Potential of On-demand Mobility and Real-time Trip Planning in Yokohama City

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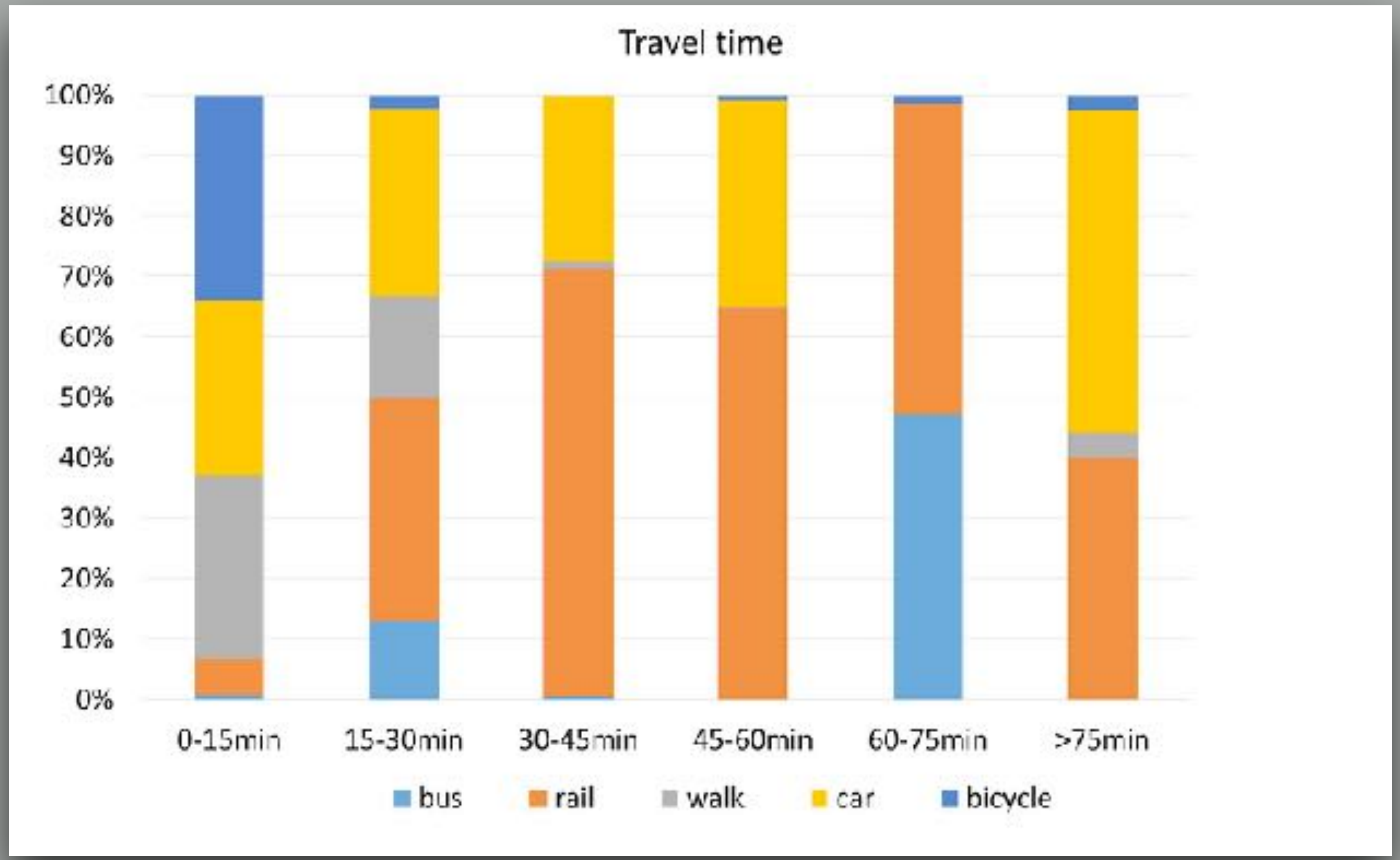
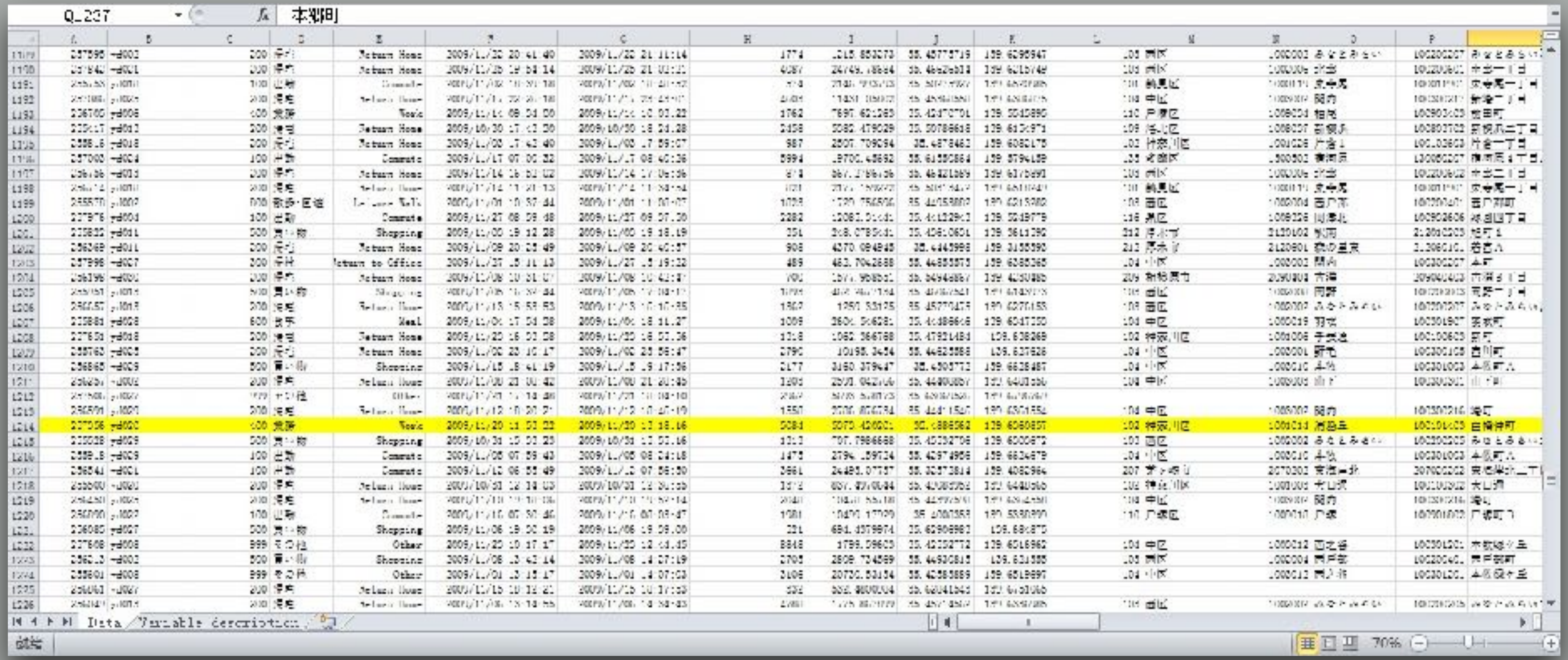
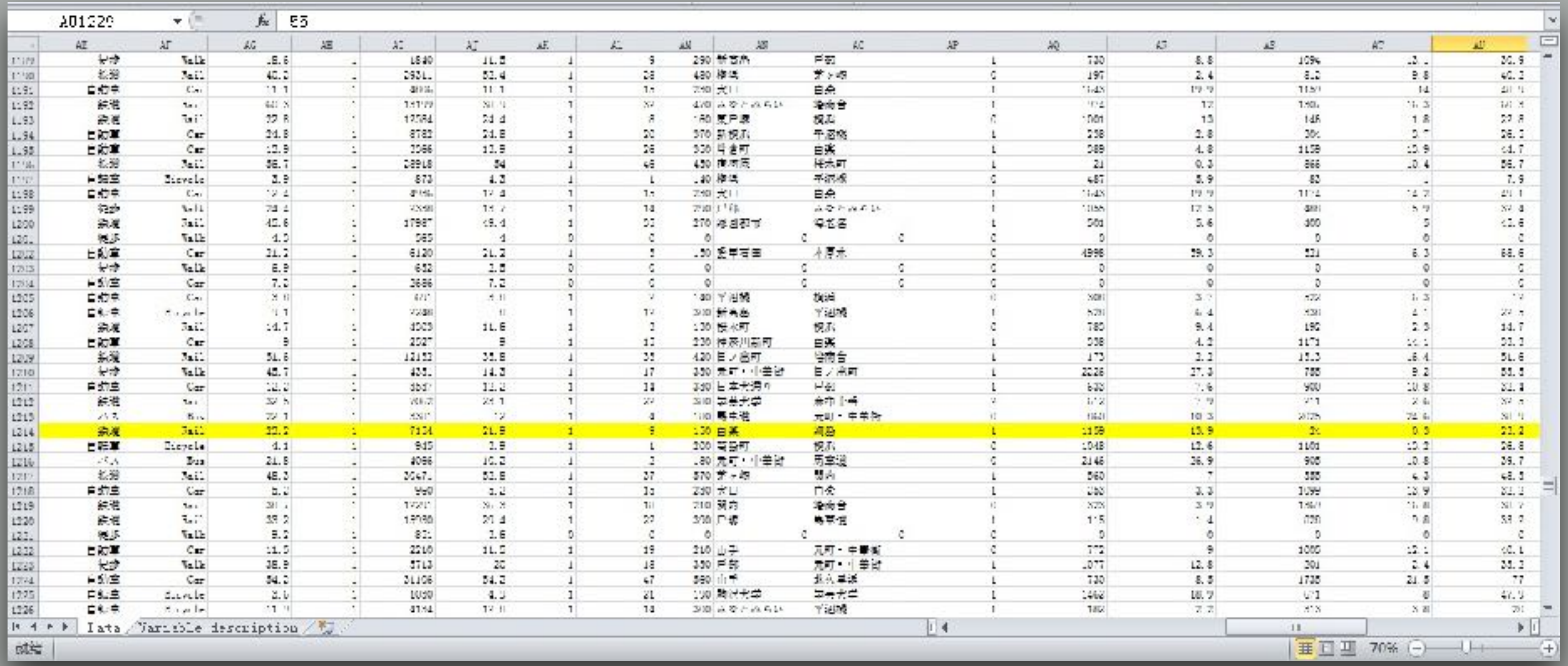
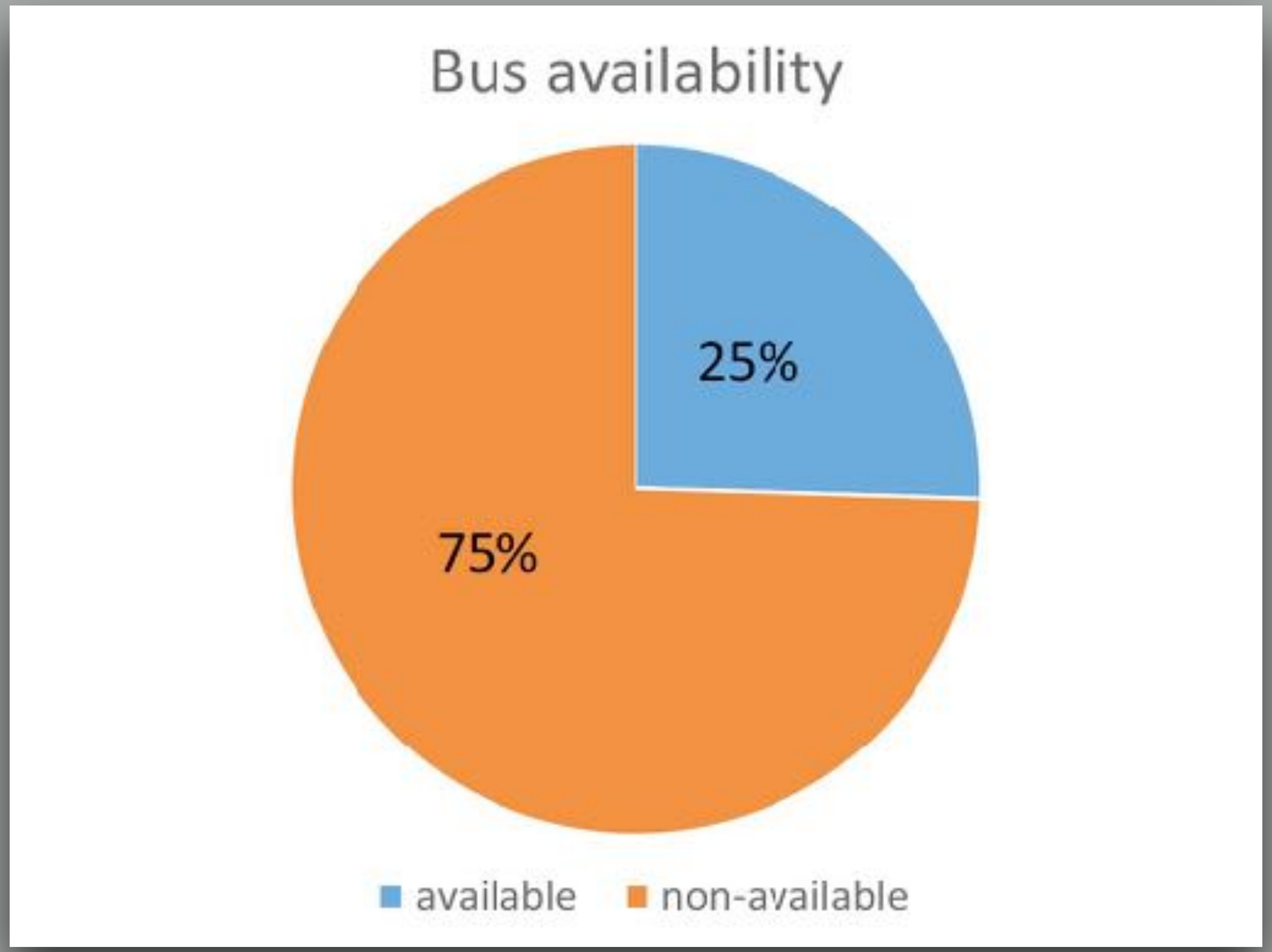
Basic Analysis on PP Data

