

Analysis Local Public Transportation Using GIS

(Baghdad Case Study)

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Abstract - Traffic congestion is a serious problem in Baghdad city due to the rapid increase in the use of the private vehicles which have adverse effects on travel time, vehicle operation costs, air quality, etc. The existing local public transport condition today can be presented by the public buses suffer from the severe traffic congestion in urban roads. There is need to analysis local public transportation using GIS to solve the existing congestion problem. Due to limited available data, Baghdad suffers a deficiency in the application of urban transportation planning process in selecting suitable transport policies to solve the transportation problems. The following study tries to analysis the existing public transportation using GIS and recommending the necessary optimum transit routes to meet the requirement of future travel demand. Results of this study will provide the transportation agencies to maximize their revenue and better allocate their resources.

Key Words: Public Transportation, GIS, Transit Assignment, O-D Matrix, Optimum Route.

1.INTRODUCTION

Geographic Information Systems (GIS) have been widely used in the field of transportation since location information is critical for transportation applications such as transportation planning, modelling, accident analysis, transit service planning, etc, [1] The purpose of transit-demand studies is to estimate and evaluate passenger demand by collecting and analysing data and models pertaining to current and future transit needs. Transit-demand studies and models form an essential part of any transit planning process,[2]. Public Transport is an effective use of space which reduces air pollution and noise. When the population of a city increases, share usage of public transport, should increase. Experience has shown that where roads do not have adequate width and share of mixed traffic (slow and fast moving vehicles) happen then road transport capacity decreased. When traffic density increases, average speed of vehicles decreases, journey time increases, air pollution increases and level of inconvenience of commuters increases. Thus when this happens, provision of rail-based mass transport should be considered. Anh et al, (2005) investigated the existing bus system in Hanoi, to examine the bus service characteristics and user characteristics, to analyze the deficiencies of bus service by applying GIS

concept [3]. The existing local public transport condition in Baghdad today are presented by the public buses suffers from the severe traffic congestion in urban roads. In addition, the average bus speed is about 20 kmph in the CBD and is worse at less than 15 kmph in the inner CBD according to [4]. Analysis the existing situation is crucial due to high existing travel demand which will causes congestion and result in longer journeys, increase waiting times for users. Since 2003, substantial increase in car ownership levels is occurred. The data provided by the Central Organization for Statistics and Information Technology as shown in Table (1). The number of vehicles imported during the period 2003 -2006 (1106913 vehicles) and registered under "temporary check" status exceeded the number of registered passenger vehicles and trucks.

Table (1) Number of Vehicle during the Period 1997-2006 [5].

Year	Saloon	Station car	Field	Bus	Total
1997	673194	9015	39350	51427	772986
1998	675707	9121	39569	51943	776340
1999	679698	9357	39758	52598	781411
2000	685751	9572	39985	53243	788551
2001	690459	9810	40147	54243	794659
2002	693700	10157	40315	56034	800206
2003	701555	10426	40544	57757	810282

Year	Passenger Vehicles	Trucks	Total
2003	99522	12595	112117
2004	541605	104577	646182
2005	207696	57069	264765
2006	59060	24789	83849
Total	907883	199030	1106913

2. OBJECTIVES of THE STUDY

The main objectives is to explore the existing travel characteristics of the study area, to develop an O-D trip matrix between bus terminal using Trans CAD software, to suggest future scenarios using the assignment results of the base year.

3. STUDY AREA

Baghdad is the capital of Iraq. It has the largest concentration of urban population in Iraq. It is the center of Iraq's finance, commerce, and manufacturing. Tigris River is the most important natural feature in the identity of the city; it splits Baghdad to Karkh and Rusafa.

4. PUBLIC TRANSPORTATION in BAGHDAD CITY

The General Company for Private Transport (GCPT) is the main company that operates the buses within Baghdad city, and from Baghdad. It has 25 large buses operating within the Mayoralty of Baghdad (MoB) ranging in a capacity between 44 and 50 passengers, and 178 large buses that operate to and from Baghdad. The GCPT also operates 18363 mini-buses within the city, with a capacity ranging between 9 and 28 passengers and 35547 mini-buses operating to and from the city. Public transport is the only means of transport for large segment of population in Baghdad. The private sector provides passenger transport services by taxi and mini bus on 270 service lines originating from 28 terminals. Table (2) lists the locations of bus terminals served by GCPT, and Figure (1) gives their locations within MoB.

