THE FEASIBILITY OF IMPLEMENTING PUBLIC TRANSPORTATION IN JEDDAH

A RESEARCH PAPER

SUBMITTED TO THE GRADUATE SCHOOL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE

MASTER OF URBAN AND REGIONAL PLANNING

BY

AHMAD SHAKKER

KELLY, ERIC DAMIAN-ADVISOR

BALL STATE UNIVERSITY

MUNCIE, INDIANA

MAY 2014
Public transportation creates alternatives for people so they can move from one place to another. Citizens move from their houses to their work place and other services like hospitals and stores on a daily base. Public transportation provides them with a comfortable and efficient option to transport them to the places they want to visit. This study addresses the feasibility of implementing a public transportation system in Jeddah, a city that lacks an efficient mass transit system. The study demonstrates how public transportation can thrive in a place where cheap gas is available and the city has high car ownership percentage. Jeddah, a well-known city in Saudi Arabia located on the west coast of the country is the focus in this research paper. The research addresses the major problem point which not having an efficient public bus system. In order to fix the issue this research demonstrates literature answering questions related to the subject. Three case studies about different cities which are Dubai, Houston and Rio de Janeiro are conducted in this research. Each of the three cities shares similar characteristics with Jeddah and
offers lessons related to the public bus system. Lastly, the research conducts comparisons and proposes a conclusion for Jeddah public bus transportation issue.
Table of Content

Introduction and Problem Statement ................................................................................. 1
Background of the Study ..................................................................................................... 3
Objectives of the Study ....................................................................................................... 7
Significance of the Study ..................................................................................................... 9
Literature Review Chapter ................................................................................................. 10

Chapter Outline .................................................................................................................. 10

The importance of transit ................................................................................................... 11
Modes of public transportation ............................................................................................ 13
The Bus System .................................................................................................................. 13

The local bus ....................................................................................................................... 13
The express and rapid bus .................................................................................................. 14
The Rail System ................................................................................................................ 15

The Light Rail .................................................................................................................... 15
The Rapid Rail ................................................................................................................... 15
The Commuter Rail .......................................................................................................... 16
The Challenges in Applying Rail System in the Middle East .............................................. 16

Where Would the Public Bus System Run and Who Would Use It? ............................... 18
How Would the Public Buses Operate? ............................................................................ 22
Who Would Be In Charge of the Public Bus System and How Would We Finance It? .... 28

Case Studies ...................................................................................................................... 32

Chapter Outline ................................................................................................................ 32

General information .......................................................................................................... 33
The Public Transportation of the City: ............................................................................... 34
The Current Public Transportation Indicators .................................................................. 36
Transportation Issues ......................................................................................................... 36
Conclusion: ........................................................................................................................ 41

Rio de Janeiro Case Study .................................................................................................. 42

General information .......................................................................................................... 42
The Public Transportation of the City ............................................................................... 43
The Current Public Transportation Indicators .................................................................. 43
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation Issues</td>
<td>45</td>
</tr>
<tr>
<td>Conclusion</td>
<td>49</td>
</tr>
<tr>
<td>Houston, Texas Case Study</td>
<td>50</td>
</tr>
<tr>
<td>General information</td>
<td>50</td>
</tr>
<tr>
<td>The Public Transportation of the City</td>
<td>51</td>
</tr>
<tr>
<td>The Current Public Transportation Indicators</td>
<td>52</td>
</tr>
<tr>
<td>Transportation Issues</td>
<td>53</td>
</tr>
<tr>
<td>Conclusion</td>
<td>57</td>
</tr>
<tr>
<td>Comparisons</td>
<td>58</td>
</tr>
<tr>
<td>The Department in Charge</td>
<td>58</td>
</tr>
<tr>
<td>Population comparison</td>
<td>58</td>
</tr>
<tr>
<td>Car ownership rate</td>
<td>59</td>
</tr>
<tr>
<td>Public bus transportation comparison</td>
<td>60</td>
</tr>
<tr>
<td>Work commuters</td>
<td>63</td>
</tr>
<tr>
<td>Bus system routes map comparison</td>
<td>64</td>
</tr>
<tr>
<td>References</td>
<td>68</td>
</tr>
</tbody>
</table>
Introduction and Problem Statement

Since I started my Urban Planning education, I always have been fascinated by the transportation methods that we use. Day after day, the importance of transportation is rapidly growing. We as human beings have been evolving, and our transportation methods were evolving with us. We evolved from using our legs to walk to taming the animals to transport us from one place to another. In the current time, we have adapted machines and developed them so we can use them to transport us. The first mechanized transportation method that emerged was the train, but everything changed when the car was invented. Moving from one place to another was easier than before thanks to the private car. The mass production of cars made them available all around the world in different shapes and sizes. With the significant increase in car ownership has resulted in many impacts on both the environment and the urban settlements. One of the ways that planners found is implementing mass public transportation means within the cities that connect them with other cities.

Public transportation creates alternatives for people so they can move from one place to another. Citizens move from their houses to their work place and other services like hospitals and stores on a daily base. Public transportation provides them with a comfortable and efficient option to transport them to the places they want to visit. The study that I am address is the feasibility of implementing a public transportation system in a city that lacks an efficient mass transit system. The study is going to demonstrate how public transportation can thrive in a place where cheap gas is available and the city has high car ownership percentage. It’s our duty as planners to provide the citizens with a basic movement service they can access without the need of possessing a car. Hoping to achieve that with this study the research is going to present a plan
to solve an existing problem in a city. The study will be implemented in a city located on the west coast of Saudi Arabia called Jeddah.

Living in the United States for almost 3 years made me realize how important public transportation is. During my stay I lived and visited different places. As a student coming from a country that is dependent on oil, using public transportation vehicles like busses and trains is a fresh experience. Throughout my experience, the places that I have visited which provided efficient public transportation options have changed my perspective. At first, using the train or the bus was annoying. After a while, I came to realize that using public transportation is actually more accessible than using the car. Probably one of the main benefits that public transportation provides is reducing the traffic in addition to reducing the sprawl of the city and preserving the environment.

Our cities in Saudi Arabia are growing rapidly due to its fast development and population increase. As any developing country, the race for providing services on different levels in Saudi Arabia is always on the governments high priority agenda. Despite the government intention for implementing public transportation, the focus on serving private cars always takes more attention. One of the real reasons behind not initiating public transportation plans is still a mystery for me. Implementing the plan might face obstacles. The main reasons are the cheap oil and the culture of the residents. Since oil is very cheap, people’s preference is to use their cars. Because of using the cars for generations and the bad condition of the current busses, that created certain stigmas against using public transportation. However, our job as planners aims for providing adequate options and try to reveal their benefits to society. That is why I am interested in this subject and determined to fix the problem. I believe that people deserve more options in mobility other than private vehicles. In addition, it will achieve a better built environment for
future generations. The world is advancing in developing more sustainable cities by improving their transportation methods. We should take the step toward a better built environment by balancing public and private transportation.

**Background of the Study**

Public transportation is a subject that encountered and is still encountering difficulties that prevents it from being functional or even existing. The main issue that usually reduces the quality of public transportation is the size of the city. The bigger the city, the more compound problems it will deal to the transportation system. Applying public transportation on small populated cities like Indianapolis for example, would be easier than applying it on a more densely populated city like Chicago. We also have to mention another factor which is the presence of an existing network. Improving an existing transportation network is different than constructing a new one from scratch. Density is also another critical issue. The population has to be dense enough to maximize the mass transit efficiency. Most of the problems are usually related to big urban areas, particularly when it’s trying to keep up with the rapid development and growth of the city itself. Satisfying the customer is always a goal that has to be accomplished.

Going back to the metropolitan areas concept, citizens of these areas are reliant on how fast they can accomplish their objectives by maintaining their businesses and jobs. That is profoundly related on the mobility, accessibility and the speed of their commute. The longer the commute, the more frustrating it would be to the commuters. Commuting is not exclusive for the residents within the city; it can extend to include those who live beyond that. We have to remember that the further the homes are from the work place the longer the commute is going to
be. Therefore, commuters will spend large portions of their time commuting from one point to another.

The transport mode whether it is bus or train has to ensure decent levels of relaxation and comfort in order to please the commuters. Another issue is the density of riders. Whenever there is high concentration of crowd especially during rush-hours, it will increase discomfort among the riders. In addition, low ridership will impact the transit system as well. Maintaining decent number of riders will help to sustain the service. Small number of commuters will have a negative impact on the income; consequently it will threaten the existence of the whole transit system. During the process of finding whether implementing public transportation is possible, we have to think about the space it’s going to occupy. Like roads and streets, transits and buses require areas that are taken from the public space. Station, tracks and designated stops are required. Even though public transit generates less pollution than cars, during the construction and operation phase it will still produce pollution. The noise produced by the circulation of the public transit is going to impact the areas surrounding it. The prices of the housing units are going to be reduced if they were next to rail lines for example.

We have to address the possibility of traffic accidents, especially in developing countries. A main issue for the places that are dominated by cars in metropolitan areas, the traffic congestions will affect the efficiency and time travel for bus circulation. In fact many problems are associated with the dominance of the private car. It’s going to be the major obstacle facing public transportation. That is backed by the fact that cars have high comfort and convenience levels. The car under the obsolete control of its driver, he or she can ride it whenever to wherever. People’s sense of freedom is always owning a car. To be realistic, if the person was given the choice between using a car or public transit, he or she will prefer using the car. Mass
car production, financing and the market demand are factors that pushed the position of cars to conquer the first place among other transportation modes. Governments without realizing are supporting the rule of the car. Cars need roads to be driven on. Even if the consumer bought a car, it still needs a street so it can move on. Local and federal governments are bearing the entire cost for building highways without any mentioned charge on the consumer.

In Saudi Arabia the focus has been always on highways. On the national level, public transportation is not being focused on. The first rail way that was constructed was between two cities, Riyadh and Dammam. This rail road wasn’t getting enough maintenance during its operation years and it has a bad reputation among the public due to its malfunctions. In recent years, The Saudi Railways Organization has proposed a new railway network that connects the major cities on the west coast, center and east coast of Saudi Arabia. On the regional level, the main focus is transporting pilgrims from the airports to the holy city of Mekkah.