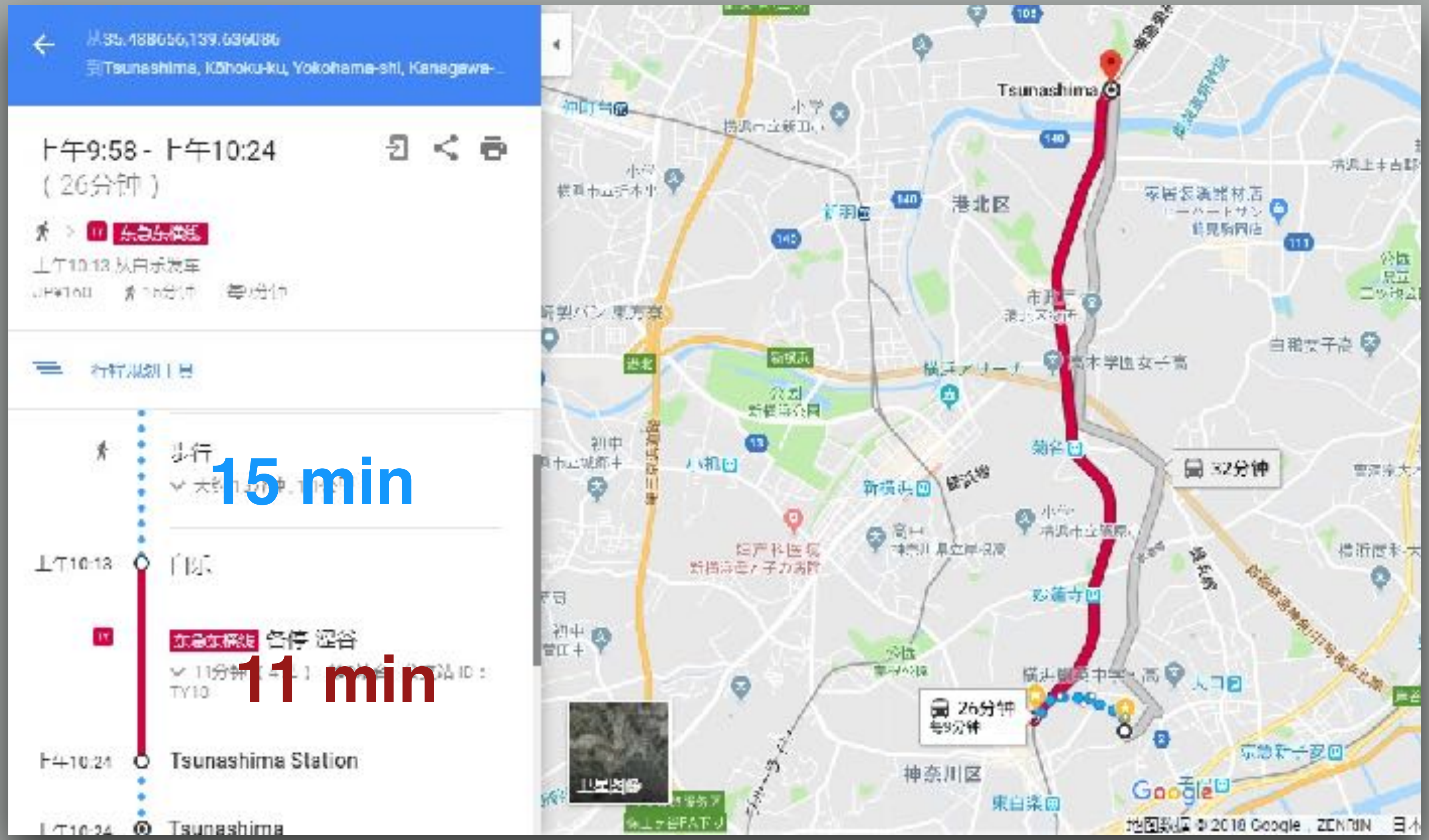








If there is a problem, there is demand.



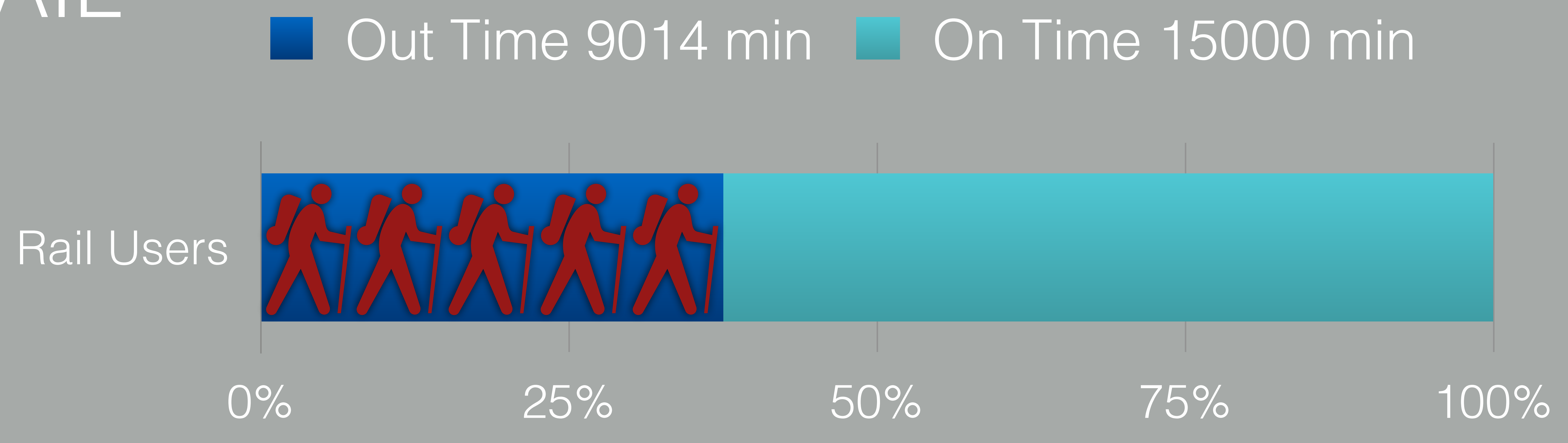
We can't force people to choose public transit, but situation like this only stop them from doing so.

Further analysis shows a serious problem.

Arduous effort is needed just to get to the rail station.

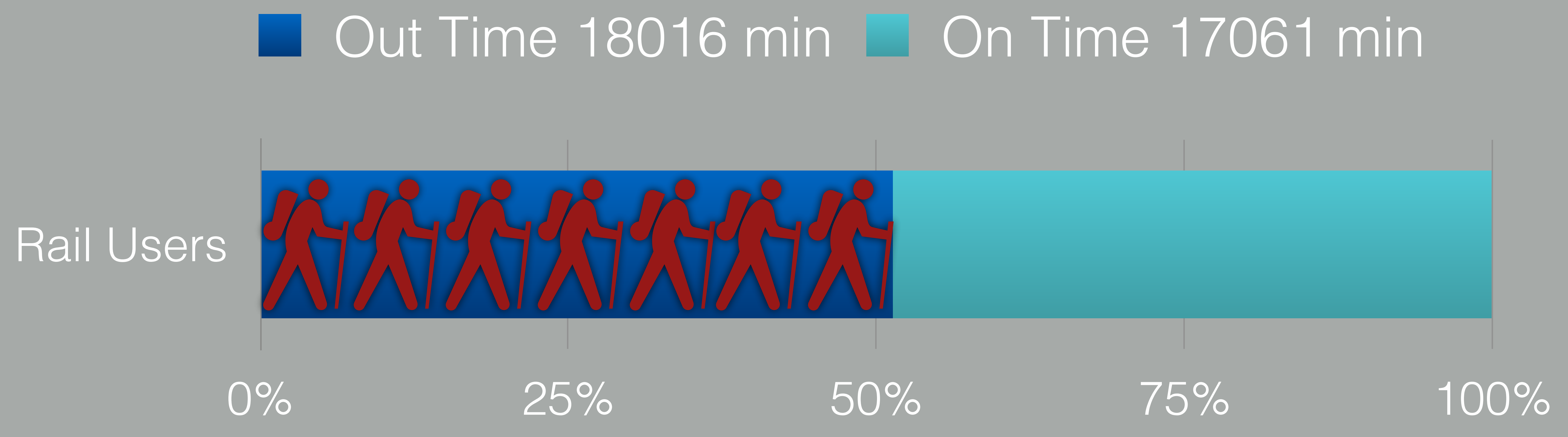
People who choose RAIL

AccessTime+EgressTime: 9014 min
Time on the train: 15000 min
Total Time: 24014 min
Percentage of trip time: 38%



People who choose CAR, but if they choose RAIL

AccessTime+EgressTime: 18016 min
Time on the train: 17061 min
Total Time: 35077 min
Percentage of trip time: 51%