Table (2) Location of Bus Terminals Served by GCPT

Terminal No.	Terminal Name	Terminal No.	Terminal Name
1	Nahdha	9	Bayaa
2	New Baghdad	10	Bab Al-Moatham
3	Al-Shaab	11	Shulua
4	Kadhimiya1	12	Sadir City
5	Kadhimiya2	13	Dora
6	Jihad	14	9 April
7	Huriyah	15	Al-Amma
8	Khullani	16	Al-Mushtal
		17	Al-Karadh

Source: Ministry of Transport, General Company for Private Transport

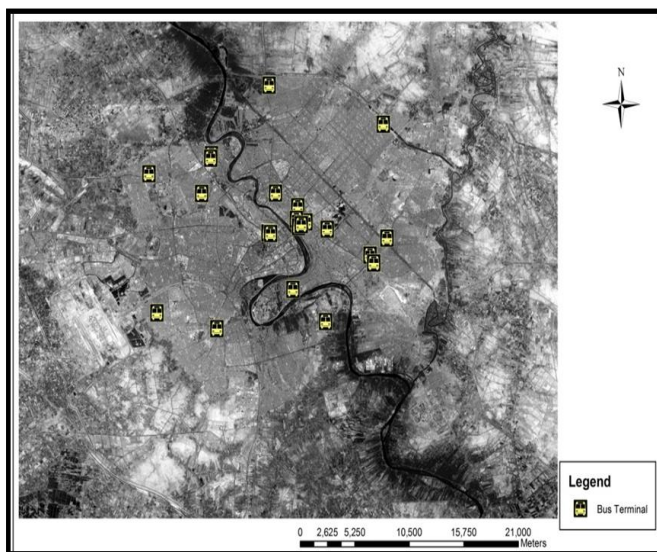


Figure (1) Satellite Image of Locations of Bus Terminal within MoB

5. ESTIMATION O-D MATRIX

The data collected from the General Company for Private Transport (GCPT) for 2014 listed all the bus terminal and bus routes that operated inside Baghdad government. The data collected included number of vehicle operating and number of passenger per day for each route. The data was organized and coded in Arc GIS. Figure (2) shows Production-Attraction of each bus terminal within MoB boundary. The bus terminal point feature class was transferred to Trans Cad to estimate O-D trip matrix using gravity model. According to the trip distribution analysis done in Trans CAD software, the result of O-D trip matrix is shown in Figure (3).

Figure (3) shows desire lines which are straight lines connecting the travel between pairs of terminal and appear as bands whose width is proportional to the travel demand. O-D matrix of public transport was obtained as shown in following figure.

