Influence of Residential Spatial Position to Trip Generation in Surabaya

Wahju Herijanto.1, Indrasurya B. Mochtar2, Achmad Wicaksono3
Civil Engineering, Institut Teknologi Sepuluh Nopember (ITS)1
Civil Engineering, Institut Teknologi Sepuluh Nopember (ITS)2
Civil Engineering, Brawijaya University3

Abstract—Zonal trip generation is usually assumed to be influenced only by demographic and economic variables. It is seldom to consider spatial position of the zones as an influence variables to its trip generation. In actual condition, people will consider strategic position of residential area when they choose to buy or rent of their home, in accordance with their place of activities such as working, studying for their children and shopping. This research aim is to calculate the influence of spatial position of residential zones from the activities centers to zonal trip generation in Surabaya, Indonesia. Surabaya has several activities centers that can be classified as urban centers and suburban centers. In order to define position of residential zones in relation with activities centers, travel time is defined as a spatial measure which can be measured using Google Maps. Trip generation data is compiled from origin-destination matrix from household interview survey. Regression analysis is used for calculation of the influence of spatial position of residential zones in relation to the activities centres to zonal trip generation. The result shows that travel time to urban center influences reduction of the residential trip generation more than travel time to suburban centers does. However, still many trips were not influenced by travel time from residential to city center since housing ownership in Surabaya is fixed system more than flexible one, and housing at periphery area much cheaper than at city center.

Keywords—trip generation, geographical and spatial position, urban centre, suburban centre

I. INTRODUCTION

The development of big city that can be concentrated at a traditional city center or spread at multiple suburban centers will generate trip generation from residential areas. It is common to assume that trip generated from origin zones is influenced by zone population. This research diggig other possibilities of variables that can influence trip generation. Travel time to city center or suburban centers can be analysed as potensial variables as suggested by Dickey (1974) in several cases in US [1]. For this purpose, this research compiles origin destination data that is derived from a household interview survey hold by Transportation Office of Surabaya in 2011.

II. METHOD

Household interview survey is held in 2011 with respondent 7000 household, that means level accuracy more than 95% in accordance of subdivision to 31 subdistrict zoning system. Several origin-destination matrix is compiled from this data, including matrix of trip by modes, trip by purpose, home based and non home based, peak hours, and daily.

Data of population [2] and daily zonal trip production is shown in Table 1, while position of each zone is shown in Picture 1.

Regression analysis is used in analysis the influence of independent variables to the trip production, in this research are population and travel time to city center. Travel time to city center is measured using google maps, which presents three option. The fastest path is used in this research.

III. ANALYSIS

Regression analysis using population as independent variables and daily trip as dependent variables resulting regression model $Y = 0.5333 X + 42419$ and $R^2 0.3552$, as shown in Figure 2. On the other side, travel time to city center as independent variable resulting regression model: $Y = -209.2 X + 146073$ and $R^2 0.1841$ as shown in Figure 3.

Because the result is unsatisfied, a partition of data using geographical position was tried. Zones close city center consist of subdistrict Gubeng, Tegalsari, Genteng, Simokerto, Pabean Cantikan, Bubutan and Krembangan is tested and resulting regression model $Y = 1.0188 X + 7025.3$ with $R^2 0.8079$ as shown in Figure 4. Using the same zones and travel time to city center as independent variable resultung model $Y = -2164.2 X - 160884$ with $R^2 0.1524$ as shown in Figure 5.

On the other hand a distant zones with rather high proportion of wealthy housing is chosen which includes subdistricts Gayungan, Tenggilis Mejoyo, Gunungananyar, Rungkut, Sukolilo, Mulyorejo, Dukuhpakis, Wiyung, Lakarsantri, Sambikerep and Sukomanunggal is tested using population as independent variable and also travel time to city center as well.
Table 1. Data consist of Population, travel time to city center and number of trip