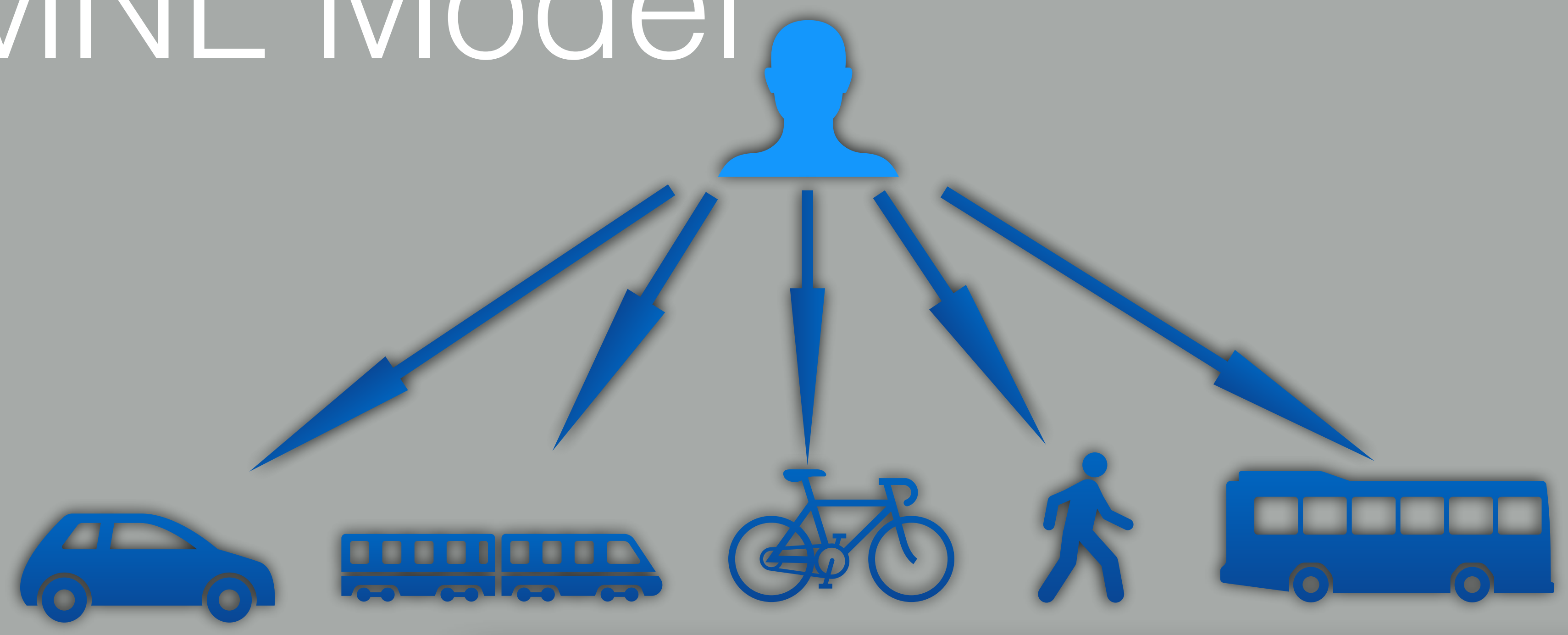
Do these people choose CAR instead of RAIL because of this reason?

Our assumption:

Is Out-of-Rail time truly a factor that hinders people choosing subway ?

needs to be justified by Behavior Choice Model.

MNL Model



MNL model:

$V_{car} = \beta_1 t_{car} + \beta_2 c_{car}$

$V_{rail} = \beta_{10} tt + \beta_2 c_{rail} + \beta_3 g + \beta_4 p + \beta_5 ot_{rail} + \beta_6$

