Evaluation of existing transportation in Holy Najaf

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Abstract. This research assessed the road network system of the Holy Najaf City. Survey of the study area was done to collect necessary data to assess the present state of the road network. The study infers that the Holy Governorate is connected to the neighboring Governorates but not with highways or railways or airways. So the journey time to the nearby capital cities is very long. Besides the condition and size of the current road network, this fact is a major disadvantage for the Holy Governorate. A connection to the railway system is very important for the Governorate. It would improve the public and goods transportation systems. for pilgrims and tourists. Railway and highway connections are basic (in a wider range). But they are not available. Furthermore, the location of the airport itself isn’t optimal. The airport is close to the city centers and is a restriction for the urban development. The noise and pollution affected the population and the environment. So, an urban development into the south isn’t possible.

1. Introduction

The holy Najaf city, arguably the most important city in the Islamic world, has the shrine of Imam Ali, the largest cemetery in the Islamic world, Wadi Al Salaam (the Valley of Peace) and the most important Shi’a seminary (the hawza).

The transport connection is one of the most important conditions for the development of a region. The variants, therefore, have to be well integrated into the road network, public transport and the airport. According to this the questions are for example: Is the transport connection sufficient for the inhabitants and accompanying traffic volume? Is the public transport network sufficient? Is the airport suitably located? Transportation includes the road and rail network, the airports and the public transport systems. Among essential infrastructure (water supply, sewage, health care, electricity…) the transportation network is a defining characteristic for a country. These networks are the lifelines for a modern state. The quality of mass public transportation, mass goods transportation and motorized individual traffic with its different forms (air, rail, truck, bus, tram, subway, car…) is an indicator for the current and future potential of a state. For potential investors the quantity and quality of the transportation network is one of the main location factors. [1],[2]

This research describes the state of transportation in the Holy Najaf Governorate. First, it takes a look at the different road systems and their current problems. The quality and quantity of the road network is the biggest problem of the transportation sector. Furthermore, this research gives an overlook about planning standards for transportation systems in the Holy Governorate about its functionality.

2. Road network
The road network is the lifeline of a state. In urban areas, roads may come across a city or village and are called streets, serving two functions as urban area and roads. Economics and society depend heavily on the efficiency of roads. [3]

2.1 Road hierarchy
The following figure (1) gives a short impression of the road hierarchy.

![Figure 1. hierarchy of the road network [1]](image)

National and country roads are approach roads to the Expressways. Country roads are approach roads for the national roads, secondary for country and national roads. If the national road passes a city like the Holy City of Najaf), it has two functions, as a national road and as an urban main road. This case could also figure as secondary and country road. As shown in table 1.

| Table 1 Possible combinations of the street category [1] |
|-----------------------------------------------|
| Number | I     | II | III      | IV   | V           | VI                  |
| A      | Highway | National | Country | secondary | subordinate | Agricultural road   |
| B      | National road without extension | Main road without extension | Main collecting street without extension | | | |
2.2 The road network and the classification in Holy Najaf Governorate

The Holy Najaf Governorate (capital city Najaf) has 4 direct connections to other capital cities to the adjoining Governorates. They are national routes, partly with dual carriageway in both directions (A II in the hierarchy network).

Based on the Center of Najaf governorate these connections are:

1. Najaf – Kerbela (route 9)
2. Najaf – Hilla (route 70)
3. Najaf – Diwaniya (route 70, 71)
4. Najaf – Samawah (28)

2.3 The road systems and its problems in the Governorate

Basically, the north of Holy Governorate Najaf with its urban and agricultural areas is much more developed than the southern parts. But, most of the Holy Governorate depends on desert. These areas are not much populated. These areas are exclusively connected by Roads with low serviceability and extremely dependent on the weather. In the past, there was a connection through the desert till Saudi Arabia but currently this road is inexistent. A development of such connections is associated with many problems. For example, the sand, the heat, sudden floods and so on. Furthermore, the maintenance is very expensive and difficult to manage.

Iraq has 12 highways; half of them are ending or beginning in Baghdad. Highway number 8 passes through Al Najaf at a distance of approximately 70 km, which means that the main traffic lifeline didn’t pass through the Holy Governorate. This fact means the significant disadvantage for Al Najaf in comparison to other Governorates. The primary routes from the highway to Najaf are route number 70 and 71. The bottlenecks are the bridges over the Euphrates (Kufa and Manathera). By increasing traffic, this connection could be overloaded in the future.

2.4 Road condition

Currently the road network in Iraq is in a bad condition. Since the main built up period in the 70s and 80s, the quality of the roads deteriorated rapidly until now. The reasons being the environmental conditions on one hand and the lack of maintenance on the other. Potholed streets, hot temperature, difference in temperature, insufficient substructure, geological backgrounds, sandstorms and a lack of drainage systems (undercutting) are the main reasons for the decreasing road quality. The existing network lacks a clear hierarchy. The hierarchy should clarify which roads are main roads, secondary roads, city and main roads.

