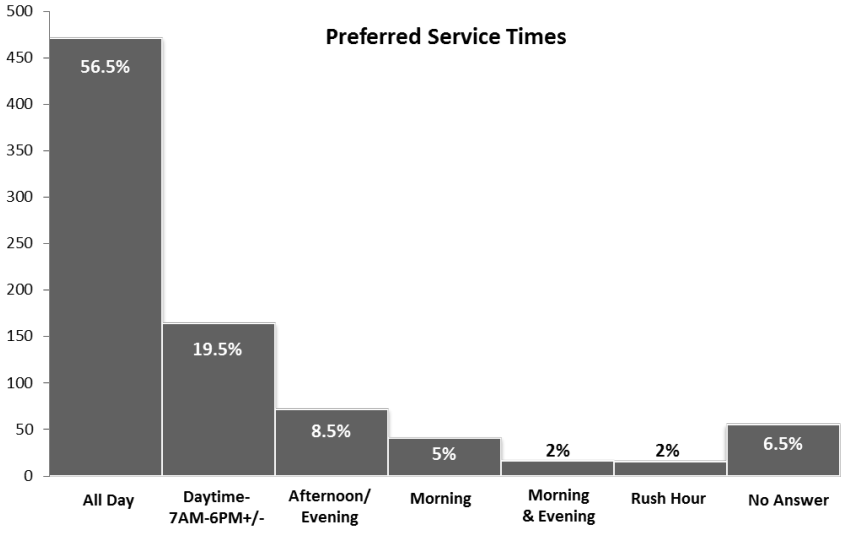

Fig. 6. Preferred service times

When asked which days would provide the best public transit service, the majority of respondents preferred service every day (59.5%). This was followed by weekday-only service (19%) and weekend-only availability (15.5%). Similarly, during question what times would offer the best service, 56.5% percent of the respondents stated that they would like an all-day (24 hour) service, with daytime service preferred by another 20%. Figures 5 and 6 show responses on the preferred service days and times.

3.3. Service Locations

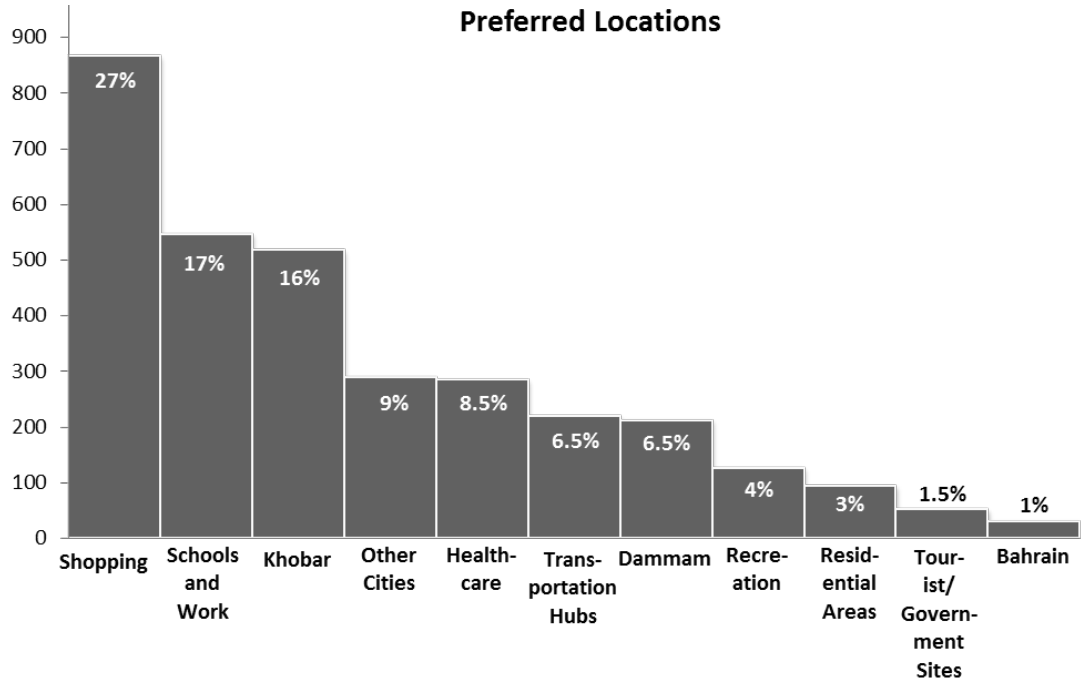

Fig. 7. Preferred locations for travel

To provide an idea of where the public transit system should run, respondents listed the five most important locations they would like to have as stops on the system. Since this was an open question, a wide range of locations was listed. However, several general areas were repeatedly mentioned and these were grouped and are illustrated in Fig. 7.

