INVESTIGATING THE EFFECT OF MAKING TRAVELING APPLICATION ON THE PASSAGES TRAFFIC BY MEANS OF MODELING IN GIS

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ABSTRACT

One of the basic foundations that must be evaluated while increasing the accumulation of the population, is the traction accountability of communication network in both public and private transport system to new trips created by new user introduction.

In this paper, we discuss about trip generation of different uses and its effects on road traffic with regard to the case study of Imam Khomeini street in Tabriz city, Iran. Also these effects have been modeled in 4 ways including logistic, MCE, AHP and membership models.

INTRODUCTION

From 1960 to 1980 the rapid growth of cities caused a failure in providing services and led to a lower quality of municipal services since 1980 the financial cuts in governmental funding to the municipalities which are the only organization providing municipal services resulted an imbalance between the residential and service usage. One of the services that suffer from the decline in the level of service and has caused a management crisis in big cities is the transport service. (Bhuyan and Nayak, 2013)

Solving urban transport problems, requires research and systematic and ongoing planning like other prevailing social problems. One of the most important sectors in the urban transportation planning studies is trip demand analysis process (Dahal and Chow, 2014). One of the basic foundations that must be evaluated while increasing the accumulation of the population, is the traction accountability of communication network in both public and private transport system to new trips created by new user introduction.

In this paper, we discuss about trip generation of different uses and its effects on road traffic with regard to the case study of Imam Khomeini street in Tabriz city, Iran in which the GIS modeling is used. The method used in this paper is objective, practical and functional-based and based on data collection, it is among analytical researches, under the category of survey, software type, field data and case studies.

The area under study

Tabriz is the greatest North-western metropolitan city of Iran which is about 131 km² at eastern latitude 46.11,46.23 and northern latitude 38.1,38.9 with 1340 m height in the plain of Tabriz.

The area under study is Imam Khomeini Street which one of the main axes of communication located in the north of district 2 and most of the area is under business or administrative application.

After Janbazan square which is a traffic nod due to the extension of the business sites we face a special change into non-accumulated area.

In addition to these nodes, the intersection of the Abresan and Shahryar Square are other nodes of this path (Zysta consulting engineering, detailed design of Tabriz, 2006).

The required data

The required data for this study are as follows:

1. The land use, building density and the street maps that can be obtained from the municipalities of the districts under study.
2. The statistical data about trip generations of uses

These statistics are gathered at the peak of traffic hours to estimate the trip generation of the uses and are gathered through field study and questionnaires.

Generating usage layers and specifying the area

Since the main area under study is Imam Street, in addition to the street margin usage, the usages that their traffic is added to this area through the north- south axis are investigated; According to the traffic laws the traffic effects of the uses that are within the 150-200 m rage of the street should be examined. Therefore, we determine the research area and prepare the maps accordingly.

The next step is to create a database for parts in Arc GIS. After preparation of the maps we can obtain the required maps.

Travel Generation of the usages

As mentioned earlier in this study, measuring the traffic effect have different and various uses and the extension of these studies depends on the scale and type of usage, the purposes and the environment of the building as well as
the time and the allocated budget for the study which are the defining factor in addressing the issue. In the real world first these factors must be determined and then the study is adjusted to them. Some traffic measurement studies can be conducted within weeks and the other need months to be conducted (Patnaik, 2013).

The following stages are considered in all studies of traffic impact assessment regardless of the size of the study, objectives and desired accuracy.

### Making arrangements
At this stage, the problem solving method and the amount of details are determined. The objectives are set and the existing data are measured. Also the field studies and the required methods to implement them are designed.

### Estimating the usage trip generation
The studies of traffic impact assessment are based on an estimation of trip generation of uses. This estimation is usually done in a casual day. In order to assess traffic impact, the road traffic must be determined in the absence of that use. The usage traffic volume determines the traffic volume in the absence of the use.

### Determining the impact on road network performance
In this step the motor trip generation of each usage is reduced from the total motor volume and the traffic is analyzed in the absence of that use and the traffic impact are assessed. Then, through reducing the motor trips of all usages from the motor traffic the motorized traffic independent of the area and usages is determined and the connective role of the street is determined.