$V_{bike} = \beta_1 t_{bike} + \beta_7$

$V_{walk} = \beta_1 t_{walk} + \beta_8$

$V_{bus} = \beta_{10} tb + \beta_2 c_{bus} + \beta_5 ot_{bus} + \beta_9$

t: total travel time

c: travel cost

g: gender

p: purpose

ot: out of vehicle time

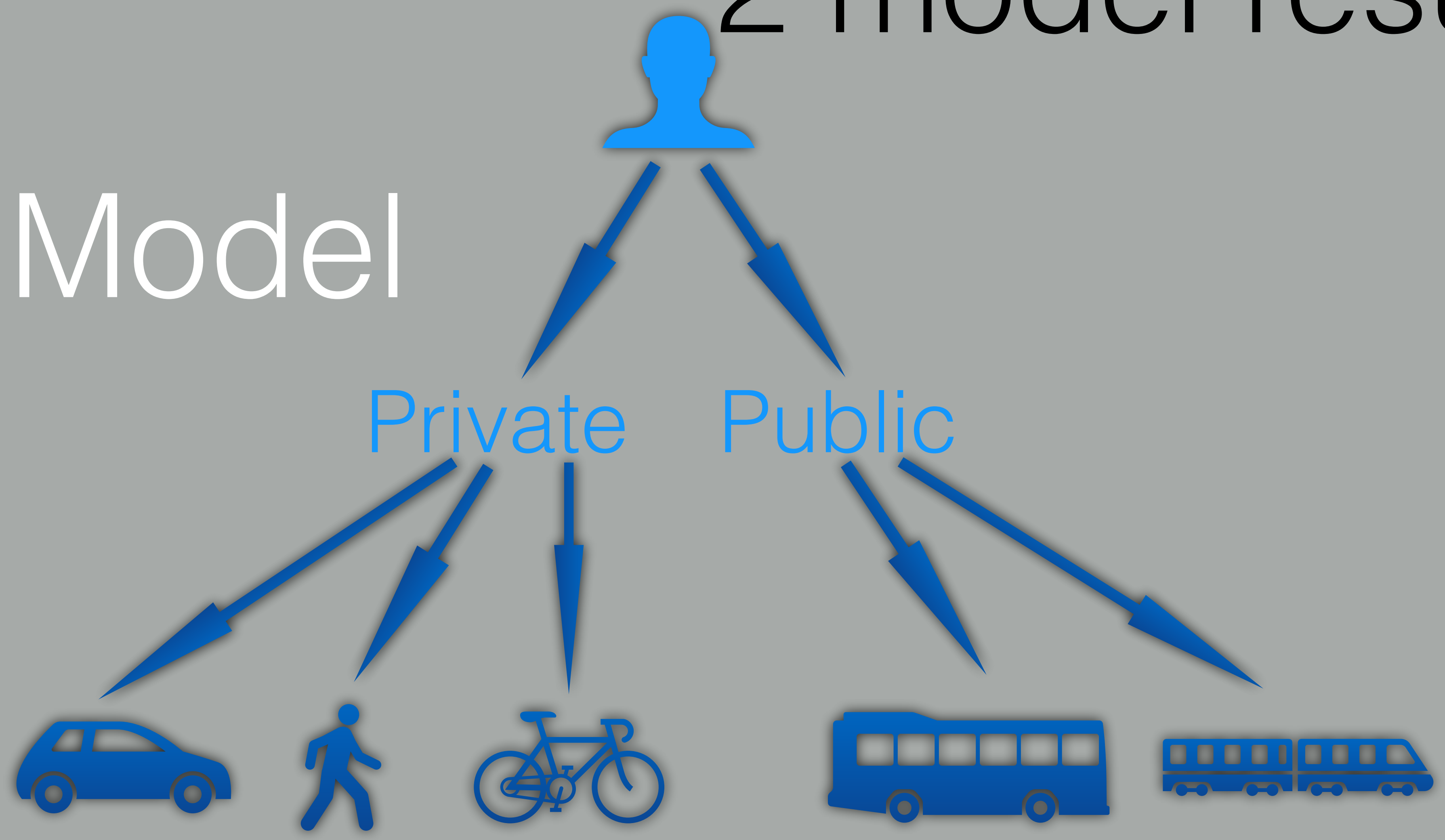
tt: time on train

tb: time on bus

```
$message
NULL

$hessian
            [,1]          [,2]          [,3]         [,4]         [,5]          [,6]        [,7]        [,8]         [,9]        [,10]
 [1,]  -3170.40057    125172.965    470.042408   199.305959   1571.51271    561.105364  -22.968689 -128.484638    34.985669   2378.91047
 [2,] 125172.96541 -12810325.721 -23276.373332 -8983.089466 -68747.94818 -30388.884915 9348.878534 6476.105057 -5491.031499 -101647.53970
 [3,]    470.04241    -23276.373   -124.651602   -37.338029   -280.23441   -124.651602   12.305465    8.266092     5.431568    -380.99625
 [4,]    199.30596     -8983.089    -37.338029   -49.514259   -132.64253    -49.514259    4.643494    3.340156     3.315351    -164.78792
 [5,]   1571.51271    -68747.948   -280.234411  -132.642528  -1036.83544   -355.330272   40.231818   29.096657   -18.966712   -1247.97788
 [6,]    561.10536    -30388.885   -124.651602   -49.514259   -355.33027   -167.948888   20.846440   14.929931     7.446854    -445.39959
 [7,]    -22.96869      9348.879     12.305465     4.643494     40.23182     20.846440 -136.291861   42.890871     7.870258      27.21688
 [8,]   -128.48464      6476.105      8.266092     3.340156     29.09666     14.929931   42.890871 -124.213395     9.756270      14.70525
 [9,]     34.98567     -5491.031      5.431568     3.315351    -18.96671      7.446854    7.870258    9.756270   -39.149165     -15.45108
[10,]   2378.91047   -101647.540   -380.996253  -164.787920  -1247.97788   -445.399587   27.216881   14.705248   -15.451075   -2018.44573

> ## L(0)
> print(L0)
[1] -2135.675
> ## LL
> print(LL)
[1] -1290.569
> ##rho-square
> print((L0-LL)/L0)
[1] 0.395709
> ## adjusted rho-square
> print((L0-(LL-length(b)))/L0)
[1] 0.3910267
> ##estimated parameter values
> print(b)
 [1] -0.9699224705 -0.0008018488  0.2884625992  1.2186737348 -1.2873174061  1.5177370088 -0.4130283893  0.7339555264 -0.1344197676 -0.8018088323
> ## t-statistic
> print(tval)
 [1] -14.8292778  -1.8184262   1.5502268   6.8237358 -15.0984926   7.2628327  -4.1789467   6.2117776  -0.7015089  -9.7472358
```

Another NL model is conducted.
2 model results are compared.

NL Model



NL model:

$$U_{car} = V_{car} + V_{pr} + \varepsilon_{car} + \varepsilon_{pr}$$

$$U_{walk} = V_{walk} + V_{pr} + \varepsilon_{walk} + \varepsilon_{pr}$$

$$U_{bike} = V_{bike} + V_{pr} + \varepsilon_{bike} + \varepsilon_{pr}$$

$$U_{bus} = V_{bus} + V_{pt} + \varepsilon_{bus} + \varepsilon_{pt}$$

$$U_{rail} = V_{rail} + V_{pt} + \varepsilon_{rail} + \varepsilon_{pt}$$

t: total travel time

c: travel cost

g: gender

p: purpose

ot: out of vehicle time

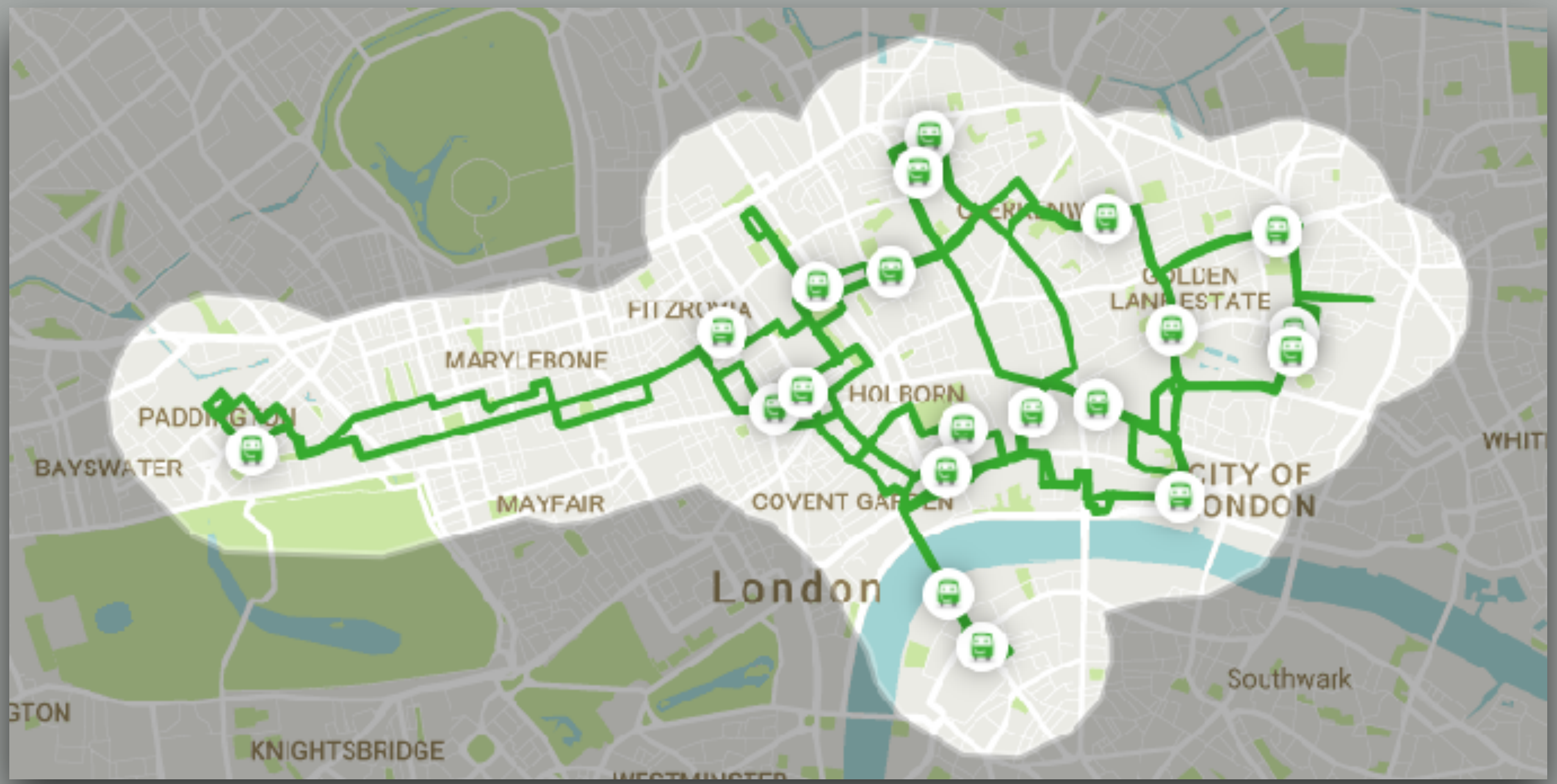
tt: time on train

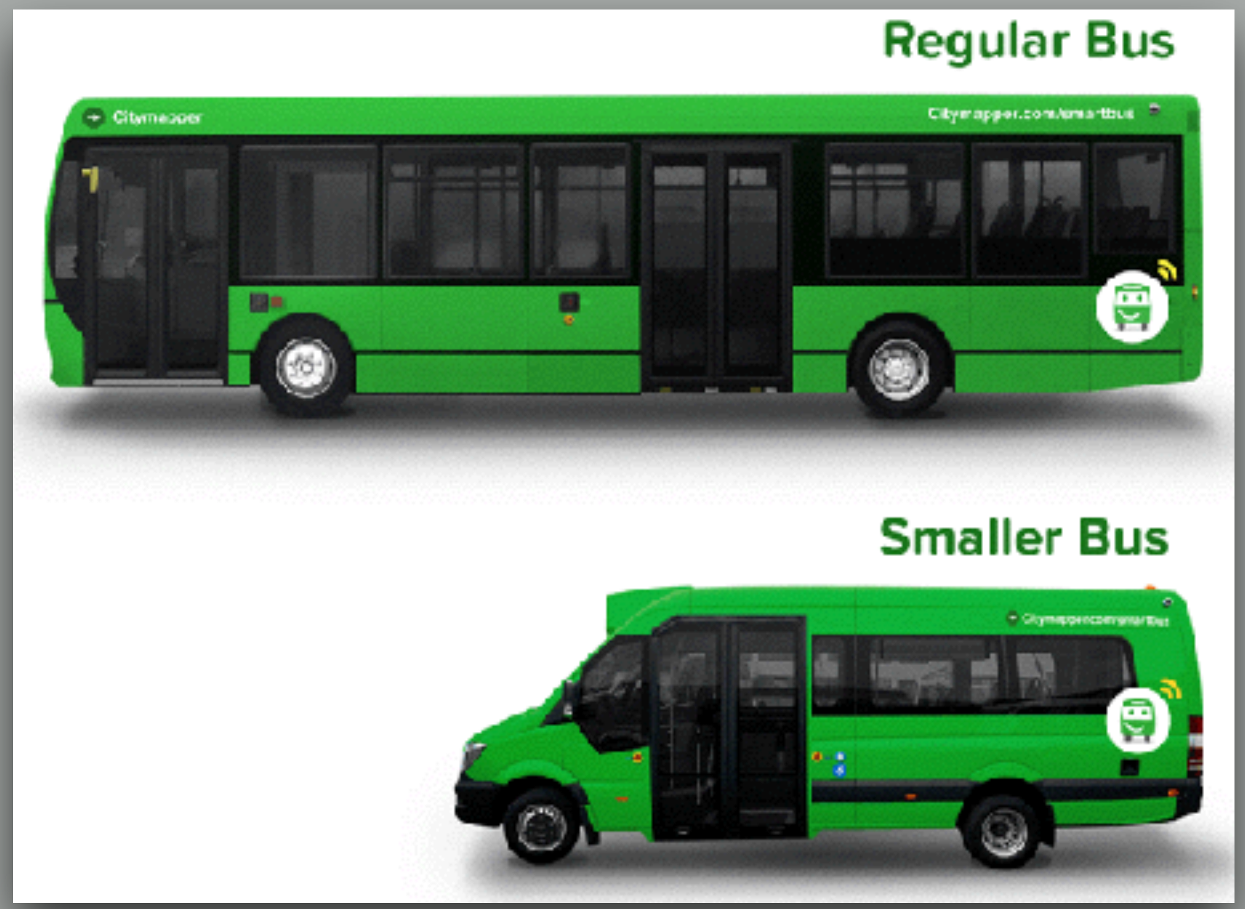
tb: time on bus

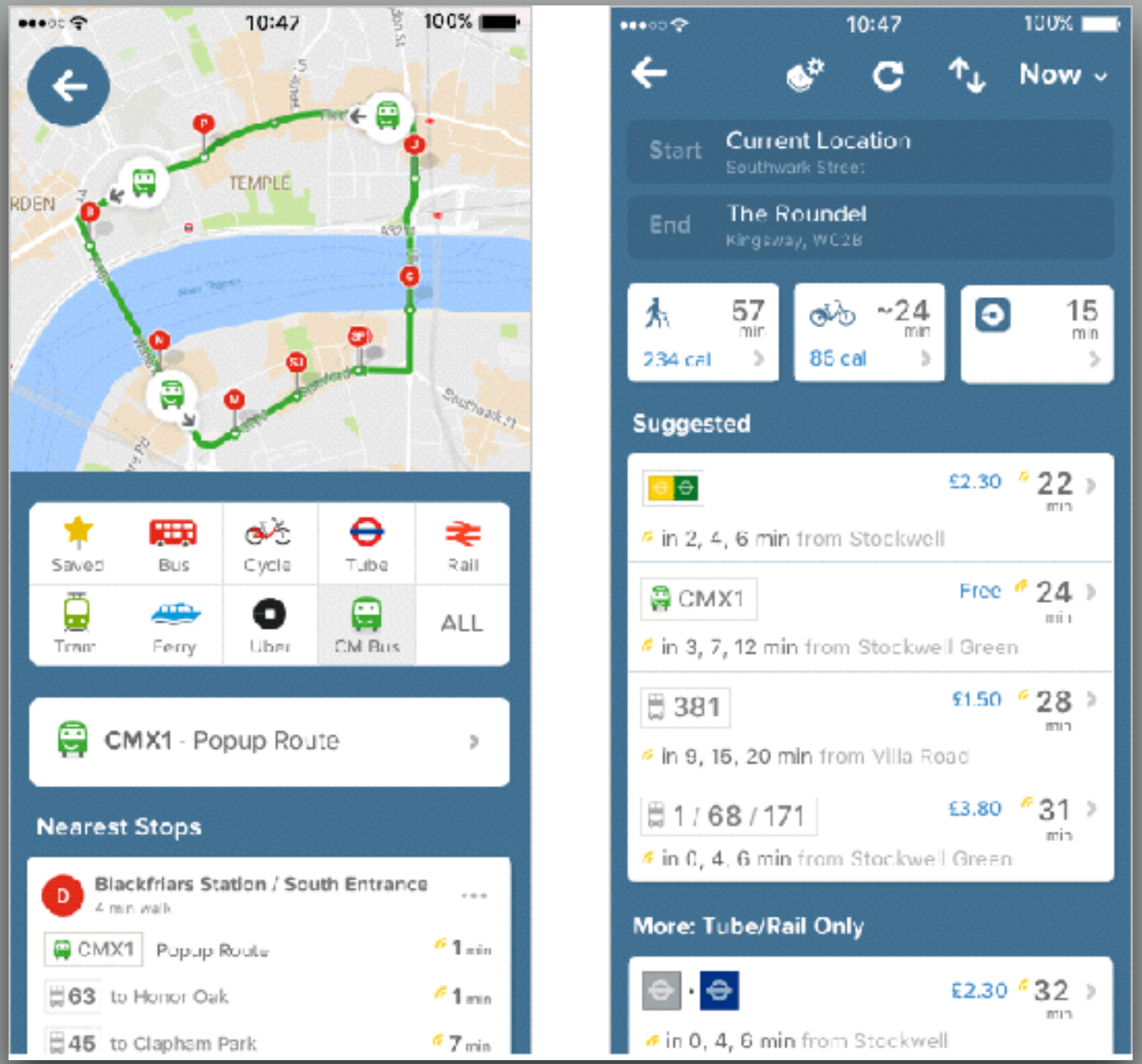
```
$message
NULL

$hessian
             [,1]         [,2]         [,3]         [,4]         [,5]         [,6]        [,7]        [,8]        [,9]         [,10]       [,11]
 [1,] -2700.824887    92584.676   406.715198   178.249971  1355.286275   478.226479   -3.936069 -132.796047   24.257037   2014.339164  -43.750082
 [2,] 92584.676081 -7314886.662 -18421.627609 -7560.094025 -56353.653462 -23710.944140 7950.766121 5240.697714 -3566.707209 -76453.244640 16469.788809
 [3,]   406.715198   -18421.628  -107.510433   -33.877677  -247.965904  -107.510433   11.228104    7.267826    5.241042   -328.399893   28.760531
 [4,]   178.249971    -7560.094   -33.877677   -44.707966  -124.459590   -44.707966    4.438584    3.094052    3.316458   -145.453933  -17.924634
 [5,]  1355.286275   -56353.653  -247.965904  -124.459590  -974.491928  -310.084466   37.350114   24.229430   -8.800355  -1062.233294  261.077212