Mekkah currently has a public rail system that transports the pilgrims from the city to the other sacred places during the pilgrimage month. Except that rail system, there is no public transportation system that exists in the region. On the local level, Jeddah has no official current public transportation system. Unorganized bus service that is managed by the bus owner without any designated planned paths is the only alternative. These bus owners still have to register and have permits from the government in order to pick up customers. According to what we mentioned, public transportation is not actively present on many levels. There are many future plans to provide more mobility options for the citizens. However, most of the plans are for railroads not bus networks.
In order for public transportation to thrive it has to be more appealing than cars. Public transportation co-exists with riders. Comfort, efficiency and price are the recipe of success. How to achieve that though still depends on the situation of the place. Car usage has to be more regulated. Many methods have appeared like downtown control. Still, financing has a huge role to play for the public transportation to happen. Without finance and good public participation, public transportation concept would appear impossible to accomplish.

Creating public transportation system in Jeddah is far from being simple. The challenges can be summarized in the following. The city’s fast and unorganized growth forces the municipality to focus on solving day to day problems. Gas price is considered one of the cheapest in the world. If the gas price is low the number of people who own cars will increase. Limited spaces in the city prevent the developer from developing locations for stations and stops for the transportation vehicles. These are not all the limitations that stand between constructing public transportation; however they are very important factors.

In this research we are going to see how we can implement public transportation in a place with certain characteristics. The knowledge that is being gathered and researched about the subject is going to make a better understanding of what kind of remedy the place needs. Creating public transit from the beginning, controlling the usage of cars, and certain cultural issues are going to be the major guides. Not many studies have been conducted on such a distinctive environment. The location has remarkable characteristics which will require a special planning solution. It’s a place that has limited options to provide mobility rather than private cars. People who don’t have cars have no option but to use taxis instead. The natural environment discourages walking or standing outside due to the extreme weather. It can be forgotten that it is a religious driven culture. Most aspects of the citizen’s life choice are driven by strong religious ethics. Not
many studies have been conducted on environments like these. However this research will provide applicable remedies that will benefit the planning field.

**Objectives of the Study**

This research will assist in fixing the current public transportation problem in the city of Jeddah. It will also examine the current situation in depth and provide answers. Being born in the city and living there most of my life, I have seen what the city was and what it became. The city has a high potential to be one of the best planned cities. This study has promising potential to find other solutions in the transportation field that others have missed.

The research scope is going to focus on a definite angle of the transportation problem in the city of Jeddah. Due to its significant location on the west coast of Saudi Arabia, the city is a hub station to many trade businesses and travelers. In line with the city’s importance, it needs public transportation options. Trying to fix the problem as a whole would take a bigger collaboration between many sides. For the purpose of this research, the scope is going to be narrowed on exploring the feasibility of implementing a public bus system in the city. The research is going to search the root of the problem that prevents the city from having an efficient public bus transportation system. The study will include the city contractual boundaries. Knowing the current situation of the road network is important. The people’s opinion of having public transportation in the city is very critical. Since the Saudi culture is distinctive, it will reflect on the kind of vehicles they see suitable to use. Then we have to test the hypothesis on a certain location. The testing site might be conducted on the downtown area since it is the densest. The location will be picked according to what result the research will give.
Essentially it is a test that will aim to extract answers and solutions to the bus problem in the city. Many opinions relate the situation to the low-cost of gas price. The country is ranked as one of the top five oil exporters in the world. That could be a legitimate reason; however it may not be the only cause. As any developing country, the fast growth of the major settlement would determine the government priority. As the growth reaches its peak, the demand for roads and highways takes the biggest share of attention while public transportation share decreased over time. Judging on the current city situation, would it be realistic to implement public bus systems? If so, what would be the rationale and effective solutions to overcome whatever obstacle is facing that implementation? This is the major research inquiry that needs to be answered.

There is big relation between using the car and using public transportation. We have to admit that people prefer to own and drive cars by themselves than use the public-transit. There is a big connection between these two variables. Whenever the use is high in one of them, the rate will decrease for the other. Travel time, prices, comfort levels, and efficiency are variables that are going to affect each other surely. Variables like land use, population density, income and the existing road network will determine what the final concept would be like. We can create public transportation if the density is not enough. If the density is high, the existing road’s network needs to be studied so we would know for sure how the public bus network would be modeled. The income of the population is an important factor. Usually the bus riders are from the lower and middle income class. Some other variable may appear through the study that wasn’t mentioned. During the research we will know for sure whether the variables are related to each other or not.
Significance of the Study

Public transportation has an important role to play for the future of Jeddah development. Answering the question of why the research is important would be similar to why public transportation is important. Looking at Jeddah population growth, we will see that the population increased from 1.3 million in 1978 to 2.8 million in 2004 (Jeddah Municipality, 2009). The population projection is that the number of people will exceed 5.6 million by 2030 (Jeddah Municipality, 2009). This significant growth will be accompanied by more services required. In addition, the city will need double the current service space. It means that Jeddah will need to double the roads space to serve the additional people. Having public transportation won’t just lessen the amount of streets space needed, it will preserve the character of the city. This research is important for its economic benefits and it will increase the mobility for residents.

The research will contribute in the field of urban planning by giving a unique case study. Jeddah has a unique characteristic in both built environment and culture. This research will open new doors to development. It will provide the citizens with better mobility option specially women. Since females cannot drive yet in Saudi Arabia, public transportation will provide an alternative method for them to travel around the city. By demonstrating the current condition of Jeddah, the research will reflect the present, the future and the past.
Literature Review Chapter

Chapter Outline

Public transportation is a hot topic that is being focused on by cities all around the world. Leaders in more cities have come to realize that role of single occupancy vehicle as the main transportation method eventually has to get less important than other alternative transportation modes. In this chapter we will review what has been mentioned about transportation by the pioneers in transportation planning and the transportation body of knowledge.

Secondly, it is important to know what has been done in Jeddah itself. Reviewing what has been published about the progress for public transportation in the city would provide a realistic approach. That includes viewing the past, current and future plans of Jeddah city. This part is essential to the research because it will show what the government has been doing in relation to public transportation. Without this section, the research would build false assumptions about the situation in Jeddah which will lead to weak and ineffective solutions at the end.

Thirdly, this chapter will include examples of what other cities have done in the field of public transportation. These cities are going to be demonstrated by showing their plans and results.

Generally, each city will form a single case study. How did each city manage to apply alternative public transportation systems? Did the city count on an existing system that previously accomplished in the past, or did the city have to start from the beginning? The answers to these questions will be included in this section. Providing comparable case studies will help to discover how these cities managed to apply public transportation methods. In
addition, the case studies will assist the research to produce an applicable solution for the city of Jeddah.

**The importance of transit**

In recent years, recognition of the importance of transit has been growing. Planners began to realize that development thrives near new light rail systems. Upon that discovery many places, especially the U.S, came to realize that development is related to transit. Even though this concept gained more attention lately in metropolitan American cities like Boston and Chicago, neither of them are considered new to this concept.

Obviously, transit oriented development needs a transit system for the development to occur. Many terms are used to describe this concept. The most common used term is TOD which means Transit Oriented Development. This term was described by Peter Calthrpe in 1990, an urban designer that is one of the founders of the new urbanism movement. There is another term which was used which is Transit Villages. This term was mentioned in by Bernick and Cervero (2004). Some other terms was published too like “transit-forced development”, “transit station communities”, and “transit related development” (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004).

Development can benefit both communities and transit if it is well executed. In the United States, many people argue that transit only captures 1 percent share of the personal travel (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004). Therefore, they argue, investing in travel is wasteful. Transit oriented development helps to counter that argument. It will not just benefit the community surrounding it; it will create a better and healthier transit market that justifies the investments. Communities also benefit from developing
around transit because it will reduce driving time and create better walkable environment with more mobility options (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004). The four main components of transit related development are density, diversity, distance and design. Usually, transit related development provides many services around the stations within walking distance. Plus it will deliver a good connection for pedestrians between the station and their residence. It will reduce the importance of parking by orienting the buildings around the streets. If we took a look at old neighborhoods, we will see that most of them are developed around the available transit. Developing around transit will help the neighborhoods to be more organized and it will provide more chances for more projects to be constructed.

One of the criticisms against developing around transit is that it doesn’t fix the sprawl of the city. According to (Dunphy2004) “solving sprawl; would require a consensus on the benefits of the alternatives to sprawl and willingness to say no to inappropriate development” (p. 5). This means that developing around transit will not repair the sprawl problem entirely; however it is a big step toward doing so. There would be a problem in the developments around transit. The problem would emerge if the development failed in linking the transit and the surrounding land use pattern to support the transit. The key to success lies with the functionality between the transit and development. The location of the transit has to be studied carefully so it covers high number of ridership or it will fail to sustain itself.

The city of Jeddah would benefit from developing around the future created transit systems. It will spread more development together with improving the built environment in the neighboring real-estates. So much potential lays in applying public transportation systems in Jeddah. However, transportation methods have many forms and modes. Before deciding which mode should be applied we need to review the transportation options.
**Modes of public transportation**

Transit systems have many modes. Mainly, they are a combination of busses and trains. However, in some cities it may extend to include water transportation like ferries. Consequently, these two main modes have evolved to include local buses, express busses, rapid bus, light rail, rapid rail and finally commuter rail.