### Determining the impact on the quality of motorized traffic
Through the determination of trip generation of the usages the amount of motorized traffic and the effect of the

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**Table 1** Important uses and their trip generating factor

<table>
<thead>
<tr>
<th>Use</th>
<th>type code</th>
<th>The main trip generating factor</th>
<th>Other Important trip generation factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>House</td>
<td>110</td>
<td>number</td>
<td>The number of parking spaces and car ownership</td>
</tr>
<tr>
<td>typical apartment</td>
<td>120</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>High rise apartment</td>
<td>130</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>House complex</td>
<td>140</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Typical house complex</td>
<td>141</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Villa complex</td>
<td>142</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Apartment complex</td>
<td>150</td>
<td>number</td>
<td>The same as houses</td>
</tr>
</tbody>
</table>

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**Figure 1** The travel generating form

**Map 1** The land use of the area under study.

**Map 2** Trip generation of the parts

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**Form No. 1** Building Usage Information

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**Map Guide**

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<td>The same as houses</td>
</tr>
<tr>
<td>High rise apartment</td>
<td>130</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>House complex</td>
<td>140</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Typical house complex</td>
<td>141</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Villa complex</td>
<td>142</td>
<td>number</td>
<td>The same as houses</td>
</tr>
<tr>
<td>Apartment complex</td>
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<td>number</td>
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</tr>
</tbody>
</table>

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**Making arrangements**
At this stage, the problem solving method and the amount of details are determined. The objectives are set and the existing data are measured. Also the field studies and the required methods to implement them are designed.

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**Determining the impact on the quality of motorized traffic**

Through the determination of trip generation of the usages the amount of motorized traffic and the effect of the
usages on the added motor vehicles to the street is determined.

Findings

In this study all usages are divided into 6 main groups:

1. Residential usage
2. Business usage
3. Administrative usage
4. Educational usage
5. Religious-cultural usage
6. Treatment usage

Some of the important uses are divided into subcategories and the trip generation factor for each one is determined.

Table 2 The usages’ trip generation

<table>
<thead>
<tr>
<th>Usage</th>
<th>Total usage area</th>
<th>Usage trip generation per 100 meter (n)</th>
<th>Total trip generation of the usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>443200</td>
<td>0.7</td>
<td>3102</td>
</tr>
<tr>
<td>Business</td>
<td>134413</td>
<td>1.25</td>
<td>1680</td>
</tr>
<tr>
<td>Educational</td>
<td>6311</td>
<td>12</td>
<td>757</td>
</tr>
<tr>
<td>Religious-cultural</td>
<td>7683</td>
<td>10</td>
<td>768</td>
</tr>
<tr>
<td>Treatment</td>
<td>8442</td>
<td>6</td>
<td>506</td>
</tr>
<tr>
<td>Administrative</td>
<td>38333</td>
<td>1.4</td>
<td>545</td>
</tr>
<tr>
<td>Total of all applications</td>
<td>649291</td>
<td></td>
<td>8867.6175</td>
</tr>
</tbody>
</table>

Due to the lack of statistical data and cooperation of the society and cultural conditions, the main travel making factor for each usage, the infrastructure and the number of usage travel are estimated as 100m and the statistics related to each traffic at the peak hours are gathered through field study and manually.
The trip generation of each usage for each travel and the effect of the usages on the service level are determined. According to the above table the residential, business and treatment usages possess the highest percentage of cars and taxi use thus they have the highest effect on street service level.

Table 3 The trip generation of each usage for each travel

<table>
<thead>
<tr>
<th>Usage</th>
<th>car</th>
<th>taxi</th>
<th>bus</th>
<th>Pedestrian and bicycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>42%</td>
<td>18%</td>
<td>17%</td>
<td>23%</td>
</tr>
<tr>
<td>Business</td>
<td>31%</td>
<td>28%</td>
<td>24%</td>
<td>17%</td>
</tr>
<tr>
<td>Educational</td>
<td>7%</td>
<td>14%</td>
<td>52%</td>
<td>27%</td>
</tr>
<tr>
<td>Religious-cultural</td>
<td>12%</td>
<td>16%</td>
<td>46%</td>
<td>26%</td>
</tr>
<tr>
<td>Treatment</td>
<td>32%</td>
<td>21%</td>
<td>34%</td>
<td>13%</td>
</tr>
<tr>
<td>Administrative</td>
<td>23%</td>
<td>12%</td>
<td>38%</td>
<td>27%</td>
</tr>
</tbody>
</table>

According to According to the Master Plan for Transportation and Traffic Studies conducted in Tabriz, factor of personal passenger for personal vehicles is 2 and factor of personal passenger for taxis has been determined by an average of 3. (The report of BRT of Tabriz 2007)

Thus through dividing the number of trip generation for each user by the related factor (2 or 3) the number of personal trips is modeled.