 [6,]   478.226479   -23710.944  -107.510433   -44.707966  -310.084466  -141.298949   18.332619   12.166687    8.116223   -376.917615   74.895249
 [7,]    -3.936069     7950.766    11.228104     4.438584    37.350114    18.332619 -140.662654   55.419522    6.133162     21.523648  -17.180576
 [8,]  -132.796047     5240.698     7.267826     3.094052    24.229430    12.166687   55.419522 -127.025311    8.125244     11.461167   -7.394286
 [9,]    24.257037    -3566.707     5.241042     3.316458    -8.800355     8.116223    6.133162    8.125244  -29.431119     -8.134845   39.833690
[10,]  2014.339164   -76453.245  -328.399893  -145.453933 -1062.233294  -376.917615   21.523648   11.461167   -8.134845  -1704.676743  101.988992
[11,]   -43.750082    16469.789    28.760531   -17.924634   261.077212    74.895249  -17.180576   -7.394286   39.833690    101.988992 -502.398273

> ## L(0)
> print(L0)
[1] -2175.421
> ## LL
> print(LL)
[1] -1409.738
> ##rho-square
> print((L0-LL)/L0)
[1] 0.3519699
> ## adjusted rho-square
> print((L0-(LL-length(b)))/L0)
[1] 0.3469134
> ##estimated parameter values
> print(b)
 [1] -1.306337015  0.003179789  0.562993164  1.463465591 -1.019869099  0.227758436  0.267544050  1.785151617 -1.050930137 -1.338185311  0.867502482
> ## t-statistic
> print(tval)
 [1]  -9.6735084   3.9280577   2.3560146   5.2467972  -8.4935720   0.7008534   2.4886310  10.8205765  -3.2812674 -10.4133017   7.5460593
```

