Developing Qatar's Regional Transit Network: Proposed Scenarios for Linking Doha City to Al-Wakra City and Mesaieed Industrial City

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Abstract: - According to the 2010 census, Qatar's population has reached 1.7 million and is expected to reach 2.0 million in 2015 with a constant annual growth rate of 3.97% and about 3.2 million people, more than double, by 2030. The Doha metropolitan area alone is a home to more than 80 percent of Qatar's population with a density of 3,394 persons per square kilometre. Accordingly, the State is experiencing unprecedented growth that will affect all aspects of its physical development resulting in growing traffic congestion on its road network and major intersections [1]. In accordance to the State of Qatar's Master Plan vision, mission, and objectives, and through promoting smart growth planning practices and development principles to the growing city of Doha, this paper introduces the idea of linking Doha City to two vital under development cities; Al-Wakra city and Mesaieed Industrial city, in which and over the long term, means understanding the changed culture and behavioural shifts that addresses ways to get around the region. The paper is encouraging the establishment of a well-designed transport system that supports the state's growth and development plans, facilitates exchange, and allows the basic access needs of individuals and societies to be met safely in a manner consistent with human health and ecosystem. The analysis detailed the main features of each alternative including pros and cons. The results of the analysis included a comparison between alternatives and a selection of a preferred alternative. It is hoped that the findings of this study may assist decision makers in the formulation and the development of a new route that connects the three cities to improve the urban transportation system in Qatar.

Key-Words: Well-designed transport system, public transportation, smart growth, urban transit strategies

1 Introduction

Over the last few years, the strong performance of Qatar's economy has resulted in a large number of projects coming online and on an unprecedented growth that affected the country's physical development leading to growing traffic congestion on its road network and major intersections [1]. To handle the rise of development within the country, a comprehensive long term master plan for Qatar is being developed by the Urban Planning and Development Authority (UPDA) and is expected to guide the physical development of Qatar through the year 2025.

According to the UPDA, the master plan will cover all aspects of development including transportation, infrastructure, environmental protection, and land use. This master plan will incorporate and run a Transportation Model for both macro and micro planning analysis and will generate transportation management solutions. A comprehensive Transport Master Plan for Qatar (TMPQ) is also being developed by the UPDA in coordination with other authorities and institutions in Qatar. In accordance to the Qatar's authorities future vision and plans, this research is proposing linking Al-Wakra City and Mesaieed Industrial city, two vital under development cities, to Doha City, the major administrative center. Encouraging the establishment of a well-designed transport system in the country, this paper will introduce three alternatives for connecting the three cities, in which and over the long term, means understanding the changed culture and behavioral shifts that addresses ways to get around the region.

2 Smart Growth as a Transportation Issue

Growth creates jobs, generates revenue, expands the services available to citizens, and shapes the urban form of our cities. This research argues that Doha city is naturally expanding east towards Al-Wakra and Mesaieed Industrial cities. Accordingly, the need has arose to develop a smart, well established, and integrated transportation system that connects Al-Wakra city, for its proximity to Ras Laffan industrial area, and Mesaieed industrial city for the tremendous economic growth it promises, to Doha City, Qatar as a means of enhancing prosperity, sustainability, and quality of life in the region.

According to Qatar 2022 bid, Qatar provides a clear transport dossier based mainly on a description of its transport master plan of Qatar (TMPQ), adopted in 2006, to improve the country's transport infrastructure during the next decade together with Qatar's UPDA [2]. A key feature of the plan is the passenger metro/rail system. The bid proposes an overall transport strategy based principally on the compactness of the Greater Doha conurbation. Al-Wakra city is proposed as a host city, due to its proximity to Doha, where shuttle buses are to be used to and from the metro stop.

The drivers of this research to link the three proposed cities could be better understood through introducing the importance of each city in accordance to the governmental development plans.

2.1 The State of Qatar; an overview

Qatar is an independent state in the Southern Arabian Gulf surrounded by Saudi Arabia, Bahrain, the United Arab Emirates and Iran. The state's area is 11,437 square kilometers, projecting northward about 160 kilometers into the Gulf. Its coastline is 563 kilometers long and bounds the country to the west, north and east as shown in Fig. 1below.

Fig.1 Qatar Location

Recent estimates from the Qatar Statistics Authority showed that total population in Qatar has reached 1.7 million which made the country the 142 in world's rankings population for 2010. The country's total population has increased 128% since 2004 where almost 74% of the total population lived in Doha and Al Rayyan municipalities. It is also expected that the population in Qatar will reach 2.0 68 million in 2015 with a constant annual growth rate of 3.97% according to the growth rate estimated by economy watch. The Doha metropolitan area only is a home to more than 50 percent of Qatar's population with a density of population is 3,394 persons per square kilometer.