The number of taxis for each residential usage = \( \frac{3102 \times 0.18}{3} = 186.12 \)

Table 4 The number of cars for each usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>car</th>
<th>taxi</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>655</td>
<td>187</td>
<td>842</td>
</tr>
<tr>
<td>Business</td>
<td>260</td>
<td>156</td>
<td>416</td>
</tr>
<tr>
<td>Educational</td>
<td>26</td>
<td>35</td>
<td>61</td>
</tr>
<tr>
<td>Religious-cultural</td>
<td>46</td>
<td>40</td>
<td>86</td>
</tr>
<tr>
<td>Treatment</td>
<td>80</td>
<td>35</td>
<td>115</td>
</tr>
<tr>
<td>Administrative</td>
<td>21</td>
<td>60</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>1088</td>
<td>513</td>
<td>1601</td>
</tr>
</tbody>
</table>

Modeling

The modeling method of this study is the logistic model, MEC and FUZZY - AHP of Idrisi software and Fuzzy(membership) in Arc GIS 10.1.

The required levels of this model to analyze the effect of usage on the street include the passage layer and the separate usage layers. The usages are divided into 6 main classes of Residential, Business, Administrative, Educational, religious-cultural and Treatment usage. Each usage is classified into 5 classes based on the density and travel making in Arc GIS 10.1 software and through the analytical functions the maps are changed into images and transferred into Idrisi software for image modeling. Then in order to perform the logistic modeling through the data entry option and edit and assign orders the classes for each layer are weighted. According to the findings of traffic study studies 3 important effective usages (residential, business and treatment) are identified and analyzed in street service level trough the logistic model. In order to perform the model the GIS analysis option, Statistics function and LOGISTICREG order are used.

Then in order to perform the MCE model the GIS analysis option, Statistics function and LOGISTICREG order are used. Also in order to perform the AHP-Fuzzy the WEIGHT and Decision Wizard were used.

Then the ROC test was performed. If the answer of the test is above 0.9 it means that the model is correct.

Then through using the Fuzzy Membership order the fuzzy model of Arc GIS 10.1 was performed.

Logistic model

The street under study is the dependant variable and the three identified usages that affect the street traffic are the independent variables:

Based on the calculations the introduced logistic model for the area and the effect of the independent variables on the dependent variables are as follows:

\[
\text{Street logistic model} = (\text{treatment} \times 13.610063) - (\text{residential} \times 11.529096) - (\text{Business} \times 372.711456) - 6.7
\]

Also the response to the ROC test for this model is 0.996 that indicates negligible error.

MCE model

In the MCE model of the classified layers all 6 usages are calculated based on the trip generation which is in the following map.

The answer to the ROC test is 0.675 which indicate a high rate of error and is not acceptable.
The weight of each usage is as follow:
Also each usage factor are classifies into 5 classes based on the trip generation and each class is weighted.
The CR of this model is 0.03 which is acceptable.
The Idrisi software does not represent a map for AHP.

**Membership Fuzzy map**
The blue points have the least and the purple points have the highest trip generation.

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Business</th>
<th>Treatment</th>
<th>Administrative</th>
<th>Religious-cultural</th>
<th>Educational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.4779</td>
<td>0.2365</td>
<td>0.1375</td>
<td>0.0593</td>
<td>0.0593</td>
<td>0.0295</td>
</tr>
</tbody>
</table>

**CONCLUSION**
System of Traffic Planning and Urban Design in order to select urban land, their densities, locating them in different areas of development or particular users, needs to be aware of trip generation characteristics of each user is the traffic impact assessment, so that the usage replacement or any other measure would be based on the impacts imposed on the networks that lead to the structure. Therefore setting the land uses without paying attention to the network facilities and access and adjustment and stabilization systems and networks without sufficient attention to the pattern of population distribution and land, is wrong and wrong and the desired result will not achieved. So, the transport and traffic planning should be accompanied by scheduled traffic impact assessment of land use and urban sprawl and this leads to reduced commuting, increased traffic safety, increased service levels, increased capacity, and reduction of air pollution.

**References**
Pan, g., qi, g., wu, z., zhang, d. & li, s. 2013. Land-use classification using taxi gps traces. *Intelligent transportation systems, ieee transactions on*, 14, 113-123.
Shahi, j. 1988. Traffic engineering. *Center for academic publication, tehran*

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Map 5Membership-Fuzzy Model