<table>
<thead>
<tr>
<th>No</th>
<th>Sub district</th>
<th>Population</th>
<th>Travel time to center (minutes)</th>
<th>Total trip (trip/day)</th>
<th>Trip by car (Trip/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Karangpilang</td>
<td>73100</td>
<td>40</td>
<td>80581</td>
<td>939</td>
</tr>
<tr>
<td>2</td>
<td>Jambangan</td>
<td>46200</td>
<td>23</td>
<td>55064</td>
<td>611</td>
</tr>
<tr>
<td>3</td>
<td>Gayungan</td>
<td>46900</td>
<td>18</td>
<td>113105</td>
<td>3296</td>
</tr>
<tr>
<td>4</td>
<td>Wonocolo</td>
<td>81800</td>
<td>21</td>
<td>109049</td>
<td>310</td>
</tr>
<tr>
<td>5</td>
<td>Tenggis Mejoyo</td>
<td>56800</td>
<td>29</td>
<td>51338</td>
<td>254</td>
</tr>
<tr>
<td>6</td>
<td>Gunung Anyar</td>
<td>50300</td>
<td>36</td>
<td>64188</td>
<td>976</td>
</tr>
<tr>
<td>7</td>
<td>Ringkut</td>
<td>99900</td>
<td>30</td>
<td>80458</td>
<td>337</td>
</tr>
<tr>
<td>8</td>
<td>Sukoldo</td>
<td>104500</td>
<td>19</td>
<td>119734</td>
<td>1323</td>
</tr>
<tr>
<td>9</td>
<td>Mulyorejo</td>
<td>82700</td>
<td>27</td>
<td>103772</td>
<td>5056</td>
</tr>
<tr>
<td>10</td>
<td>Gubeng</td>
<td>154400</td>
<td>9</td>
<td>132050</td>
<td>1147</td>
</tr>
<tr>
<td>11</td>
<td>Wonokromo</td>
<td>184300</td>
<td>13</td>
<td>45838</td>
<td>1782</td>
</tr>
<tr>
<td>12</td>
<td>Dukuh Pakis</td>
<td>61100</td>
<td>22</td>
<td>18378</td>
<td>501</td>
</tr>
<tr>
<td>13</td>
<td>Wiyung</td>
<td>65000</td>
<td>23</td>
<td>42250</td>
<td>922</td>
</tr>
<tr>
<td>14</td>
<td>Lakar Santri</td>
<td>51600</td>
<td>40</td>
<td>43312</td>
<td>325</td>
</tr>
<tr>
<td>15</td>
<td>Sambi Kerep</td>
<td>55700</td>
<td>41</td>
<td>15525</td>
<td>91</td>
</tr>
<tr>
<td>16</td>
<td>Tandes</td>
<td>95200</td>
<td>31</td>
<td>152842</td>
<td>2248</td>
</tr>
<tr>
<td>17</td>
<td>Sukomanunggal</td>
<td>98700</td>
<td>25</td>
<td>102503</td>
<td>1359</td>
</tr>
<tr>
<td>18</td>
<td>Sawahan</td>
<td>221400</td>
<td>15</td>
<td>234004</td>
<td>2741</td>
</tr>
<tr>
<td>19</td>
<td>Tegal Sari</td>
<td>112200</td>
<td>8</td>
<td>159903</td>
<td>6910</td>
</tr>
<tr>
<td>20</td>
<td>Genteng</td>
<td>67900</td>
<td>9</td>
<td>78667</td>
<td>5525</td>
</tr>
<tr>
<td>21</td>
<td>Tambak Sari</td>
<td>229800</td>
<td>16</td>
<td>143076</td>
<td>3856</td>
</tr>
<tr>
<td>22</td>
<td>Kenjeran</td>
<td>134200</td>
<td>27</td>
<td>77173</td>
<td>1453</td>
</tr>
<tr>
<td>23</td>
<td>Bulak</td>
<td>37500</td>
<td>31</td>
<td>101409</td>
<td>807</td>
</tr>
<tr>
<td>24</td>
<td>Simokerto</td>
<td>102700</td>
<td>21</td>
<td>164850</td>
<td>5123</td>
</tr>
<tr>
<td>25</td>
<td>Semampir</td>
<td>196600</td>
<td>25</td>
<td>153909</td>
<td>11406</td>
</tr>
<tr>
<td>26</td>
<td>Pabean Cantian</td>
<td>91500</td>
<td>24</td>
<td>52268</td>
<td>758</td>
</tr>
<tr>
<td>27</td>
<td>Bubutan</td>
<td>114900</td>
<td>21</td>
<td>96284</td>
<td>6470</td>
</tr>
<tr>
<td>28</td>
<td>Krebangan</td>
<td>123700</td>
<td>19</td>
<td>89510</td>
<td>5641</td>
</tr>
<tr>
<td>29</td>
<td>Asemrowo</td>
<td>38800</td>
<td>28</td>
<td>83010</td>
<td>3148</td>
</tr>
<tr>
<td>30</td>
<td>Benowo</td>
<td>48700</td>
<td>40</td>
<td>101021</td>
<td>3174</td>
</tr>
<tr>
<td>31</td>
<td>Pakal</td>
<td>42900</td>
<td>45</td>
<td>44723</td>
<td>1627</td>
</tr>
</tbody>
</table>

Figure 1. Position of zones based on subdistrict in Surabaya
Figure 2. Influence of population to trip production of all zones

Figure 3. Influence of travel time to trip production of all zones
Figure 4. Influence of population to trip production of inner zones

Figure 5. Influence of travel time to trip production of inner zones
Figure 6. Influence of population to trip production of distant zones

Figure 7. Influence of travel time to trip production of distant zones
With population as independent variable a formula \( Y = 0.9619X + 985.2 \) and \( R^2 = 0.3154 \) as shown in Figure 6, While travel time to city center as independent variable give formula \( Y = -2574.5X - 141152 \) and \( R^2 = 0.2976 \).

IV. RESULTS AND DISCUSSION

For the whole city, regression model \( R^2 = 0.3552 \) and 0.1841 for population and travel time to central respectively. Both are unsatisfied.

For inner city trip, the population and travel time to central give \( R^2 = 0.8079 \) and 0.1524. It is shown that population significantly influencing trip generation.

For trip generation of distant zones, \( R^2 \) for population variable is 0.3154, while travel time to central give \( R^2 = 0.2976 \). Therefore influence of travel time to central to trip generation is slightly increase, but it is not significant.

IV. REFERENCES