**The Bus System**

**The local bus**

In the beginning we are going to review local busses as our first mode of transit. As (Dunphy2004) described “The bus is the workhorse of public transit”. He also mentioned that two-thirds of the transit trips in the United States are carried with buses. Local bus is considerably slow. The average speed of the bus goes around 13 mph. Since the bus runs in the local level, the stops that it makes are frequent and convenient. Planning for local busses should be fixable. Adjusting the bus route or increase the number of busses in case of abnormal events like car accidents or natural hazards should be considered. Looking at the huge amount of riders that the local bus transport every year, we realize the importance of local bus system. However, it doesn’t provide big development around the bus stops. It is accurate that the bus stop will improve the accessibility of the place, but it will not increase the property value of the surroundings. That is in relation to the distribution of the bus stops around the area itself (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004).
The express and rapid bus

The second types of busses are the express and the rapid transit busses. The main difference between these types of busses and the local buses are the speed and the number of stops. Express buses transport the riders between two major destinations with few stops between (Dunphy R, Deborah M & Pawlukiewicz M, 2003). The express bus in fact is faster than the local bus in average speed. As for buses of rapid transit, they are express busses that have an exclusive lane on the roads. On these exclusive lanes other type of vehicles like cars or trucks are prohibited from driving on them. Rapid transit busses are relatively similar to the rail system. They require bus stations, fast busses, and efficacy in loading and unloading the riders. Dunphy R, Deborah M & Pawlukiewicz M (2003) mentions how bus rapid transit is growing in popularity around the world in many cities. Express bus service offers fast transportation option. With fewer access points and stops, properties around express busses have higher value in comparison with local bus stops. It has relatively similar effect on property value as rail stations. In many cities like Ottawa, Adelaide, Brisbane, and Curitiba have proved that bus rapid transit systems can achieve both economic and land use benefits that is similar to those generated by the rail systems.

According to Jeddah municipality, 4 percent of the trips in Jeddah are done by busses while 10 percent are done by taxis. Currently, according to the Saudi Company for Public Transportation, the bus service is not reliable. Many indications show that the service is not in the reach of the public and there are no specific paths. In addition there is an existing unorganized bus service that is run by individuals. This service is used by a certain crowd which is usually from the working category among the citizens.
The Rail System

The Light Rail

Shifting gears to view a third mode of transportation which is the light rail system. Light rail vehicles are an enhanced concept of its predecessor the trolley or streetcars. The light rail tracks are located on either streets or separate ways. Since the light rail might have tracks on the street level, its speed would be an average of 20 mph. This speed might get lower as the traffic increases on the streets. The light rail efficiency is dependent on the conditions of the streets they are running on. The streets traffic might have an impact on the travel time of the light rail if they were running on the same street. Currently in the United States, most urban places prefer to construct light rails among other rail oriented transportation systems. The reason is because light rail are more fixable and cost less to develop. In comparison with buses, light rail services are usually more popular to use. That is due to their higher speed, less stops in general, and more convenient rides. In addition rail station increases the value of the surrounding properties. Transit oriented projects now a day is usually proposed neighboring stations operated by light rail (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004).

The Rapid Rail

It is the fourth transportation mode, the rapid rail system. Rapid rails have different names. It is also known as the metro system, the subway and the heavy rail. The main difference between light and rapid rails is that rapid rails run on designated tracks that don’t cross with any other service. Usually, many cities construct underground type of rapid rail system. With faster trips and less designated stops the rapid rail has a big advantage on light rail. On the other hand rapid rails have cost more to develop. In order to cover its running cost, rapid rail has to operate
on high density areas. Due its big benefits and few stops, rapid rail station increases the real estate value of the surroundings (Dunphy R, Deborah M & Pawlukiewicz M, 2003).

**The Commuter Rail**

Lastly, the biggest mode of transportation in this category is the commuter rail. Comparing it to its brothers the light and rapid rail, commuter rail service runs for great distances. The average distance between commuter rail stations is habitually 3.5 miles. Since the distance is great between stations, the rail trips are fast. The lines extend to include outer cities. The stations attract riders from a wide range. Due to the fact that many riders drive to use the commuter rail, car parking is provided. The land uses around the station are commonly industrial and parking. Consequently, the development around the transit station is limited which may not have a property value increase to the surrounding real-estates (Dunphy R, Cervero F, Dock F, McAvey M, Porter D & Swenson C, 2004).

**The Challenges in Applying Rail System in the Middle East**

If we look at the Gulf Operation Council, we see that it is formed from six countries. These countries are UAE (United Arab Emirates), Qatar, Bahrain, Saudi Arabia, Kuwait and Oman. Since the discovery of oil in these countries, the development and population has been increasing rapidly. During the development process, these countries made their priority in developing infrastructure and roads. The high growth in population increased the traffic in the roads and exhausted the infrastructure. The need for public transportation is now a must and the governments in the gulf countries are planning to apply them. (Brufal, 2010) said that “it is expected that more than US$100bn will be spent on rail in the Middle East over the next 10 years”.
Currently the UAE formed its master transport plan which will finish by 2023. Both of their cities Dubai and Abu Dhabi have feasibility studies to implement public transportation systems. Qatar is planning to create a rail system that connects the gulf countries. Both Oman and Bahrain have the same project proposal. In Kuwait, the government has developed a plan for public transport that contains 4 metro lines. In Saudi Arabia, the government has a plan to connect Jeddah in west coast with Dammam in the east coast (Brufal, 2010).

“One of the most significant challenges facing domestic and international rail projects in the Middle East will be the procurement of finance given a lack of liquidity in the market and the difficulty in obtaining long-term debt commitments” (Brufal, 2010, p. 56). It is clear that the gulf countries are committed to develop a rail line system that will connect them. Financing these projects will form the largest obstacle facing these projects. However there is a large discussion of how to provide more funding alternatives. One method is some countries are trying to attract private investors to form partnerships to develop the rail projects.

Many of the cities in the Middle East are growing hastily. Dubai for example is one of the fastest growing cities in the region. The accelerated development is driven by big business investment is constantly increasing the demand for land. “Today in Dubai, about 700 new vehicles are being registered on a daily bases and one of two persons owns a vehicle” (Kaiser 2007). Currently, the city government is working on a master plan for bus systems. This master plan is aiming to achieve safe and fair transportation circulation around the city. To accomplish the master plan goals, the bus system has to be designed to accomplish efficient, modern and comfortable trips for everyone. The project for the bus system started in 2009 and it is still ongoing. By 2020, the project will produce a successful bus system network that has 26percent
Jeddah needs a combination of multiple transportation modes. The city joined a national rapid rail project that connects different cities in the country. This project started on 2006 upon the proposal of the extension of the city international airport (Jeddah Municipality, 2009). The main goal for this project is to transport the pilgrims from the different cities comfortably and efficiently. Essentially, the project is transporting travelers from a city to another. Each city will have a major station for the rail to arrive and deport. However, it is not clear yet whether the project will include more stops or transporting people within the city itself. Jeddah Strategic Report (2009) mentions that the municipality is planning to add light rail system with 3 lines. Additionally, Jeddah municipality is also planning to add 816 busses distributed on 38 lines that covers 337.5 miles. All of these proposals are still under study. No maps for transit lines are yet revealed.

If we were to put public transportation stops in the city, where would we put them? Jeddah mainly built on the usages of private cars. The location of the transit system is critical. A lot of variables go to the equation, what we need to know is what these variables are.

Where Would the Public Bus System Run and Who Would Use It?

In order to creating efficient public bus transportation system, we need to address where such systems would run. To address this question, first we need to predict who will benefit the most from this system. According to Downs (1992) only in few metropolitan cities are most work trips made by public transit trips. Aside from that the less populated cities and suburban
most of the daily trips are not extensively heading to work places. He also concluded from the US census records that most of the individuals using public transportation are category that don’t own an automobile, live in the center region of the city and work in within that region or live in the densest areas in the city. Most of (Downs, 1992) findings were concluded from the US census data. The records suggest that the people who don’t own a private vehicle and live in dense areas are the dominant users for public transportation with 71.6 percent which was in 1980. He continues by showing that usually the people who own even a single car most likely to live and work away from the central area. In addition the same people have less desire to use public transportation. As a conclusion working in the downtown area of a city reflect the possibility of using public transportation.

In the United Stated the focus on developing the downtown areas has been growing. As (Filion P, Hoernig H, Bunting T & Sands G, 2004) mentioned, the planners should emphasis and put more effort on maintaining the downtowns. Each downtown of any city has a distinctive character differentiating it from other urban regions like the suburbs from example. Moreover, city department around the US are becoming increasingly conscious to reduce the traffic and improving the connectivity within the urban areas (Filion P, Hoernig H, Bunting T & Sands G, 2004).

As recognition, improving the downtown of the cities would also address improving the pedestrian circulation. According to Morris R & Zisman S (1962), Improving public transportation goes hand to hand with improving walkability. The movement of the pedestrians is highly important especially in the downtown and improving them would beneficiary reflect on the public transit (Morris R & Zisman S, 1962).
Development and growth in cities has been gradually associated with developing transit especially in the US (Porter D, 1998). Furthermore, Porter D (1998) illustrated that concerted development of the downtown areas would continuously benefit from creating and improving public transit in the central area of the city.

Relating this perception in Jeddah it would appear that the location that would be chosen to run the bus service is the downtown area. The rationale behind the location is because this area contain both of the two people categories which are the ones who live and working in dense areas. Furthermore, choosing the downtown to develop public transit would also increase development of the area itself which could improve the city as a whole (Porter D, 1998).

In a nutshell, working in the business district areas is an important factor that contributes the use of public transit. However, it is essential that the central area contains the higher employers in the city. If the main employers of the city are located elsewhere, the generated trips are going to shift toward their direction. (Downs, 1992) also mentions that commuters that live in sub-urban areas are significantly more likely to use the private car than public transportation. Agreeing with his conclusion, focusing on connecting the downtown of Jeddah with its suburbs would not appear as the best option in comparison with creating a public bus system within the downtown area as a start. Many of Saudi Arabian cities share common facts with the American cities. According to (Jeddah Strategic Plan, 2009) they mentioned how the use of car in Saudi is somewhat similar with the United States in regards of the preference to use the car over public transportation.

Downs studies could be old, but the cities are still continuing to grow attracting more jobs and population. (Bruun, 2007) mentions how the population of the metropolitan areas is
increasing. It is expected that the inhabitants will grow in cities that is less than 1 million in populations will attract 500 million people. In London, according to (Blacombe, 2004) the study that they did on the city of London showed the means of travel to work in different areas of the city. The National Travel Survey (1997/1999) showed the percentage of these means. Driving to work took the majority among other transportation modes in most of the areas except the central area of London. In most areas driving took an average of 60 percent among the traveling modes. However in the central area of London driving to work took 26 percent which left 64 percent to the other modes. The report also mentioned that these numbers are taken for the whole day not specifically during the peak times.