2.5 Traffic network model for Holy Najaf Governorate

With the program PSV (program-system town traffic) the current and the future traffic situations in the Governorate Najaf is calculated in detail and shown graphically. All the calculations for future developments are based on an assumption of 100 motorized vehicles per 1.000 inhabitants in 2030. [5] The traffic prognosis is calculated from the state of the existing road network situation and does not include future improvements of its efficiency.
Also, the calculations do not include an improvement of the public transport system but, nevertheless, do assume a rising usage of public transport. The following figures and tables present the traffic volumes sorted by sub-districts of the governorate. In addition, traffic volumes generated between the Najaf governorate and adjacent governorates and countries are also shown. The listed traffic volumes are sub-divided into Motorized Individual Traffic (MIT), Public Transport (PT), by bike and foot. All assumptions are based on traffic volumes generated on a typical working day. When looking at traffic model of the motorized traffic (MIT and PT) it has to be mentioned that not only interior traffic is taken into account, but also journeys generated into and from other adjacent governorates. The Non-motorized traffic is neglected, since no trips between governorates or countries are done by foot or bike.

Altogether, about 1.020 thousand journeys per day are done by all motorized vehicles, bikes and on foot. As the tables 2 and 3 reveal, in 2030 the total traffic volume generated by all motorized and non-motorized vehicles will rise up to 1.907 thousand journeys per day. The highest increase can be realized in the city of Najaf.

The total increase until 2030 generated by public transport (PT) is 122.000 ways per day. This assumption is based on a moderate development of public transport systems and networks, not comparable with European standards. If the quality of PT will reach European grade in the future, the total amount of journeys per day done by PT would be about three times higher.

When looking at the public transport it has to be mentioned that only the interior traffic is taken into account, and not the journeys generated into and from other governorates.

| Sub-districts | MIT      | PT       | by bike  | walk on the feet | total |
|---------------|----------|----------|----------|------------------|-------|
| Kufa City     | 68.000   | 30.000   | 3.000    | 58.000           | 159.000|
| Kufa Rural    | 12.000   | 2.000    | 1.000    | 21.000           | 36.000|
| Abassia       | 21.000   | 1.000    | 1.000    | 37.000           | 60.000|
| Huria         | 7.000    | 0        | 0        | 12.000           | 19.000|
| Najaf         | 231.000  | 49.000   | 10.000   | 258.000          | 548.000|
| Al Hydaria    | 9.000    | 0        | 0        | 15.000           | 24.000|
| Al Shabaka    | 0        | 0        | 0        | 0                | 0     |
| Manathera     | 28.000   | 2.000    | 1.000    | 45.000           | 76.000|
| Meshkhab      | 20.000   | 1.000    | 1.000    | 39.000           | 61.000|
| Al Quadesia   | 1. 12.000| 2. 0     | 3. 1.000 | 4. 24.000        | 5. 37.000|
| Total         | 6. 408.000| 7. 85    | 8. 18    | 9. 509           | 10. 1.020.000 |
Table 3. Traffic volumes in 2030 according to the sub districts

| Subdistrict    | MIT  | PT   | By bike | Walk on the feet | Total  |
|----------------|------|------|---------|------------------|--------|
| Kufa City      | 125.000 | 74.000 | 6.000 | 106.000 | 311.000 |
| Kufa Rural     | 24.000  | 3.000  | 1.000  | 40.000  | 68.000  |
| Abassia        | 40.000  | 4.000  | 2.000  | 64.000  | 110.000 |
| Huria          | 13.000  | 1.000  | 1.000  | 22.000  | 37.000  |
| Najaf          | 402.000 | 115.000 | 18.000 | 480.000 | 1,015.000 |
| Al Hydaria     | 13.000  | 1.000  | 0      | 20.000  | 34.000  |
| Al Shabaka     | 0      | 0      | 0      | 0      | 0      |
| Manathera      | 54.000  | 5.000  | 2.000  | 81.000  | 142.000 |
| Meshkhab       | 43.000  | 3.000  | 2.000  | 73.000  | 121.000 |
| Al Quadesia    | 24.000  | 1.000  | 1.000  | 43.000  | 69.000  |
| **Total**      | 738.000 | 207.000 | 33.000 | 929.000 | 1,907.000 |

Figure 2. Journeys per working day after modal split and sub district (2008).
Figures 2 and 3 also show the current and the assumed traffic volumes according to the sub-districts and the modal split. It is remarkable that in 2030 still most of the journeys will be done by foot. Nevertheless, the amount of individual traffic will also be rising. The highest increases of motorized individual traffic can be mentioned in Meshkab (increase about 115% up to 43,000 journeys/working day), in the rural areas of Kufa, where it is estimated to rise about 100% up to 24,000 journeys/working day, and in Al Quadesia (also 100 %, up to 24,000 journeys/working day).