Economically, Qatar has emerged as one of the richest places in the Gulf and has one of the highest per-capita incomes in the world due to the major economic transformations, specifically in the oil, gas, and petrochemicals industry. Qatar was announced the No°1 world ranking with GDP growth rate of 19.4 % in 2010 according to the U.S. Central Intelligence Agency (CIA), that is almost 12.09 times more than the world GDP average and 84.64% of what it was in 2009. In the coming years, it is expected that the non-oil and gas sector will continue to grow and contribute significantly to the overall GDP, as major initiatives (Qatar Financial center, education city, Qatar Science and technology Park, energy city Qatar, tourism, construction and real estate, Sports, conferences etc.) continue to diversify the economy.

The country's overall employment growth rate has increased 290% since 2004; both private and mixed employment sectors grew almost three and half times, while it's governmental sector grew almost 25% more than it was in 2004 [3].

2.2 Cities of Interest

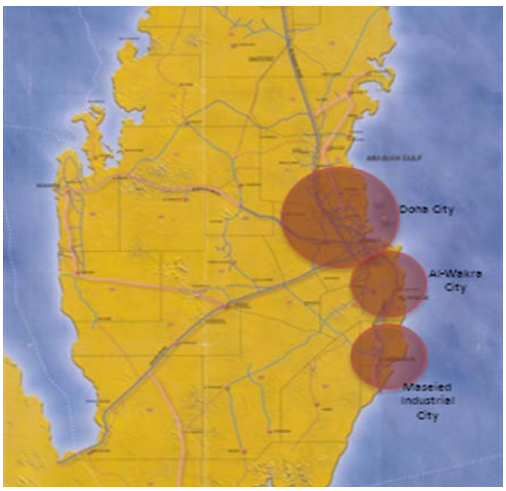

Fig. 2 Doha Map Showing the Location of the Three Cities Studied

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This section provides an overview of the cities of interest to be connected to support the state's growth and development plans. These cities include Doha City, Al-Wakra City, and Masaieed Industrial City (MIC). The location of the three cities is shown in Fig.2.

2.2.1 Doha City

The State of Qatar has 7 municipalities with a total population of 1699435 people. Doha is Qatar's largest city, with over 80% of the nation's population residing in Doha City and its surrounding suburbs. According to Qatar Census (2010), Only Doha (Ad-Dawhah) municipality is a house for 744,029 people on a total area of 11,427 km2 [4]. Doha City is also the economic center of the country; its economy is built on the revenue the country has made from its oil and natural gas industries. It is currently experiencing a very large boom, with explosive growth rates of population as the city is developing very rapidly.

2.2.2 Al Wakra City

Al-Wakra City is situated half way between Doha City and MIC, 15 km from Doha City 'The goal behind developing Al-Wakra City is to develop a regional centre of Qatar and a residential city of choice. According to the UPDA, the draft study to develop the scope of the municipality of Al Wakra City comes within the framework of comprehensive development experienced by the state and will always require overall integrated, long-term plans to guide its urban development [5]. The Wakra City master plan has conceptualized special zones for educational institutions, public offices, commercial complexes and marina, and a new downtown regional centre.

The master plan envisages Al-Wakra to be developed as a preferred waterfront destinations and a vibrant city where people would really want to visit and stay over. Considering the city's heritage history, a separate area will be developed as a heritage zone. Re-establishing Al Wakra city's historic core with distinctive sense of place and traditional architecture is another proposal.

2.2.3 Masaieed Industrial City (MIC):

The MIC has developed a long term strategic master plan which serves as the overall blueprint guiding cohesive and sustainable development over a 25-year (2006 – 2030) horizon, and secures MIC's continued sustainable growth and progress. The master plan ensures appropriate zoning and allocation of land for comprehensive and integrated development. A critical outcome of the project is the required expansion of MIC's geographic limit to accommodate the projected growth. The existing MIC area is approximately 117 km2. The proposed expansion is approximately 200 km2. [6]

2.2 Linking Smart Growth Principles to Qatar Transportation needs

As defined by Litman (2003) smart growth is a set of planning practices and development principles that result in more efficient land use and transport patterns [7]. It is an ongoing process that attempts to redress and to alleviate the many problems associated with sprawl, including unnecessarily high public and private costs, environmental degradation and a reduction in our overall quality of life.

Most recent discussions on smart growth benefits focuses on infrastructure savings, environmental protection, increased accessibility and improved livability as well as traffic safety. In fact, traffic safety is one of the most important benefits of smart growth and smart growth is one of the most effective ways to reduce traffic risk.