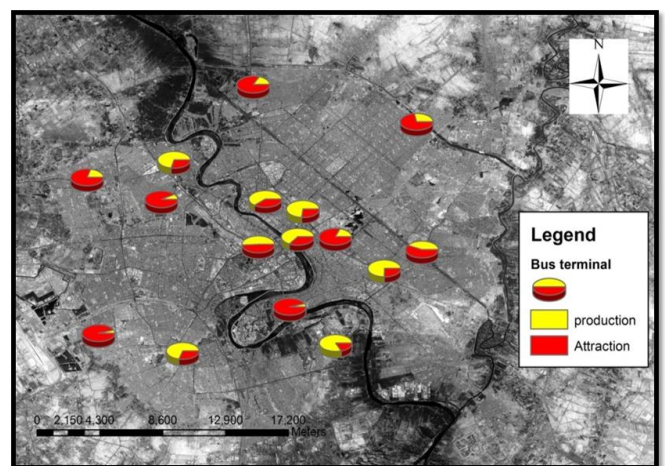


Figure (2) Satellite Image of Production-Attraction of each Bus Terminal

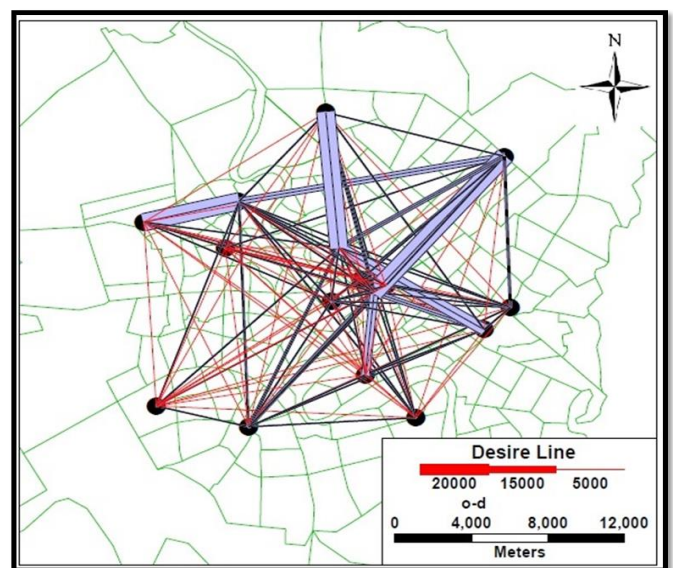


Figure (3) O-D Trip Matrix of Bus Terminal.

Based on the analysis of O-D trip matrix results, it is observed that the most O-D terminal pair with high travel demand is as follows:

- 1- Al-Shaab – Bab Moatham
- 2- Shuula- Kadhimiya
- 3- Sadir City – Bab –Alsharquie
- 4- Karadh- Bab –Alsharquie
- 5- New Baghdad- Bab Al-Moatham

6. TRANSIT ASSIGNMENT

6.1. Highway Network Preparation

Building the road network of Baghdad City was conducted using a transportation planning software Arc GIS and Trans CAD. Highway network was drawn in Arc GIS and then exported to Trans Cad. Converting the GIS file to a Trans CAD file requires a network modification.

Basic elements of a network are nodes and links. Links refer to actual highways (excluding most minor local roads) found in the highway network. Nodes are end points of links and connect links together. Nodes are usually located in intersections. These links are coded with their characteristics such as speeds, length, capacities, and highway functional classification types. Once the network is created, it was checked to correct topology, and final checking was done for accuracy by performing the “shortest paths module” between any two pair of zones in the study area. Figure (4) shows existing highway network.

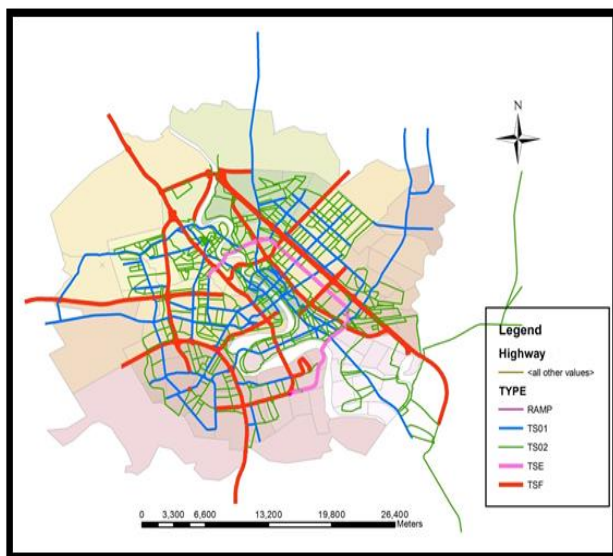


Figure (4) Existing Highway Network.

6.2 Transit Network Development

Public transport lines were built based on road network and stored as geographic file. The existing public passenger

movement is studied. The total number of bus route services operated along study area is drawn in Trans Cad. Trans Cad has special tools for building transit networks. Transit network is created from a route system layer, using information from the routes, the stops, and the underlying line geographic file (streets layer, node layer). Transit network analysis in Trans Cad requires fares that are used to calculate the best transit skims. A transit fare was entered as flat fare (where the fare on each route is fixed regardless of the distance traveled). Using transit networks, shortest path problems can be solved; transit path attributes (i.e. skims) can be calculated between stops in route system or nodes on the underlying line layer. Figure (5) show the existing public routes.