Blacombe (2004) pointed out that in addition to large numbers of riders that are taking the buses to their work, the buses are still being used to reach other destinations. In some cases, Blacombe (2004) mentioned that occasionally buses transport more riders to shopping malls than transporting them to work destinations. That might be explained by the lack of parking spaces in the downtown area which could show buses as the better option.

Buses are more likely to flourish in transporting to educational facilities like schools. According to Blacombe (2004), the buses carried the children aged 11 to 16 from their home to schools by 23 percent which is more than the private car at 19 percent and that is 1999-2001.

Relating what has been reviewed so far on the city of Jeddah, choosing the downtown of Jeddah as starting point would be logical. Setting bus public transportation system in the downtown area will serve the groups that in most need for such service. These groups consist of the residents in the central area of Jeddah which commute from their homes to their work. The busses will also assist in transporting the students to their schools. In addition the tourists who
visit the city will highly benefit from this system. According to the "Jeddah Strategic Plan" (2009), 67 percent of the tourists coming to Jeddah are for the purpose of entertainment and shopping. They also mentioned Jeddah downtown area is one of the most prominent factors to attract tourists besides the sea coast.

In summary, determining where the public bus system would run is critical for its success. The buses should provide an alternative for those who do not own a private vehicle to transport them. The network should be comprehensive; however in this research we are setting a narrower scale as example to address the availability of public transportation in Jeddah. Aiming for the best option to create this network, the downtown area has qualified for the best location to serve as much riders as possible.

**How Would the Public Buses Operate?**

In most of the projects that are related to public transportation, deciding the need for the service is not the only objective in order to create the network. “Public transportation routes are the ultimate output of public transportation agencies” (Bruun, 2007). Planning for the operation of the bus system is the real challenge for planners. As Bruun revealed, creating an efficient bus system would not be possible without examining the existing urban characteristics. Growth densities, the existing infrastructure and road forms are factors that should be considered when designing the bus network. Adding other factors that like the geological feature of the place and the public expectation are factors the Bruun’s added. Agreeing with the author on these points with adding an additional one that is imperative which is the culture of the place.

In many of the Saudi cities, according to the Islamic belief, single men and families are separated in closed places. That applies to restaurants and some malls, shops and open spaces. In
Jeddah this role applies, however it’s less common happen in large spaces. As for small spaces, it’s usually required to separate the two. Applying this concept on public transportation, the vehicles would include two separate sections in every bus.

One of the most important aspects that would support or harm the public bus system is its efficacy. (J. Ward, Shankwitz, Gorgestani, Donath, Waard & R. Boer, 2006) mentions that there is a huge connection between the effacing of public transportation and the quality of life of the society population. The system would significantly benefit the local population of Jeddah if the bus system was capable on achieving high transportation standards. As for the buses routs, different methods are being suggested according to the transit methods used. “The use of dedicated bus shoulders is a key method for implementing bus rapid transit (BRT) in areas that do not have space for additional infrastructure”. BRT or Bus Rapid Transit is a system that is designed to reduce the delays of the regular bus system usually with dedicated lanes. “It is a flexible, rubber-tyred form of rapid transit that combines stations, vehicles, services, running way and intelligent transportation systems (ITS)elements into an integrated system with a unique identity” (Zimmerman 2001).

The bus rapid transit system follows many categories of which it may be operated. According to (Hardy, Stevens & Roberts, 2001) one type of these services are typically operated on high commuting roads headed for distant locations. Furthermore, they would connect to links of other transportation modes. Most of these services require a dedicated or smi-dedicated lanes or shoulders. Since these services are normally serve on high speed roads, the buses should ensure safe, secure and fast trips to its riders (Hardy, Stevens & Roberts, 2001). In relation to Jeddah, we have to address the different options to use to run the bus service.
Among these methods is using the street shoulders. The shoulder of the road usually serves as an emergency stopping lane. This new substitute for the emergency lanes in currently used to maximize the capacity of the roads. This would be an alternative for cities that not using the transit system (McCarthy & Davis, 1996). The usage of emergency lanes as bus routes could form the best choice to Jeddah. That is due to difficulties to construct additional lanes or adding bus lanes on existed high traffic roads. However, this method would be challenging to be abundantly applied on the downtown area of Jeddah. The streets in the downtown area vary between narrow to wide and some of the streets may not have emergency lanes to begin with. On different occasions car accidents and breakdowns might occur next to these lanes. Consequently, the busted cars would occupy the emergency until the assistance arrives. In these cases the traffic control would inform the bus service. It would cause service delays in the system so the response has to be quick. Either the management tow the busted vehicles or to advert the buses to take an alternative routs.

Dedicated Lanes used specifically for the transit use only. These lanes function similarly to a rail system. As Hardy, Stevens & Roberts (2001) mentioned, creating dedicated lanes is possible, yet it can be very expensive to implement. Furthermore, the operation would depend on two important factors which are the quality of the streets and the buses competences. As we mentioned before, the implication on Jeddah would be problematic on the existing road network.

Semi-dedicated Lanes is another possible idea. These lanes are shared with other privet vehicles like private cars and trucks, but they are mainly for transit means of transportation (Hardy, Stevens & Roberts, 2001). As the authors mentioned the cost for these lanes are lower than the dedicated ones and more flexible. It could include a new design for the standing roads or broadening it to include the semi-dedicated lanes. These lanes could be feasible for Jeddah. Since
the traffic is high in most of the streets especially during the peak times, sharing the roads with cars could a temporary solution until it would be possible to create dedicated lanes.

Going back to the geographical features, the city has many flood plains that are cutting through it. These natural hazards should be avoided for the safety of passengers and competence of the bus network. During the rainy season, many parts of the city would get flooded including the roads which would inquire special measures during these seasons. Rain in Jeddah do not occur around the season it occur only one time or two times a year and each year they occur on different days and cause Flash Floods.

Sometimes these floods happen without a warning. According to FEMA (http://www.ready.gov/floods) these types of floods happens after an excessive rainfall. As they mentioned the flash floods can happen within few minutes to hours after the rainfall. Additionally the flash floods sometimes follow a dam failure. This incident happened in Jeddah in 2011 (Okath Newspaper) when the dam Om Alkheer collapsed and caused a major flood that covered big parts of the city. As the report mentioned the flood usually carry rocks, mud and other fragments from different sites. That is the common way that Jeddah get flooded which the low capacity to flood water drainage. According to Jeddah Municipality (2009), the city is working on major projects to maintain the current dams and construct a drain wall to transfer the flood water. Six projects are finished that are dam constructing projects which are Wadi Qos Dam one, two and three. Additional Dams where finished from construction which are Wadi Mathoob the first and the second dam. Flood plains are not the only environmental issue that might affect the creation of public bus transportation which is the weather.

Jeddah weather is one of the most complained-about topics by the citizens. The weather nature is considered hot in general due to the city desert environment. The weather according to
Jeddah/King Abdul-Aziz International Airport Weather Station (2012)\(^1\) annual weather report, the temperature in Jeddah varies from 65°F to 102°F. The temperature rarely goes below 59°F or higher than 106°F. The warmest period starts from the mid-month of May until early October. The month of July is considered the hottest months of the year with a temperature that reaches 100°F. As for the cold period, the cold season starts from December and finishes by the end of February. The average during that period is a high of 84°F and low of 65°F. According to (Watson, 2000) during a hot day is when it’s above 90°F and the humidity is high. During such weather heat disorders might occur which is related to the body ability to shed the heat by sweating trying to maintain the body temperature. During these days the long times that the person stays under the direct heat might affect his health. According to (Hodges, 2011) heat would impact the vehicles’ and equipment’s which might cause them to malfunction. The extreme heat would have an impact on the vehicles’ durability and efficiency. As a result the buses schedules could be interrupted causing unwanted delay on the total trip time. In a hot temperature city like Jeddah, maintaining well air-conditioned vehicles is important. High temperatures are a threat to the customers and workers health alike. Sustaining the comfort inside the buses would allure higher use for public transportation in the city. However it might have reverse impact when the buses aren’t consistent in offering good internal environment to occupy.

On the other hand, keeping the vehicles comfortably cold would increase the maintenance cost. Nevertheless, this might take place during the hottest time of day only. The same issue would apply on the bus stops. There are many creative ideas for design and construction of bus stops. Taking a city that has common characteristics with Jeddah would be

\(^{1}\) http://weatherspark.com/averages/32766/Jeddah-Makkah-Saudi-Arabia
Dubai. According to the RTA (Roads and Transport Authority) in Dubai, many of the bus stops are designed to be air-conditioned and shaded. The commuters usually aren’t discomforted by the temperature outside of these stations which increase their riding possibility. However, constructing the stations would require wide sidewalks and higher funding than constructing a regular bus bench. Creating these stations would be challenging. Most of the streets in the downtown area in Jeddah have narrow streets and sidewalks. Nevertheless, this design could be used wherever is possible. Locating and assigning where would require further studies.

Bus stops design could be different from one location to another; nevertheless these stops need to follow certain standards to be successfully effective. According to Keuren (2010) bus stops should address the following materials for constructing a considerate bus stop. Each stop should contain material that doesn’t constrain visibility. As Keuren (2010) mentioned the glass shelters could be problematic to maintain in some locations. In addition the structure should be easily cleaned and resistant to sabotaging. They are suggesting that the structure should be transparent. Additionally, some of the issues that should be addressed in relation with Jeddah are what we have mentioned about the heat. The stops should perform as a shelter from the high temperatures. However the point mentioned about the transparency of the bus stops is important. The stop should reach a middle ground in design that it doesn’t be fully transparent to extent that eliminates the privacy. Or entirely block that encourage unwanted activities like vandalism.