Moreover, smart growth stresses the importance of including pedestrians, the most basic and fundamental form of travel, as well as cyclists and transit users in planning new developments and improving and infilling existing developments. It focuses on accessibility, which is the ability of people to reach desired goods, services, and activities, and decreases distances between various trip origins and destinations.

Adopting all or part of recent smart growth principles to the growing city of Doha, the capital, and its surroundings, could accumulate in several benefits to the city including linking transportation, the workplace, and housing. In this research key smart growth terms and principles like transportation choices, connectivity, accessibility, and adequate mobility had been carefully addressed considering the regional attributes and the impacts of transportation alternatives and choices affecting the quality of life in Qatar. These key principles were defined in the research process as follows:

(1) Providing a variety of transportation choices through coordinating existing land use and transportation; increasing the availability of high-quality transit; and creating redundancy, resiliency, and connectivity
(2) Promoting connectivity and avoiding traffic problems on the existing road system as

growth occurs. This could be achieved through constructing new links between existing roads to provide residents with routing options and allow them to avoid the most heavily travelled roads.

(3) Promoting accessibility when development is concentrated at major hubs or is located along existing major corridors to allow for efficient transportation system that makes maximum use of existing infrastructure and builds new major transportation corridors.

(4) Providing adequate mobility enhanced by efficient transportation systems that provide flexibility in choices of travel modes when people are travelling from place to place

3. Challenges & Opportunities

In present days, Qatar has earmarked a massive amount of money for modernization of the road network and other related infrastructural projects with aims to broad-base the population and to ensure an all-round development of other parts of the Peninsula. According to a report published by the Urban Planning and Development Authority (UPDA) under the Public Works Authority (PWA – Ashghal), as much as 41 percent of the budget has been allocated to develop the major public projects, which will facilitate the expansion of the country's infrastructural landscape in conformity with the 2030 Qatar National Vision [2]. The UPDA has planned to connect Al Wakra City and Al- Wukair City to Doha City with multi-lane roads, which will help people cover the distance between the Doha International Airport and these two areas approximately within 10 minutes. This will create an attractive opportunity for expansion of the residential landscape outside Doha City. The above-mentioned road will also reduce the travelling distance from the end point of Doha City Center to the New Doha International Airport (NDIA,) a new under construction airport being constructed 5 Kilometers east of the current Doha Airport, to an incredible 35 minutes.

Accordingly, this proposed project to link Doha City to Al-Wakra City and MIC could accumulate in so many advantages such as; providing comfortable and safe driving within the region, easing traffic congestion on Al-Wakra road, creating a direct connection to the NDIA, providing direct connections to existing and future housing projects constructed along the highway such as Ezdan villages existing between Al-Wakra City and Al-Wukair City, south east Al-Wakra City, providing different choices of transportation to passengers through connecting the under-construction Doha Expressway to the proposed highway. Doha Expressway is quite prominent as it links not only southern part of Doha with its western part through a free-flowing traffic but also NDIA to Al-Wakra City and MIC. Fig.3 shows Doha Expressway, proposed transport nodes in circles, long distance passengers' route in red, and freight route in black.

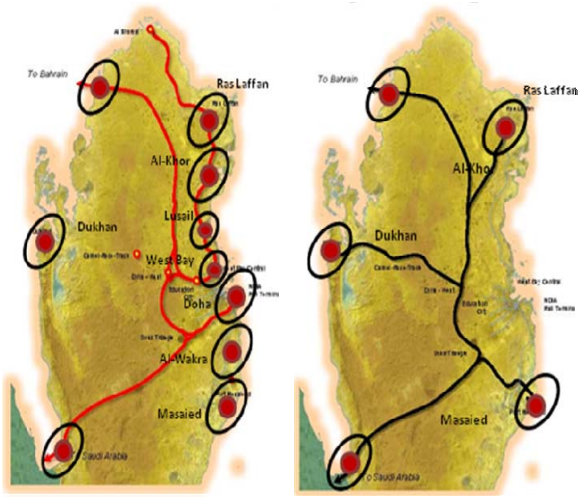

Fig. 3 Doha Metro System

4. The Proposed Project

The purpose of this project is to compare different alternatives to connect Doha city to Al-Wakra city and Mesaieed city and to identify technically and environmentally sound alignment alternatives that meet the State of Qatar needs and that are acceptable to the community.

4.1 Design Guidelines:

More than any other design consideration, horizontal and vertical alignments establish the general character of rural highways as the configuration of line and grade affects safe operating speeds, sight distances, and opportunities for passing and highway. In general, the proposed highway should include tangents (segments of straight lines), circular curves and, in some cases, spiral transition curves. The manner in which these components are assembled into a horizontal alignment should also significantly affect the safety, operational efficiency, and aesthetics of the highway capacity.