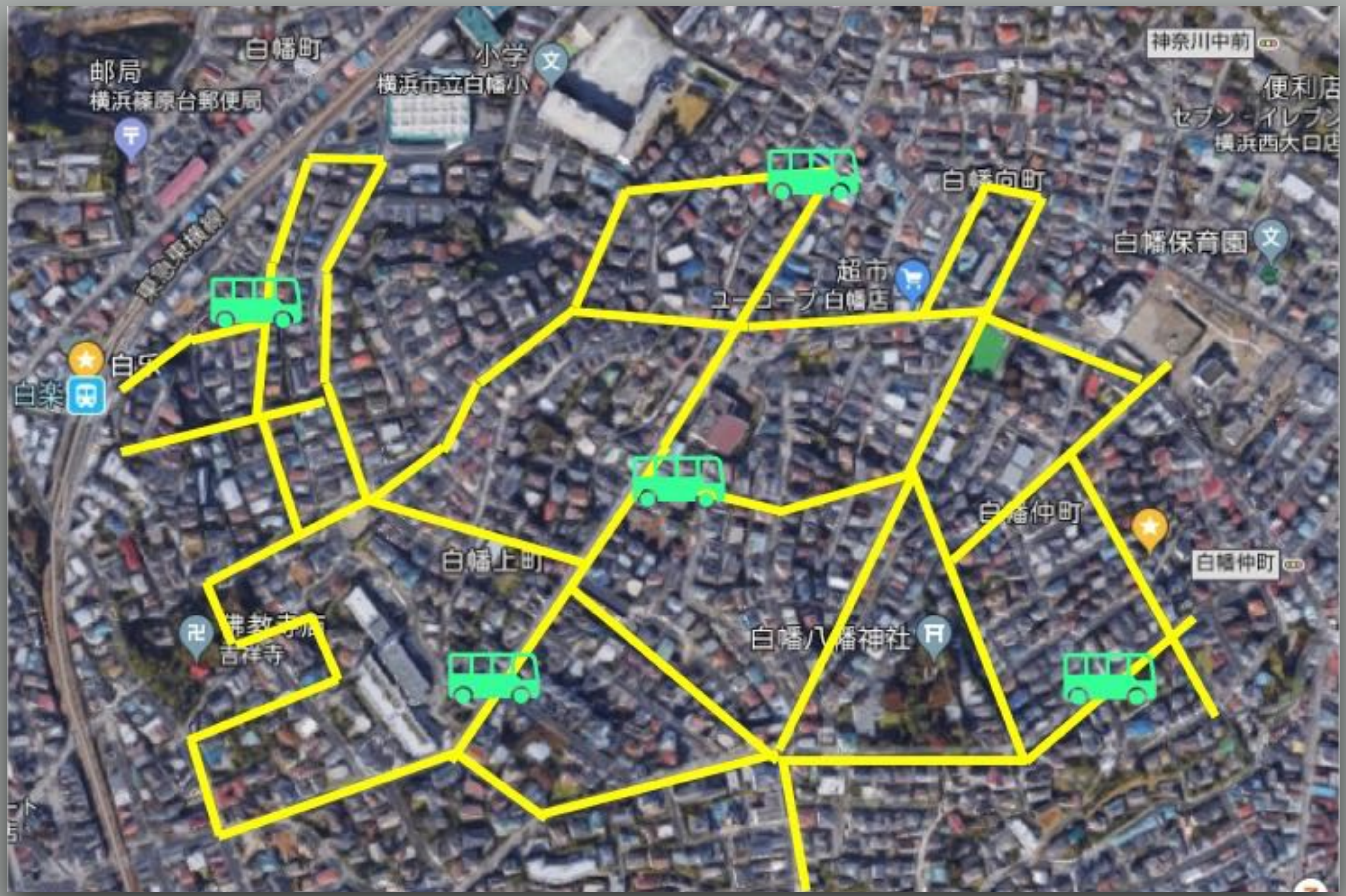
	MNL model	NL model
L0	-2135.6	-2175.4
LL	-1290.5	-1409.7
Adjusted rho square	0.391	0.347
Scale parameter	1	0.868

A Case Study-Policy Proposal.









Suitable size.

Frequent and punctual service.

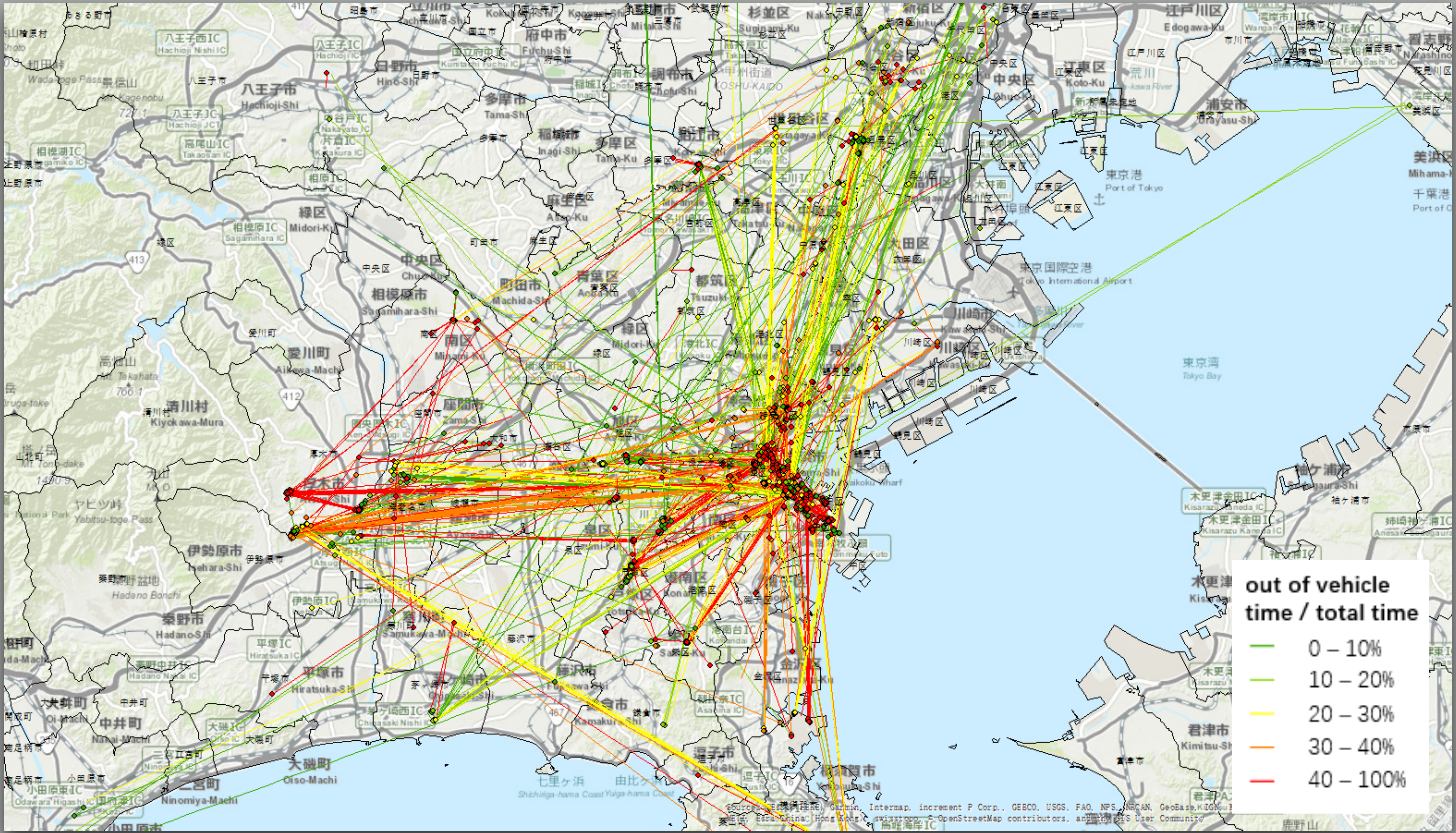
Trackable bus.