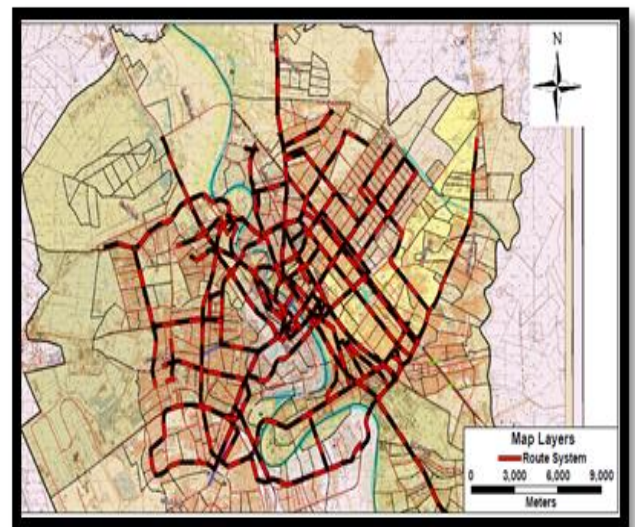


Figure (5) Public Transportation Routes

In addition to route system, it should have non-transit links from the underlying line layer to make connectivity. Non-transit links in a transit network provide access and egress between the centroid node and the stop, and to facilitate walk and transfer access between stops. These links represent either walking links or different types of transfer links and can prepare the numeric attributes for these links (walking time, transit travel time on the links that routes traverse), [6].

6.3 Transit Assignment Application

Transit assignments in Trans Cad require two main inputs: highway and transit network file and an origin-destination matrix. Transit assignment use the same impedance function (travel time) as was used for trip distribution. Trips are loaded onto the highway system using User Equilibrium assignment technique. The flow is distributed between origin and destination to multiple routes, depending on their attractiveness. Passenger’s route choice in urban transit networks is influence by the following factors :

- Traveling Time
- Fare

- Passenger Comfort

Transit assignment needs the following data:

- A transit route system that defines the routes and stops
- A transit network built from the route system, with complete settings and fare structure information
- An O-D passenger demand matrix

The output of assignment results is shown in Figure (6) which is a key element in the urban travel demand forecasting process and used in a variety of applications.

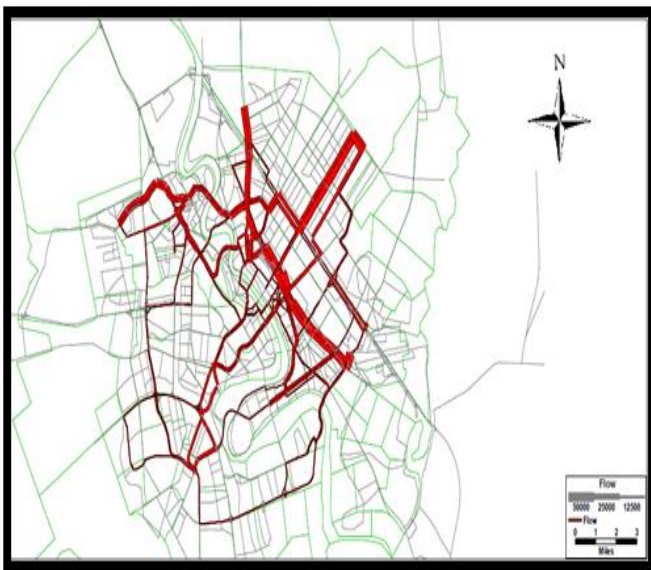


Figure (6) Transit Flow Assignment.

7. RECOMMENDATION for URBAN RAIL TRANSIT

Highly urbanized regions like Baghdad city face problem like traffic congestion stimulated the planners and the implementing agencies to go for strategic transportation projects. The existing local public transport suffers from the severe traffic congestion in urban roads. Due to high existing travel demand which causes congestion that result in longer journeys and increases waiting times for users, a new urban rail transit is recommended to provide sustainable solutions to the existing network problem. The attractiveness of urban rail transport due to the reduction in the journey times will encourage a substantial shift from private cars.

Maximum revenues can be achieved when the urban rail system aligns along the high passenger ridership routes. And according to the analysis and results of current study, the following proposed routes are suggested to introduce urban transit system such as: Metro, Light rail transit, Monorail. These routes are recognized based on the travel demand values and the following Figure (7) recommended connecting

Al- Shaab Area to city center because of highly travel demand produced from this area.