To achieve successful operation for the public buses there are objectives if achieved the system would be competent. Many of the commuters in the cities use their cars to reduce the travel time to reach their destination. Some of the citizens in Jeddah believe buses are usually slow and won’t be able to avoid the traffic. As for the people who have low income they are constantly worry about their traveling cost. That is because many of the low income class don’t
own a car. Not having a car in the city means that person could have two options. Either that person rides a taxi to the destination or pays a private driver for transportation. Many people who own cars do not worry about the transportation cost due to the cheap gas price. They are mostly concerned about reaching their destinations on time.

Forming public bus transit system might require a great deal of planning and designing. Some of the complications that prevent such system from being constructed may not be with the planning; it would be with financing the system.

**Who Would Be In Charge of the Public Bus System and How Would We Finance It?**

Before we get into financing the transit bus system we have to illustrate the public bus condition in Jeddah and who were the parties involved. The company that took the privilege of administrating and operating public transportation is a public sector called Al-Naqle Al-Jamaie which means public transportation. This company was supported by the government by sharing a percentage of the profit. Consequently, due to augment occurred between the two sides the company decided to shift its focus from the inside the metropolitan areas to transportation between the cities. The main issue was that the public transportation company had a strong competitor which was the private owned buses. The company argument was that these private buses are taking a large share of the profit especially from the high density corridors. After a while the company decided that transporting within Jeddah wasn’t profitable and caused them to focus more on transporting between the major cities, even though there stocks were declining. One of the issues is that the public transportation company responsibility was to cover the whole...
area of Saudi Arabia which also was one of the factors that contributed in their decline (Al-Sharif, 2010).

This is a problem that is occurring in Jeddah and many of the developing countries. Many of the developed countries have formed partnerships between the private and public sectors. This cooperation between public and private sector started to be popular with many governments since the 1980s (Siemiatycki 2009). Another statistics shows that between 1985 and 2008 the projects that were cooperation between the private and public sectors have reached 1100. These projects were all around the world with an estimation of $450 spent in developing (AECOM, 2005). Delivering public transportation was shaped with many elements. One of the most important trends that helped shaping it was public private partnerships (Sagalyn, 2007). This would be one of the directions toward a better public transit in Jeddah. Forming successful public transportation wouldn’t be easy because of the rapid growth in population and space in the urban settlement. Jeddah would need to form a strong cooperation between its municipality and the private company to share the responsibility. If we were to create such a concept in Jeddah, what would the private sector be responsible of? How much responsibility the private sector would take?

Typically the partnership between the public and private sectors ends by putting the private sector in charge to create the transit system. In the United States and many other countries the private sectors construct, design and finance large scale transportation infrastructure (Siemiatycki 2009). Some concerns Siemiatycki have shared in his research trying ti create criteria to evaluate work of the private sector and to develop applicable criteria. He has divided them to concerns on the short and long term.
On the short term, in many of the developing projects, funding for infrastructure projects is always a concern. Financing in many places form an obstacle in the way of providing new infrastructure projects (Vining & Boardman, 2008). Some governments face difficulties in spending on the infrastructure, especially if it wasn’t a priory. Health and education could take the most priory in spending in some countries, others public safety and military might take the highest concerns. Therefore, public and private partnership would be the best answer to the funding shortage. On the other hand the government could focus more on other development matters in different sections.

The collaboration between the public and private sector in Jeddah was successful in the beginning. Their partnership helped to deliver public bus system to the city. However, the conflict raised and the efficacy of the bus system was reduced. Conflict between both parties happens, but as (Siemiatyci 2009) described in his journal that would the project success be affected by the conflict between the two sectors.

The relationship between the two parties is hardly flexible. Due to the long contract between the two parties and can stretch for years, many problems can occur during that period. As Garvin (2008) mentioned that infrastructure related projects between the private and public sector are mostly enterprises or leases, and they are arranged financially. He also pointed out that the contractor has the right to earn all of his expenses; however their revue doesn’t have to always come from the customers. Vining & Boardman, (2008) have also mentioned that many of the conflicts between the two parties can happen over the tolls. Two other reasons they also included in their research that might affect the partnership. Service quality and creating an additional competing side could create conflict between the private and public partnership. One of the main reasons that caused the public bus service to reduce its efficiency in Jeddah is
including another competitor in the same service. This action reduced the revenue and caused the bus company to diminish its emphasis on local bus service.

How to create better partnership between the private and public sector? Some of the ideas were introduced by Jacobson and Choi (2008) for a better delivery to public projects. Both of the private and public sectors should have clear and trustful communication with the will to negotiate and cooperate. The success of their partnership might determine the quality of the delivered public transportation system.

Financing in Saudi for infrastructure projects is usually fully paid by the government. Since there are no taxes in the kingdom, the government is mostly the finance supporter of many of the infrastructure projects. According to (Saudi Gazette 2013) the private sector in Saudi is increasingly taking an important part in the development of the country which reflects the amount of big projects that are planned for. Furthermore, the development and construction for new infrastructure has been invested by the government (Saudi Gazette 2013). Mega projects that are undoing that is funded with 597 billion in Saudi riyal which is almost a total of 159 billion dollars shows how much the government is willing to contribute in the development process. These transactions have made independent from the public and private partnerships. That leads to the usual way to finance infrastructure in Saudi Arabia which are the government spending and bank loans for the contractors (Saudi Gazette 2013).
Case Studies

Chapter Outline

Rendering what has been discovered in the previous chapters, the nature of the materials has influenced the style of methodology that would be the best to examine the topic. The research is going to proceed using the case study research method. The case study method is usually descriptive criteria that explains and explore the cause of a problem. This method is going to help us to better understand the different dimensions of the main issue. Understanding the efforts of other experiments would always improve our results and lead to enhanced outcomes.

Three main cities have been selected representing the public transportation system that is running through their urban environment. These cities have characteristics that are fairly similar to Jeddah city. The cities would have to be metropolitan cities that stand as an important center as an economical and urban environment. In addition, these cities weather is imperative. Since its weather is an issue facing efficient transportation (Jeddah as was demonstrated to have a hot climate), the chosen cases would need a parallel climate to Jeddah to a certain extent.

The case study format has an analysis which is more focused on what have been learned from each case. This style would improve our vision toward a better solution for the public transportation issues in Jeddah. In order to achieve the best outcomes from these study cases, we would need a parallel outline. In this outline there are sections that are going to demonstrate certain information that are related to the elected cities public transportation. There will be an overview to the main information about these cities like population, weather and economy base
relating them to Jeddah. Their pervious history of public transit would be vital to observe their progress and how they reached their current transportation condition. The way of financing public transportation and transportation strategy is essential for better lessons outcomes. At the end, we will provide a final conclusion for each city that was presented.

Using this method would provide great advantages. It would give the research large amount of information and the lessons that are going to be learned would give profound results. It would give us a worthy benefit from experimenting with different places learning from achievements and inaccuracies. On the other hand, there could be disadvantages for using this method. The lessons could not be used widely for other studies since it could be specific to the cause. Since the research is going to address three case studies, there would be chance that the selected areas would not be well representative. However this method would be accepted be a wider audience due to its simplistic presentation and straight to the point ideas without distracting the viewer.

**Dubai Case Study**

**General information**

Dubai is located in the United Arab Emirates. This city has developed a distinct character as an international hub for modern and dynamic urban environment. Not long time ago, Dubai was a small fishermen town that none heard about. Now days the city is well known worldwide for its commercial, business and ecstatic value.

The population of the city estimated to be 2.1 million individuals according to 2012 census with a percentage of 76.12 percent men and 23.88 percent of them are women. These are the numbers of the residents who live within the city. As most of the hubs around the world,
Dubai population increases to 3.14 million during the day period. Most of the additional travelers commute on daily bases for work or businesses (Al Labban, 2012).

According to Dubai Meteorological Office, the weather in Dubai has fair similarities with Jeddah. The highest temperature could reach 105 °F during the summer in the city and the lowest the weather could get during that season is 86 °F. Moreover for Dubai winter, the highest temperature could reach 75 °F. As for the lowest recorded temperature it would reach 57°F. Dubai weather can be certainly related to Jeddah, since both cities are considered hot climate areas (Dubai Airport, 2014).

The economy of Dubai was based on both oil and gas exportation and manufacturing. However, at this time the city has more diverse economy. It has transformed to focus more to be a central business hub and finance. During the recent past years the city has been a destination for tourism around the world. Dubai currently is expected to grow independently from the oil industry’s leading the United Arab Emirate as a potential hub for investment and business (QNB, 2012).

**The Public Transportation of the City:**

In their effort to eliminate the daily traffic congestion which took a part of peoples’ everyday life, the city increased its focus on its public transportation system. This system is considered fairly young if we were to compare it to the mass transit system in New York or Chicago for example. However, they managed to create an efficient public transportation system in an urban place that is dominated by the use of private cars since one of two people currently owns a car in the city.
Roads and Transport Authority (RTA) in Dubai was established in late 2005; since then the company has been responsible of planning and implementing transportation projects in the Dubai region. Currently this company has around 500 busses which are working on 70 routes around the city (Kaiser J, 2007).

The major focus for the RTA is to develop transit projects. Only 5 percent of the residents and less of 10 percent of the workforce are living near the metro stations areas. A road based transport is needed to transport the remaining percentage to the stations.

The planning for public transportation in Jeddah is not the only issue; financing will be the main obstacle. Creating a public transportation system from the beginning will require billions of dollars that includes initiation, running and maintaining costs. To overcome this issue, the city of Dubai has partnered with the private sector to successfully build the mass transit system.