Smart route based on real time demand.

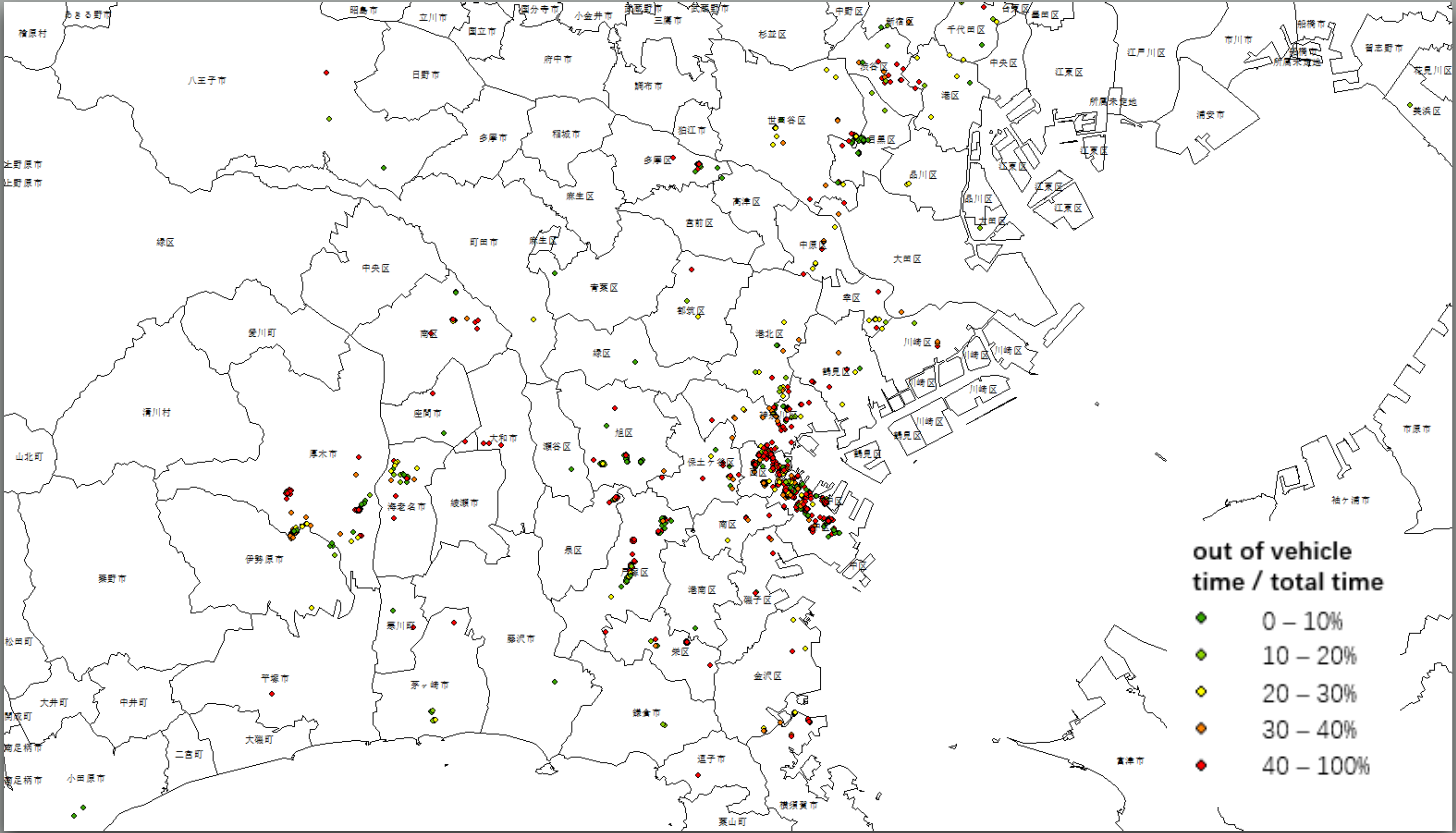
Shared vehicle, thus environment friendly.

Pay-as-you-go based.

A Case Study-Implement Locations.

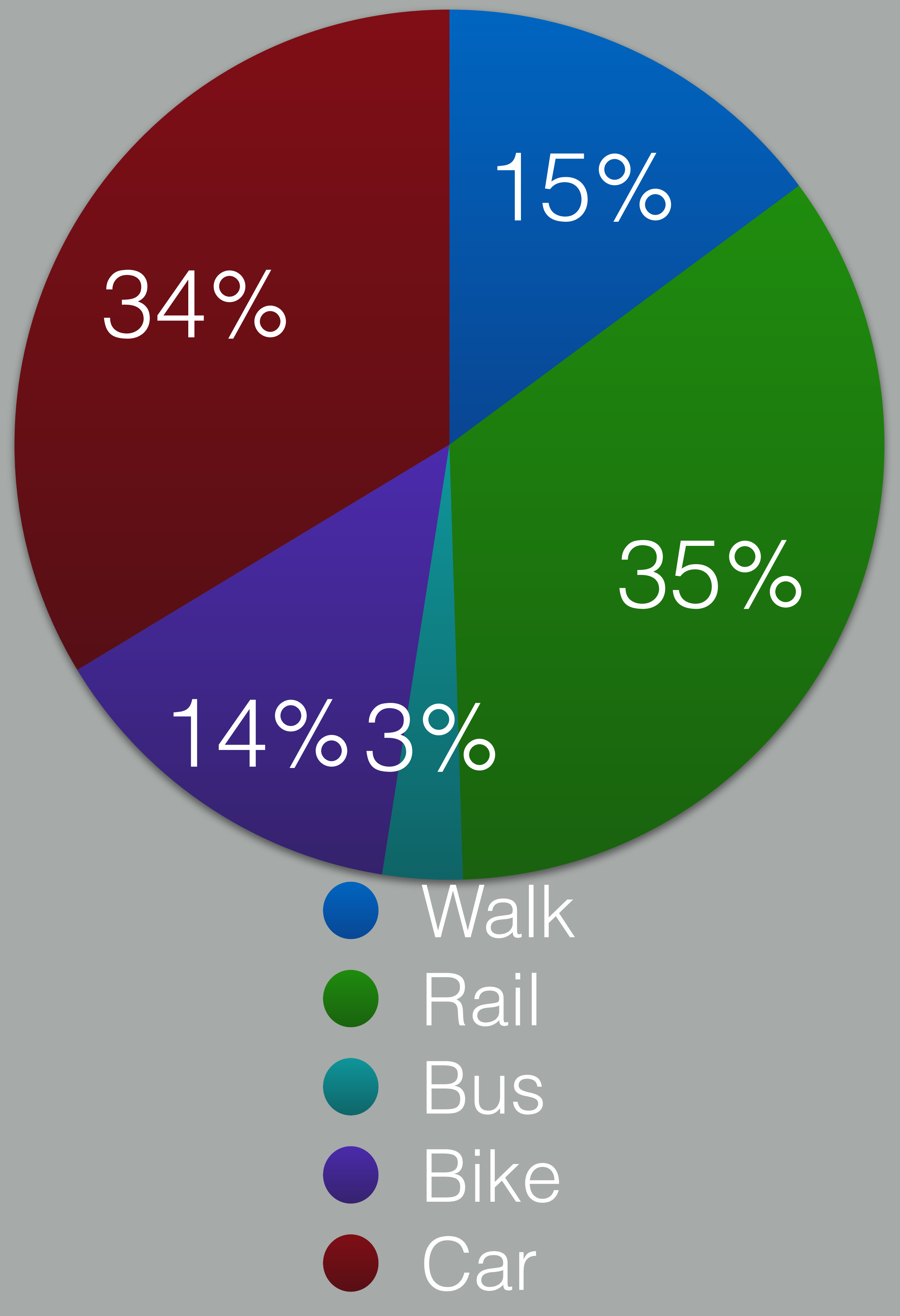


A Case Study-Implement Locations.



A Case Study-Simulation of Mode Share.

Before



After