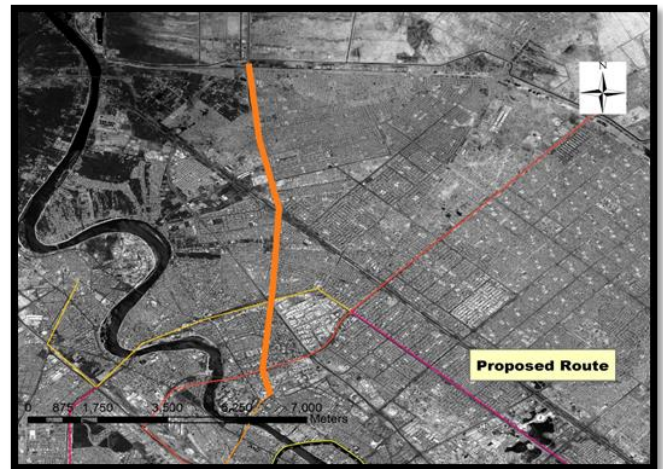


Figure (7) Proposed Route to Al- Shaab Area.

According to the feasibility Study of RTS in Baghdad, it was ordered by the Ministry of Transport of Iraq, and performed by Swiss Consultant – De Consult. They developed alternative strategies to meet the requirements of future demand. The study recommends that the public transport should be provided in an integrated system of metro and bus service. In general, the bus route would act as feeder service to the metro system in order to maximize the usage of this proposed new facility. And this study recommends constructing suggested metro routes as shown in the following Figure (8).

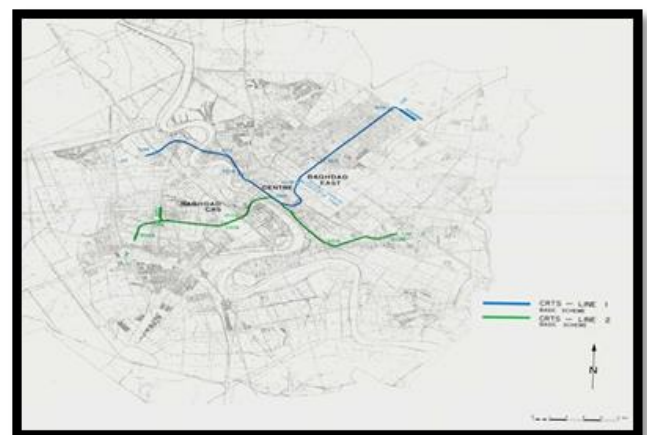


Figure (8) Metro Routes as suggested by Swiss Consultant – De Consult

Another recommended route is to connect highly population area (Sadir City) to Kadhimiya city by mass rapid transit as shown in Figure (9), to release highly traffic pressure on existing road network and to remove congestion because of highly travel demand produced from these areas.

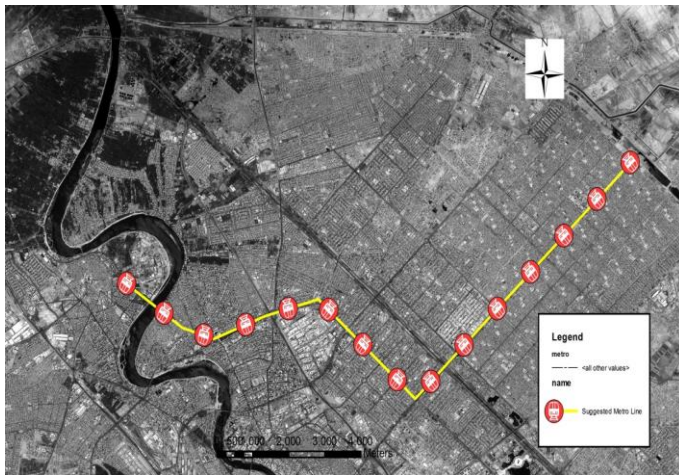


Figure (9) Suggested Route to Connect (Sadir City) to Kadhimiya

8. ACKNOWLEDGEMENT

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9. REFERENCES

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