3. Public transports

Public transport (also public transportation, public transit, or mass transit) comprises passenger transportation services, which are available for use by the general public, rather than for private use modes such as cars or rental vehicles. Some services are free though most charge some sort of fare.[4,5]

3.1 Bus network and workload

The bus transport system in the Holy Governorate can be divided into three types.
- Bus transport inside the cities (urban public traffic)
- Bus transport inside the Governorate and between cities and villages.
- National bus transport to other capital cities (long distance traffic)

3.2 The bus transport and its problems

Public transport in Governorate Al Najaf is almost always organized by private companies. There are no information about the organization and the proceeding bus lines. Basis of the buses are the garages, which are available in every bigger city. Buses drive without any schedule and have no permanent bus stops. This is a big problem for passengers and the quality of the supply. It costs a lot of time to wait for a departure in the garages and along the bus line. Often they had to wait for a connecting bus. A time scheduling is almost impossible and the journey time increases rapidly.
Another problem is that minibuses are the only public transport system in the cities. They create a lot of traffic and pollution. Bigger buses could be more effective. There is no alternative transportation system (for example tramways).

4. Railways
The Governorate is not connected to the railway network. The nearest railway line to Holy Najaf Governorate is the Baghdad - Basra line. It lies approximately 40 km to the east of Najaf. This is one part of the 5 lines of the National Railway Network. The nearest stations to the main urban centers are in Al Hilla. This gives the city a competitive advantage.

Railway can be divided into two segments. The first part is the passenger transportation and the second part is rail cargo. Tramway, undergrounds and light railway are railbound too, but in this case not object of consideration. Figure 4 shows the railway network in Iraq. The lack of connections is a big problem for Al Najaf.

Figure 4. The rail network in Iraq

5. Airport
The new opened Najaf International airport (Al Imam international airport) is a big step for the development of the region and the Cities Najaf and Kufa may see significant economic benefits. The introduction of commercial flights into Najaf and Kufa will strengthen agglomeration of the two cities position as a major city in Iraq and is likely to boost economic development opportunities as well as religious tourism.

On the other hand, the connection to the airport is bad. Railway and highway connections are basic (in a wider range). But they are not available. Furthermore, the location of the airport itself isn’t optimal. The airport is close to the city centers and is a restriction for the urban development. The noise and
pollution affect the population and the environment. So, an urban development into the south isn’t possible.

6. Conclusions
 Basically every city is connected to a street (dirt roads included). But, the majority is unpaved and partly in a very bad condition. The weather, potholes and scanty materials are responsible that many roads are impassable. Certainly many villages have generally no connection with adequate road. Additionally many bridges are also in a bad condition.

Indeed, Holy Al Najaf Governorate is connected to neighboring Governorates but not with highways or rail. So, the journey times to the next capital cities is very long. Besides the condition and size of the current road network, this fact is the major disadvantage for the Holy Governorate.

The public (bus) transport system in the Governorate has to be developed. This includes new bus lines (inner city, interurban and national) with corresponding organization and transport fleets and trams (mass transport) for the cities Kufa and Najaf. The biggest problems are the irregular (no schedules) and long journey times, the uncomfortable journey, a lack of supply and the lack of regular bus stops. A positive aspect is that there are connections to Basrah, Baghdad and other bigger cities.

A connection to the railway system is very important for the Governorate. It would improve the public and goods transportation (agricultural freight, industry products). Furthermore, the accessibility for pilgrims and tourists would be much more effective. Ideal for the industry and airport would be a direct connection by rail. A railway connection could be a strong location factor for the region.

The connection to the airport is bad. Railway and highway connections are basic (in a wider range). But they are not available. Furthermore, the location of the airport itself isn’t optimal. The airport is close to the city centers and is a restriction for the urban development. The noise and pollution affect the population and the environment. So, an urban development into the south isn’t possible.

Traffic collision avoidance system in driverless environment needs to set a decision making algorithm which will lead to cover most of situation where the car needs to take an action to avoid crash, the decision is basically taken according to a set of factors plus the situation itself, the speed of the forward traffic and the distance between the car and other traffic should be collected continuously.

Many of sensors (speed and distance) plus radar and camera should provide a wider area of the decision to take.

References
[1] Ministry of Transport, Building and Housing July 2017 Aviation Strategy for Denmark. Copenhagen. ISBN internet version: 978-87-93292-32-1
[2] Data on the barriers and motivators to more sustainable transport behaviour is available in the UK Department for Transport study "Climate Change and Transport Choices"
[3] Bent Flyvbjerg, Mette K Skamris Holm, and Søren L Buhl How (In)accurate are demand forecasts in public works projects Journal of the American Planning Association 71:2 pp 131–46
[4] European Commission 2004 “DG for Research and Innovation, DG for Mobility and Transport (2011). Flightpath 2050 Europe’s Vision for Aviation. Brussels” ISBN 978-92-79-19724-6, Volume 14
[5] Akshima T Ghate and S Sundar June 2014 “Proliferation of Cars in Indian Cities” The Energy and Resources Institute

[6] Air Transport and Airport Research September 2010 Airport Accessibility in Europe. Cologne. Release: Final Report 1.02