To start planning for public transportation system in Jeddah there is certain data that is needed. According to Dubai comprehensive plan, for their transportation proposal, they have gathered land uses, population data, other planned modes of transportation, and physical constraints; planners have also identified trip generation nodes were the major data that they needed for the plan. Furthermore, the city of Dubai used modern technologies to optimize demand management policies and accident management procedures will improve the integration of the transportation system. Bus Demand forecast was also use in building the public bus system in Dubai to decide where to offer a higher service.
The Current Public Transportation Indicators

Dubai would appear to be one of the best cities for public transportation development in the Middle East. That is due to city leaders’ dedication to overcoming the high traffic volume that exists within the city. The car ownership was estimated as 541 cars per 1000 people (Chaudhry A 2012). As for the fatalities caused by car accident were 24 per 100,000 people (Chaudhry A 2012). Many of the problems that caused by the high use of the private cars exist in Dubai. However, the city traffic administration is dedicated to manage the traffic jams effectively with providing consistent public transportation. RTA, the department in charge of Dubai public transportation, leading the development of transportation have developed a comprehensive transportation plan to optimize and enhance the public transportation in the city which could increase the quality of life for their residents.

At the end we have to mention that that public transport represents an extremely low share of transportation modes in Dubai, compared to that of other cities around the world. A benchmarking analysis shows that only about 7 percent of the population in Dubai uses public transport, compared to 19 percent in London, 25 percent in Berlin, and 41 percent in Singapore (Kaiser J, 2007). Dubai government is still working on improving the accessibility and transportation within the city. According to the RTA the standing daily ridership for public transportation is around 250,000 trips and this number is expected to increase in the near feature.

Transportation Issues

Dubai would be considered the closest example related to Jeddah. That is due to their location in fairly the same region and nearly the same culture. As the survey mentioned, Dubai is considered the city with the most traffic congestions in the Middle East overcoming Cairo and
Jeddah (Gulf Talent, 2007). The survey also stated that the average commute time per day to and from work is 1 hour and 45 minutes.

Successes in providing efficient public transportation in Dubai is remarkable considering the city initiated public transportation not long ago. The RTA (2013) in Dubai claimed that the public transportation system of the city transported around 440.67 million riders in 2013. The number had obviously grown from the last two years which was 367.6 million in 2012 and 346.5 million (Al Hilal, 2014). The upmost achievement would be altering the attitude to accept the concept of taking the bus or the train instead to riding the car. RTA chairman and executive director (2014) has explained that Dubai citizens are beginning to understand the positives of using public transportation. The public transportation is growing in popularity and more people are considering using it over the private car (Gulf News, 2014). The current operation hours of public transportation in Dubai starts from 5:30 am and ends at midnight (Emirates 24/7 News, 2013).

However, the majority of users of the public bus system are from low income groups. The majority of the higher income residents would prefer using the private car. What would it seems that there are no specific plans to attract users from higher income classes to use the public transportation system. Furthermore, as a respect for the local traditions, the buses do include women and children section in the front of buses so they would feel safer if they were traveling alone. These section are not exclusive on the buses, there are available on the metro service also.

The commuter in Dubai is required to obtain a Nol card in order to use the public transportation. The Nol card enables the commuter to pay for the different transportation mods
using only one card. This card can be personalized using online account and the RTA has provided an online transaction option for the users to add more value on the card which is a huge step. Currently, the commuter could manage the Nol card online and pay for the commutes (RTA, 2014). Unfortunately, in order for the online transaction to be successfully completed the operation needs around 48 hours which could be frustrating for the users.

One of the issues related to Dubai buses system would be the limited distribution of bus cards transaction machines. Even though there are 64 bus stations available for the commuter to add value to the bus card, there are around 1600 bus stops that would not offer this service. The RTA in Dubai is still working on the issue aiming to provide the service in many other bus stations. It is yet not possible to generate on board tickets which has been previously suggested (Leijen M, 2014). There would be a great possibility for the commuter to not be able to ride the bus because his or her bus card was empty.

The development of mass transit in Dubai could be deliberated very positively. On the other hand the system has negatives to be addressed. Bus riders’ frustration would grow with limitation of the Nol cards. Purchasing transportation tickets or value had better to be much easier for the commuters to increase their satisfaction which would reflect on better ridership rate. Attracting more riders from higher income classes other than the low income would appear as parallel goal to public transportation development. Jeddah has also its share of different income classes.

The ridership in Jeddah would be indicated fairly similar to Dubai since the direct recipients could be the low income workers class. Consequently, the future bus system in Jeddah could be sustained by the low income class for many years. However, drawing the middle and
high income class attention to use public transportation is important. More public transportation
users would ease the traffic congestions on the existing roads which could generate less travel
time for Jeddah residents and outside commuters.
Conclusion:

Dubai is one of the closest examples that can be related to Jeddah. Both cities are regional hubs for business and investments. Many of the teachings that are used for developing public transportation could be used for Jeddah. Creating an independent government department in Dubai, RTA, was an important step that had a positive effect toward success.

The focus in Dubai wasn’t always directed toward creating new roads or improving the existed ones, lunching campaigns that promotes safe driving improved the awareness of the population. Moreover and more importantly, creating applicable legislation and lows that is strictly applied to reduce reckless driving and create better traffic circulation. Reducing the reckless driving in Jeddah is important for the effectiveness of the future bus system. Additionally, applying strict consequences for irresponsible driving toward the bus service is essential. Careless driving might impact the future Jeddah bus system and decrease its efficacy since the driver may use the dedicate bus lanes to avoid the traffic.

Overcoming the challenges facing public transportation needed many efforts by RTA in Dubai. Implementing, financing and improving new public transportation is an achievement. They future aim is to create more sustainable development which could be the backbone for the new public transportation direction.

In the end, many of the lessons can be applied on Jeddah due to the relativity that the two cities share in economy, culture and natural environment. However, we need to continue on the research finding comparable cities to Jeddah in order to upkeep a proficient solution to implement public bus transport conceptual system.
Rio de Janeiro Case Study

General information

Rio de Janeiro is one of the major cities in Brazil. The population of the city reached 6.3 million in 2010 (Rio Negócios, 2010). Rio is one of the foremost tourist destinations because of its beautiful beaches and colorful environment.

The city is currently preparing for 2 major sport events the World Cup and the Olympics. This is considerably similar to the city of Jeddah. Jeddah has a topographical boundary from the east that limits the city extension beyond that point. Furthermore Jeddah receive high share of pilgrims to do the annual Hajj since the city is very close to Makkah the holy city.

The weather in Rio is described as tropical. The temperature during the summer times normally reaches 104 °F, but the annual average with reach 81°F which is considerably hot. As for winter season the weather would stay noticeably warm. The annual low temperature varies between 41°F and 60°F and it happens mostly in the winter time. In 2005, the maximum average temperature was 96°F and the lowest was 56°F. Moreover, rain falls most of the year but during the winter season it could be infrequent. Normally, the total rainy days could reach 130 days (Rio Negócios, 2010).

Among Brazil’s cities, Rio de Janeiro is considered the second in GDP rate (Ministry of Work, 2009). The city economy is based on industries, construction and public services. According to the Ministry of Work (2009), public services and administration provides the most amount of jobs with 68.5 percent of the city’s job opportunities. Currently the city is highly investing in the upcoming world event that is coming to the city which is the World Cup and the Olympics. Infrastructure and construction are taking the highest amount of financing priority.
Nevertheless, the city has high investment in petrochemicals and naval industries (Decisão Rio 2011).

**The Public Transportation of the City**

Public transportation started in Rio de Janeiro in the mid-19th century. There were trams and trains that carried the riders to other areas to both north and south of the city. This change made it possible for the people to move from the city center to other areas more easily and transported them to other areas. Nowadays, the responsibility of public transit lay on the Department of Transportation to develop the plans for public transportation.

The city of Rio increasingly is bringing more adjustment to the public transportation system and over 5 billion dollars will be invested for that cause. Lastly, the bus ticket would cost BRL 2.75 which is around 1.16 US dollars (Rio 2016, 2009).

**The Current Public Transportation Indicators**

In 2010, the national total number of registered vehicles in Brazil was 64.8 million. The country also has an average of one car per 2.94 persons. Moreover, the METRO number of passengers has reached 164 million in 2010. As for the trains, the number of passengers is estimated at 136 million during the same year. According to the Department of Transportation in Rio de Janeiro the average number of daily trips made using public transportations is 727,000 trips per day. Additionally, in 2003 it has been estimated that nearly half the population uses public transportation with 68 percent of the motorized trips are done using public buses (Teixeira, 2011). In another research, it’s been estimated that the bus system transports around 2.8 million people each day (Ônibus Rio, 2010). These numbers indicates the large number of
public bus users and the how many people are depends on them. Other modes of transportation are available for the public to use as the metro and ferries (Carius, 2011).

Rio’s streets get packed during rush hour. According to the transportation specialists in the city, the transportation methods in the needs to be more integrated. They also say that the disintegration between the transportation mods makes it hard on the tourists to travel from point to another within the city. Fixing the integration would increase the opportunity for more tourism. One way to achieve this is to unify the tickets for all public transportation modes (Sharpin A, 2013). A way that they recommended is to create one hub that combines all the transportation types in one stating creating a mixed used station. That will decrease the used space and create better integration between them as the city also said they are going to use TOD (Transit Oriented Development).

Because of the big upcoming sport events the city decided to implement one of their strategies to reduce the car congestion especially in large event is to prevent solo riding. This strategy will promote more carpooling to lower the traffic. This is a good strategy that can be implemented in Jeddah also. The city of Rio also mentioned the issue of signage for public transportation. This issue they consider critical to better orient the riders to their destination around the city. This is one of the important factors for public transit to succeed which makes the routes and stops clear for the public to use them. With the support of modern technology application like phone maps should be included to ensure safe and efficient trips. As the city report mentioned, using these technologies specially phone applications made the travelers less dependent on the private cars and taxis and encouraged them to use the mass transit system.
Transportation Issues

It has to be said that the city of Rio de Janeiro transportation system has improved during the recent years. The city government is trying its best to improve and expand its transportation services. However, currently the city is facing serious challenges that are reducing the effectiveness of the public transportation system. The public on different occasions react aggressively to the delays caused by the system. Some stations got damaged and train wagons were set on fire as a reaction to the service deficiency. There were some reported train breakdowns that happens infrequently which affects the passengers who are using the service on daily bases (Favelas O, 2013).