Shopping seemed to be the highest priority for transit stop locations. Twenty-seven percent of the respondents itemized malls in general, as well as specific locations, such as Rashid Mall and Dhahran Mall and supermarkets. Downtown Al Khobar, and the corniche both in Al Khobar and in Dammam were also important. Many people (17%) requested stops at schools, universities and work locations to make commuting to their daily school/work obligations easier. Transit to the airport, train station, bus station and local hospitals was also requested. Some stated that they would like transportation between cities in the Eastern Province and beyond, such as Qatif, Jubail, Riyadh, as well as the neighboring country of Bahrain.

3.4. Comments

Respondents were asked to add comments. In general, comments focused on several key points. First, the transit service would need to be safe, especially for women. In addition, the vehicles would need to be clean and service must be reliable and on time. Many comments indicated the need for some sort of public transport, while others underlined the desire to own and drive a private car- with or without a driver. Several respondents also commented that a public transit system would improve traffic conditions in the area. Comments made in the questionnaire frequently refer to the importance of

women's freedom of movement. Fig. 8 lists selected comments that reflect both approval of and concerns about public transportation.

- Good planned stations, clear schedule, good drivers, nice waiting area, clean buses, ticket shop
- No need for driverless cars, gas
- Transportation is a very good thing. We need to develop it.
- I wish we get this fast as we can coz we can't drive.
- Not safe for women. Public transportation is a service so if it is not helpful for all people, there is no use of it.
- Useful if transport provided to schools as many students find it a major issue. Payments should be electronic using advanced technology. All machinery tested and approved. A security check point should be present before entering the station for passengers' safety.
- Need to be clean, reliable and efficient. If transit similar to Dubai in this area it would alleviate traffic congestion and make movement around the city, especially for females, easier.
- Have own car. Women - why not!!!
- I wish there was public transportation
- Public transport as in other countries. Women should be free to do tasks alone. Streets are crowded
- Please we need this instead of going with taxi or driver. It would be more safe, comfortable and match with our customs as women not allowed to drive.

Fig. 8. Selected respondents' comments about public transportation

4. ANALYSIS

Based on the responses to the surveys, it appears that attitudes toward public transportation in the Al Khobar/Dammam area of the Eastern Province are essentially positive. The respondents preferred full service coverage and their requests for connections were predictable for planners. Responses showed that routes that pass close to major shopping centers, schools, work hubs, hospitals and downtown areas as well as connect to transportation hubs such as the airport and train stations are needed. A twenty-four hour, everyday service would provide the greatest access and convenience for all users. There were some negative comments reflective of attitudes based on previous inadequate forms of transportation and traditional cultural philosophies about the protection of women. However, if transportation authorities are careful about respecting cultural norms, providing clean, safe and modern transit facilities, the data indicate that there is interest in public transit in this area. This can only benefit the Eastern Province through replacing cars on the road by public transit vehicles, which would ease traffic congestion, reduce traffic noise, diminish air pollution with its negative health effects and contribute to reduction of CO_2 emissions, as well as provide access to work, school and shopping to those with limited transportation access.

This study finds that despite former negative views toward public transportation, residents of the Eastern Province would be interested in a clean, safe, well-operated public transit system. Further extensive study should be pursued to more fully involve stakeholders including low-income Saudi nationals, expatriate laborers, most of whom do not own cars, and residents of other areas of the Eastern Province. This would more completely determine the overall acceptance and services required. In addition, with an increase in the number of women drivers in Saudi Arabia, it would be interesting to gauge if attitudes toward public transportation will change as an increasing number of women drive and own cars.

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