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The factors below were seen to influence the location and configuration of the proposed horizontal alignment linking Doha City to Al-Wakra City and MIC as follows:

- Existing physical controls like topography, and other land use, man-made and geographical conditions.
- Current environmental considerations and community impacts on adjacent land use and ecologically sensitive areas.
- Construction costs.
- Functional classification, level of service, design speed, and design standards.

Other concept design criteria and guidelines were also pursued as follows:

- 4 lanes, grid like street network with transit routes every half a mile were preferred.
- Speed should be limited to 100 km/hr.
- Safe crossing and continuous sidewalks within city limits.
- Where on-street parking is not practical, other types of buffering such as landscaping, street trees, seating, etc., should be used to improve perception of pedestrian safety.

4.2 Concept Design Alternatives

Several alternative corridors for route connecting the three cities were identified and evaluated. The objective of the alternatives analysis process was to identify technically and environmentally sound alignment alternatives that meet the State of Qatar needs and that are acceptable to the community. Based on the evaluation results, Alternative # 3 was found to be the most viable option.

4.2.1 Design Alternative # 1

Distinct advantages and limitations associated with Alternative # 1 (Fig.4) are as follows:

Advantages:

- Provides direct connection to "Doha Express Highway" as well as a direct connection from MIC to NDIA.
- Provides direct Connection to Ezdan villages and between Doha and Al-Wukair City.
- Promotes and increases trading in Al-Wukair City.
- Reduces the traffic congestion in Al-Wakra City.

Limitations:

- Will create a major intersection at the boundaries of Doha City that will require an interchange.

Fig. 4 Alternative 1; Proposed Alignment

4.2.2 Design Alternative # 2

Distinct advantages and limitations associated with Alternative # 2 (Fig. 5) are as follows:

Fig. 5 Alternative 2 Alignment

Advantages:

- Provides direct connection between Doha City and Al-Wukair City and to MIC;

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- Promotes and increases trade in Al-Wukair City;
- Reduces the truck volume in the center of Doha by providing a direct connection to the Industrial area;
- Will go through an undeveloped area, which will assist in the development of this area in the future.

Limitations:

- Traffic has to go through Salwa road, which is a congested arterial that passes through Doha City;
- A high percentage of heavy trucks will be generated from the Industrial area in MIC.
- Will not provide a connection to Al-Wakra City or to NDIA;
- Higher cost due to the construction of the new alignment.

4.2.3 Design Alternative # 3

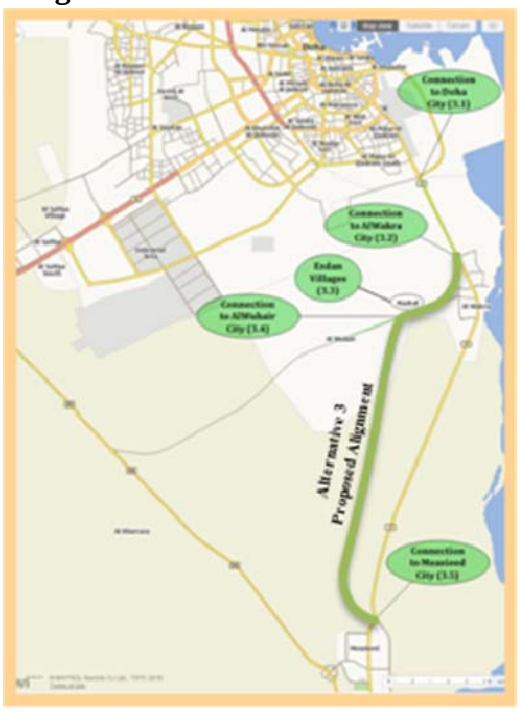

Fig. 6 Alternative 3; Proposed Alignment

Distinct advantages and limitations associated with Alternative # 3 (Fig. 6) are as follows:

Advantages:

- Using existing roads between Doha City and Al-Wakra City, which will reduce the cost of the project;
- Direct connection between MIC and NDIA;
- Will avoid the traffic inside Al Wakra City.

Limitations:

- Will not alleviate the traffic congestion in Doha City.
- Will not provide access to MIC.

5 Conclusion

Several alternative corridors for route connecting the three cities were identified and evaluated. Alternative 1 was found to provide a well-designed transport system that supports the state's growth and development plans, facilitates exchange, and allows the basic access needs of individuals and societies to be met safely in a manner consistent with human health and ecosystem. It is hoped that the findings of this study may assist decision makers in the formulation and the development of a new route that connects the three cities to improve the urban transportation system in Qatar. Future research should include further refinement and development of the preferred alternative.

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