The operation hours for Rio public transportation starts from 4 am and close at almost 11 pm in week days. In Saturday, the service starts from 7:30 am and closes at midnight. As for Sunday the service closes at 10 pm (Rio metro schedules, 2014).

According to The Wall Street Journal (2014) a huge protest occurred in Rio de Janerio upon the increase to the bus ridership fare. The cost for the bus ride increased by 8.5 percent, this decision went affective by the government since the 8th of February. The protest went violently after the special Brazil police intervened (Kiernan P, 2014).

Currently many of the population in Rio de Janerio are using the public bus system. About 3.3 million people board the buses to transfer them to many destinations. With this huge numbers of users and the increasing traffic, the buses are usually over crowed by passengers. Commuting time is increasing. Whether the commuter takes the private car or public transportation, the commuter would not witness any change in the travel time. That is because many of the buses get caught in traffic. Many of the bus commuters are complaining about the
bus services, majorly because the system is receiving the highest amount of investment in the county and they are not witnessing any change in the quality of service (Favelas O, 2013). On the other hand, in many areas of Rio the busses would travel fast and more efficient with more frequency between the trips. It appears that the quality of service varies according the routs and the destination.

In Rio de Janeiro, buses are usually get stuck in the daily traffic (Lonely Planet, 2014). That could be accounted to the lack independent bus lanes in some areas. Further issue with the bus service is the number of pickpocketing inside the buses. Additionally, it has been reported by the Lonely Planet (2014) buses are usually driven recklessly. This driving would oppose as a threat for the safety of the passengers. This type of driving could be interpreted as a reaction to the driving environment in Rio. The traffic congestions could cause the bus operator to drive hastily trying to be on schedule.

The current contractor with the government to operate and maintain the bus service is Rio Ônibus. Due to the huge are of Rio de Janeiro, the city is divided to four areas Santa Cruz, Internorte, Transcarioca and Intersul (Rio Onibus, 2014).
The buses in Rio are split to two types, each one of them has different characteristics and fares. The regular buses that are operated by the city of Rio are split to two which are air-conditioned and non-air-conditioned. The fare is $2.75 for the regular bus and between $3.10 and $3.50 for the air-conditioned buses (Rio Onibus, 2014).

Real Auto Buses offers higher quality buses with more comfortable trips. These buses are famously called “Frescao” by the locals. These buses run only during the week. The Frescao buses transport to the main tourist spots and upper-class neighborhoods. These buses are highly used by the tourists since is considered safer and more comfortable than the regular local buses. The coast for the Frescao bus starts from $3.50 and it could reach $12 depends on the destination (Real Auto Bus, 2014).

Today, Rio Ônibus has initiated an online service which is a bus trip planner. The commuter now can insert the starting address and the final destination. The service will show the option that the commuter can choose from to reach the destination using the buses (Fetrtranspor, 2014).
Even with the growing investments in the transit system, the average travel time spent commuting to work in Rio is around 40 minutes on one-way trip. As mentioned before this time range is unchanged between taking the bus or the car. The situation amazingly puts the different people regardless of their income in the same position (Favelas O, 2013). Apparently, the low-income and high-income classes would not be able to avoid the traffic in Rio. Furthermore, the integration between the buses and other mods of mass transit may possibly be weak. The excessive use of the bus system, causing the system to get congested, could occur due to the lack of efficient alternative transition between the busses and trains for example.

It appears that public transportation bus of Rio is affected by several issues. Some of the interesting issues that been concluded, which is different from other study cases, there is a huge ridership rate for the public buses. However, what would appear is the Rio government is facing major complications maintaining the efficiency of the system. Perhaps some the deficiencies occurred due to the lack of the public involvement in the development process of the public transportation. In addition, the high usage for public transportation would cause a dilemma to the transportation developer.

Keeping up with the rapid demand by expanding the service by adding more vehicles, routs and adding accessing more areas could be one choice. Another situation is to maintain the current service by increasing the capacity of the system without covering more areas.

**Conclusion**

Rio still has a long way to be a transit oriented city and reach its full potential. Yet the city is proving that is up to the challenge. More development and ideas are being brought to the table. New proposal is being considered by the city which is the use of cable cars as a mode of
transportation. This is a large project with a half a billion dollars budget with 3.8km long lines and six cable-car stations. This project is one of its kinds as a mass transit mode in Brazil. These lines are also integrated with the rail way station which will provide easy access and overcome the topographical boundaries. Currently most of the transportation projects are funded by the department of transportation in Rio and the system is run by Rio Onibus which is a private partner.

Many lessons are learned here as the integration of the mass transit and the creative ideas to overcome the physical restrictions. It also proves that public transit is never impossible and can be achieved in many places if there was enough determination to do so.

Huge numbers of visitors are expected to visit Rio de Janeiro as the country is hosting two of the most popular sporting events in the world. The current public transportation mods are highly used by the city residents and visitors. Huge financing is being directed toward expanding the capacity of the current public transportation systems as an attempt to decrease the use of private cars. Public transportation is taking a big share of the city development priority aside with health and safety.

**Houston, Texas Case Study**

**General information**

Houston is one of the biggest cities in the state of Texas, located in the United States of America. According to the US census the population of Houston was estimated to be 2.16 million people in 2012 (US Census, 2012). The city is the most populated city in the state of Texas and ranked the fourth on the United States after New York, Los Angeles and Chicago (US Census, 2012).
The climate in the city of Houston is humid and subtropical in general. The heat can reach its peak during the summer with a high of 95.2 °F during the month of August. During the rest of the year the average annual maximum temperature was 79.6 °F during 2013. Additionally the humidity causes the heat to increase above the real temperature. As for the lowest temperatures, the coldest time of the year happens during the winter periods which are the months of January, February and March. Through that period the lowest temperatures could go between 45 °F and 49°F (NOAA, 2013).

As in many metropolitan cities, the economy of Houston has many attributes. Nevertheless, the major job provider that contributes over half of the local economy is the energy sector. Two main natural resources are being exported through this sector, which are oil and natural gas. Along with the city strategic location, import and export activity, Houston plays an important role in the job market. Furthermore, the city has always have attracted strong business and its famous for commercial companies expansions. One of the factors that put Houston as a hub for business is its accessibility. The city has two major airports, a global port, rail roads and well developed roads. These factors stretched the economic development creating more jobs and businesses (Bridges, 2012).

**The Public Transportation of the City**

Public transportation in Huston current main local transit provider is the METRO Company. The company is in charge of developing Houston public transit and solving the traffic congestion within the city using different modes of transportation including rail and buses (METRO, 2013).
METRO of Houston currently has 1,230 buses; 443 of these buses are diesel hybrid in
strive toward reducing the amount of harm emission in the air. As they mentioned, the company
include 100 busses annually with a preference of obtaining hydride vehicles (METRO, 2013).
Financing for transportation project in Houston is through federal funding and private
partnerships. Funding for the transportation would count on local, state and federal funds. In
addition, fares, tolls and local private contributors are likewise support public transportation
projects (Shah S, 2003).

The Current Public Transportation Indicators
Similar to many metropolitan areas, Houston as a major hub in the region is expected to continue
on growing in both population and economic activity. The government of Houston in its regional
plan for 2025 mentioned how to develop the city to provide better mobility that is safe, efficient
and affordable. Along with their development comes the aim to provide transportation systems
that are environmentally responsible (HGAC, 2005).

The budget to implement the transportation major plan is $65 billion. One of the strategic
goals to improve the mobility in the city is reducing the traffic congestion. The city also would
enhance the businesses by reducing the travel time for transporting merchandise. Three major
policies are the focus of the transportation plan. First is the emphasis on increase existing
capacity of the transit system and the high ways practically. Second is improving the operational
management of the current facilities. Third is managing the travel demand during the peak hours.
Many of their strategies have also involved public participation and surveys (HGAC, 2005).

According to the US census, the number of workers who travel to work in Houston was
772,957 people in the year 1990. Of those, 6.5 percent only used public transportation means.
This percentage is divided between all public transportation means (US Census, 1996). As for traffic congestions, the annual amount of hours delay for the car commuter in Houston was 52 hours in the year 2011 (Schrank D, Eisele B & Lomax T, 2012).

The implementation of transportation plan in Houston is interesting. In the city’s battle to improve transportation, local officials are developing and examining the relationship between transportation and land uses. As they mentioned in their plan that better understanding to the connection between the land uses and transportation mods in the city would result in better transit oriented urban environment. Better integration for transportation wouldn’t be achieved without including other simple transportation modes, moreover they city is developing a bicycle and pedestrian plan. Additionally, the movement of goods and merchandise is still taking a big importance for the city (Shah S, 2003).

As for public transportation fares, the commuter is able to buy a daily pass in Houston. The METRO day pass will provide the commuter with unlimited riders on different transportation mods just for $3 each day. However, if the commuter wants to travel in one direction the ticket will cost $1.25 (METRO, 2013).

The approach that the city of Houston is taking is more tactical. The city has a major focus on connectivity beyond the city urban structure. One key for a successful public transportation is to overview the connectivity with other urban settlements in the area, more like a regional approach.

**Transportation Issues**

Houston traffic situation is somewhat similar to many of the US cities. Sharing many of its characteristics with Jeddah, Houston is thought to be a car dependent city by many. Many of
the residents in Houston have to drive to their work because they don’t have another choice. According to Dietrichson M, (2013) mentioned that around 22 percent of Houston work commuters live within a quarter of a mile near their work while the rest live beyond that limit.

They mass transit system of Houston is having difficulties advancing and developing. Some of the point has been shared by Lewis, K (2010) which, according to him, prevents the development of Houston mass transit. Some of the interesting points he shared that Houston metro is following an honor system depending on the commuter integrity to pay the tickets fares. This means that a person could simply board the train avoiding purchasing a ticket. This could harm the efficacy of the system since it would limit the revenue. Creating an honor payment system in Jeddah could oppose a risk. Jeddah is lacking an efficient bus system and offering an honor paying method could seriously harm the service self-sustainability.

Another issue would be the citizens’ mentality of having to own a car. Similarly to Jeddah, many of Houston population still prefer to use the car over public transportation. During the last decade, the ridership for the local buses of Houston has dropped despite the stable ridership on other public transportation modes like the light rail (Spieler C, 2013). That could be explained that the buses are not directed to the correct directions. Occasionally, buses get overloaded by passengers in central areas of the cities which could cause them to be irregular. As Spieler C, (2013) also reported that the bus system routes are difficult to understand with the lack of directions in some bus stations. This could frustrate the commuters and even discourage them to use the buses. As a commuter it would be easier to use the train service than the buses. The rail service routes are usually easier to understand since the routs are usually clear and straight ahead.
Eventually the riders could adjust to the system especially if they are taking the same direction every day. However, it would always be intimidating for the commuter to take other routs if the system was hard to understand. Additionally, Houston is one of cities in the US without a formal zoning. This could oppose big difficulties for the system to evolve since there are no certain ordinances that could support the system.

The buses clear and easy routs would appear more appealing to the commuters in Jeddah than the complicated ones. This could be a determining factor for the bus system to success in Jeddah along with its consistency. Additionally, the potential bus system in Jeddah could benefit from creating specific ordinance to support the system. Limiting the parking in the downtown area and independent bus lanes could be some examples of these laws.
Conclusion

The emphasis for public transportation is growing in Houston. With the increase of traffic conditions the city is developing alternatives by expanding the roads and increasing replacements for mobility other than the private car. More station is under construction to extend the current public transportation coverage. Aiming to promote for cleaner air and better environment, the city is encouraging more citizens to use the public transit.

Houston is another metropolitan city that is comparable to Jeddah. Some aspects could be related as the diversity of city economics and their position as hub attracting more population and business. Both cities were developed regarding the use of private cars. Houston public transportation is considerably new compared to London or New York. Nevertheless, the city was able to develop an efficient public transportation with worthy planning and enough funding. The creating of a department that is committed to develop mass transit proves its success. Moreover, the hot climate and car-dominated environment did not prevent Houston providing transportation alternatives. Integrating pedestrians and bike circulation is an advance step and can be processed with providing other transportation means. In the end, emerging public transportation wouldn’t be a huge burden with the right dedication to provide a better urban environment. With enough finance and planning Jeddah would acquire an effectual public transit bus system.
Comparisons

The Department in Charge

<table>
<thead>
<tr>
<th>City</th>
<th>Operators of the Transit System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubai</td>
<td></td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>[Image] RIO Onibus</td>
</tr>
<tr>
<td>Houston</td>
<td>[Image] METRO</td>
</tr>
</tbody>
</table>

Each city has created a new administrative department in charge of the public transportation systems. All of them are a result of partnership between the public and private sectors. Each department takes the responsibility to shape, develop and operate the public bus systems. Apparently this common point would lead to a similar decision in Jeddah. The city of Jeddah needs its independent department given the license to develop the bus system.

Population comparison

![Population chart]

<table>
<thead>
<tr>
<th>City</th>
<th>Population (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubai</td>
<td>2</td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>6</td>
</tr>
<tr>
<td>Houston</td>
<td>3</td>
</tr>
<tr>
<td>Jeddah</td>
<td>5</td>
</tr>
</tbody>
</table>
The population of the cities is considerably close except Rio de Janeiro population which exceeds 6 million people. The need for public transportation increases with the population growth. Jeddah population appears to be decently average among the rest of the cities which reflect a high possibility to develop public bus transportation since the other cities were able to provide it.

**Car ownership rate**

The chart indicates that car ownership rate vary between the cities. Houston has the higher car ownership rate per person among the other cities with a car for every 1.7 persons. Jeddah has 2.86 car ownership rate which is close to Rio de Janeiro 2.94. More outcomes can be interrupted after integrating rates with the population data.
In Jeddah, 35 percent of the city population owns a car which leaves 65 percent without car depending on alternative transportations mods. The situation is similar to Rio de Janeiro, however over 60 percent of the people use public transportation system. As for the other cities, more than half of Houston’s population own a car which is fairly similar to Dubai.

**Public bus transportation comparison:**

As for the public bus users, Rio de Janeiro takes the highest percentage in comparison with the rest of the cities with a percentage that reaches 68 percent. As for Dubai and Houston, the bus ridership is less than 9 percent.
The high use for the busses in Rio could be explained by the large number of bus routes in the system. The number of bus routes in Rio reaches 831 which cover a big space of the city. These routes are spread all around the city and the high percentage for the users indicates the good distribution of the buses. Houston bus system is formed with 426 routes which put it in the second place while Dubai has 70 routes only; However, Dubai has the youngest bus system.
Subsequently, the number of routes is reflected on the number of buses. The number of buses in Rio is significant to the Dubai and Houston. Rio de Janeiro has 9000 buses operating throughout the city. Next to it is Houston which has 1230 bus and lastly is Dubai with 500 buses.

![Bar Graph showing number of buses in Dubai, Rio de Janeiro, and Houston]

The cost of the ticket varies according to the city. Riding the bus in Rio is the most expensive while in Dubai is the cheapest. However, the trip in Houston cost 1.25$ but the daily pass cost 3$. As mentioned before the 3$ pass in Houston will qualify the rider to use as many daily bus rides as possible including the metro service.

<table>
<thead>
<tr>
<th>Cost Of A Bus Ticket</th>
<th>Dubai</th>
<th>Rio de Janeiro</th>
<th>Houston</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>0.49$</td>
<td>2.75$</td>
<td>1.25$</td>
</tr>
<tr>
<td>To</td>
<td>3.16$</td>
<td>3.50$</td>
<td>3$</td>
</tr>
</tbody>
</table>
**Work commuters**

The number of people that commute daily to work is different between the three cities. The number of commutes in Dubai and Houston is close to the total population in the city. That is explained by the number of people that commutes from beyond the city limits.

![Number of Daily Commuters (by Millions)]

<table>
<thead>
<tr>
<th>City</th>
<th>Number of Daily Commuters (by Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubai</td>
<td>2.3</td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>3.3</td>
</tr>
<tr>
<td>Houston</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Not all the commuters use public transportation in the three cities. Again, Rio takes the biggest numbers of commuters using public transportation. In comparison, Houston and Dubai has relatively close numbers, however that are far from the number of users in Rio de Janeiro.

The average daily time taken to commute to work is fairly parallel. The average round trip takes the commuter in Rio and Dubai is between 1 hour and 1 hour and 50 minute. While in Houston the round trip to work could extend to 2 hours.
Bus system routs map comparison

Each of the three cities has its unique features. The city of Rio has vastest map routs due to its large space and many routs. As mentioned before, Rio is divided to 4 different reigns combined altogether to form a comprehensive bus system operated by Rio Onibus. The city characterized with its water front which moreover served by the bus system.
Houston bus routes appear to form a centric shape. The map shows how high concentration of bus routes is fairly concentrated in the central area.

As for Dubai, the city bus routes extend along the gulf coast line. The upmost connected area would be the north side of the city. The central business area is located approximately close to the sea shore which differentiates Dubai bus system from Houston’s. Dubai is closely related with Rio in regards of their central areas are relatively close to the sea shore. However Rio bus routes system is more spread around the city than the bus routes of Dubai.

In comparison with Jeddah, the Dubai map shares the most similarities than the other two cities. Both Jeddah and Dubai are expanding alongside with the sea coast with little incursion to the land side. Additionally both central business areas are relatively close to shore.
Conclusion

The development of public transportation in Jeddah could not be achieved without improving the existing roads circulation. The future of bus transportation system in Jeddah would be constructed on the existing road network. Increase the road network and transportation capacity was one of Dubai’s main objectives towards an effective public transit system. The road capacity in Jeddah needs to be studied to decide the proposed bus running network. Increase the road network and transportation capacity.

The safety of the roads is an important issue that will affect the efficiency of both public and private transportation. The city of Dubai has spent fortune in advertising to a safer driving environment and increasing the awareness of the public which is important for Jeddah likewise. Additionally, other factors that Jeddah need to improve simultaneously. For a safe and smooth transportation many factors are involved: pedestrians, roads, public transportation, policies and legislations, traffic and safety awareness. Influence the drivers’ awareness should not the only campaign. Implementing strict regulations with ensuring effective enforcement against traffic violators would decrease the recklessness of the driving in Jeddah.

In Jeddah, the demand for public transportation could not be determined precisely. However, the system has to be fixable in order accommodate the demand for the bus service. The service would need to meet the public expectations as well. The high demand for the public bus transportation service would oppose as positive. More ridership equals higher income invested in the system which would keep the service on going. On the other hand if the capacity of the system could not address the numbers of users, similar issues of busses like the ones appeared in Rio’s case study could emerge in Jeddah.
Jeddah is a substantial city in the west coast of Saudi Arabia due to its economic importance. The city is known for its commercial reputation because it contains an international airport, a global port and the connection of roads networks. Accessibility could boost effect on the economy of the city in right circumstances. However, Jeddah is yet short in providing a railroad connection to exchange merchandise which expectantly is changing soon with the upcoming rail projects.

Furthermore, taking the first steps to reach a bigger mobility on the region level we first would develop the standing public transportation within the city. Including the public participation and involve the in the development process would improve the future public us system efficacy in Jeddah. Registering to the public opinion would help the development process competently and could explore more opinions.

The feasibility of implementing public bus transportation in Jeddah is possible. Financing for such a system is very possible which the strong direction for the country of Saudi Arabia to support new transportation projects. The government always financed transportation projects like bridges and expanding the current roads. Furthermore, it is recommended to track the study cases footsteps by creating a dedicated department in charge of public transportation in Jeddah. Moreover, the issues related to public bus transportation systems which appeared in the study cases offers worthy lessons can be addressed in Jeddah new public bus system.
References


http://jeddah.gov.sa/strategy/English/JSP/index.php


Al-Sharif, M. (2010, 3 15). The problem of public transportation inside the cities. *Aleqtisadiah*


US Census. (1996). *Census and you*


Sharpin A. (2013). Rio’s transoeste: Brazil’s romance with brt rekindled. Sustainable Transport, 24,