Providing Real-time Information for Transit Riders: In Search of an Equitable Technology

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UTC | March 24, 2014
Outline

- Introduction / Background
- National and American Transit Agency Trend
- St. Louis Metro Rider’s Mobile and Technology Utilization
- Trend Analysis & Alternative Technology Access
- Summary/Suggestions
Background

- Increase in Transit Real-Time Information
  - The availability of the technologies providing this information is unknown
  - Communication Preferences & Technology Utilization

- Agencies need to utilize the positive effects of real-time information
  - Customers will ride the system more
  - Lower perceived wait time
  - Overall higher satisfaction with service
Real-Time Information Technologies

- Smartphone Application
- Interactive Voice Response (IVR)
- Text Messaging (SMS)
- Mobile-Based Website
- Computer-Based Website
- Signage

Next Train Arrival Time at Station | Washington, DC
National and American Transit Agency Trends
• In 2013, 91% of Americans own a Cell Phone
• Steady increase since 2004

Source: Pew Internet
Smartphone Ownership

• 2013 - the majority of Americans own a smartphone
• Smartphone ownership is higher among Transit Riders

Source: Pew Internet
Alternative Real-Time Information Technologies Availability among Americans

- Internet Access on Mobile Device: 56% Yes, 44% No
- Text Messaging on Mobile Device: 80% Yes, 20% No
- Internet Access in General: 77% Yes, 23% No
St. Louis Metro Rider’s Mobile and Technology Utilization
St. Louis Methodology

- Saint Louis Metro Transit
  - On-Board Survey | Summer 2012 + 2013
  - Statistical Analysis:
    - Overall Availability
    - Cross Tabulations
    - Chi-Square Test
    - Binomial Logistic Regression
4) What type of cell phone do you mainly use?
   1) iPhone    2) Blackberry    3) Android-based    4) Windows 7-based    5) Non-Smartphone    6) Don’t use a cell phone
   → If you use a cell phone, does it have internet access \textit{that you use}?    Yes    No
   → If you use a cell phone, does it have a text messaging ability \textit{that you use}?    Yes    No

5) Do you have internet access from a computer at home, work, school, or other place?    Yes    No

12) I am:    Male    Female

13) I am:    1) Black/African American    2) White/Caucasian    3) Latino/Hispanic American    4) Asian/Asian American    5) Other

14) My age is:    1) 18 or under    2) 19 – 24    3) 25 – 30    4) 31 – 35    5) 36 – 40    6) 41 – 45    7) 46 – 50    8) 51 - 64    9) 65 – 74    10) 75+

15) I am \textit{(circle all that apply)}:    1) Employed Full-Time    2) Employed Part-Time    3) Unemployed    4) Student    5) Homemaker    6) Retired

17) What was your \textit{combined household} income before taxes in 2011?
   1) Under $20,000    2) $20,000 - $39,999    3) $40,000 - $59,999    4) $60,000 - $79,999    5) $80,000 - $99,999    6) $100,000 or more
Mobile Technology Trend

Cell Phone Ownership

- 2007: 68%
- 2008: 70%
- 2012: 92%
- 2013: 91%

Smartphone Ownership

- 2012: 70%
- 2013: 73%
Cell Phone Ownership Based on Age

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Smartphone</th>
<th>Non-Smartphone</th>
<th>No Cell Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>65+</td>
<td>39%</td>
<td>38%</td>
<td>23%</td>
</tr>
<tr>
<td>51 to 64</td>
<td>51%</td>
<td>33%</td>
<td>17%</td>
</tr>
<tr>
<td>46 to 50</td>
<td>66%</td>
<td>23%</td>
<td>11%</td>
</tr>
<tr>
<td>41 to 45</td>
<td>70%</td>
<td>21%</td>
<td>9%</td>
</tr>
<tr>
<td>36 to 40</td>
<td>78%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>31 to 35</td>
<td>76%</td>
<td>16%</td>
<td>8%</td>
</tr>
<tr>
<td>25 to 30</td>
<td>86%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>19 to 24</td>
<td>86%</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>18 or under</td>
<td>83%</td>
<td>10%</td>
<td>7%</td>
</tr>
</tbody>
</table>

n = Number of respondents

Legend:
- Smartphone
- Non-Smartphone
- No Cell Phone
Cell Phone Ownership Based on Employment

- **Employed Full-Time**: 77% Smartphone, 17% Non-Smartphone, 6% No Cell Phone, n = 1221
- **Employed Part-Time**: 77% Smartphone, 15% Non-Smartphone, 8% No Cell Phone, n = 459
- **Student**: 80% Smartphone, 15% Non-Smartphone, 5% No Cell Phone, n = 260
- **Employed Full-Time and Student**: 89% Smartphone, 5% Non-Smartphone, n = 55
- **Employed Part-Time and Student**: 83% Smartphone, 16% Non-Smartphone, n = 98
- **Unemployed**: 57% Smartphone, 29% Non-Smartphone, 14% No Cell Phone, n = 270
- **Retired**: 48% Smartphone, 29% Non-Smartphone, 24% No Cell Phone, n = 153
- **Homemaker**: 44% Smartphone, 34% Non-Smartphone, 22% No Cell Phone, n = 41
Mobile Technology Availability

Cell Phone Ownership Based on Race

- **Black/African American**: 76% Smartphone, 16% Non-Smartphone, 8% No Cell Phone (n = 1970)
- **White/Caucasian**: 62% Smartphone, 27% Non-Smartphone, 11% No Cell Phone (n = 471)
- **Asian/Asian American**: 73% Smartphone, 27% Non-Smartphone, (n = 49)
- **Latino/Hispanic American**: 74% Smartphone, 17% Non-Smartphone, 9% No Cell Phone (n = 35)
- **Other**: 78% Smartphone, 12% Non-Smartphone, 10% No Cell Phone (n = 91)
Mobile Technology Availability

- Inverse relationship between age and smartphone ownership
- Retired, unemployed, and homemakers most likely to not have smartphones
- Slight relationship between income and smartphone ownership
- White / Caucasians have lowest percentage of smartphone ownership
- No notable difference between males and females
# Chi-Squared Test

## Technology Utilization

<table>
<thead>
<tr>
<th>Age</th>
<th>MetroBus Riders</th>
<th>2012 Survey</th>
<th>Chi square test of independence</th>
<th>MetroLink Riders</th>
<th>Chi square test of independence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Owns a Smartphone with Internet Access</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>X² = 168.212, 1 d.f.</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>40 and Under</td>
<td>62%</td>
<td>38%</td>
<td>65%</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Over 40</td>
<td>28%</td>
<td>72%</td>
<td>37%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td>X² = 54.740, 1 d.f.</td>
<td>p &lt; 0.0001</td>
<td>X² = 45.005, 1 d.f.</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Full-Time, Part-Time, Student, or Full-Time &amp; Student</td>
<td>53%</td>
<td>47%</td>
<td>57%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>Unemployed, Homemaker, Retired</td>
<td>28%</td>
<td>72%</td>
<td>33%</td>
<td>67%</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td>X² = 3.105, 1 d.f.</td>
<td>p &gt; 0.05</td>
<td>X² = 3.448, 1 d.f.</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>Under $20,000</td>
<td>46%</td>
<td>54%</td>
<td>51%</td>
<td>49%</td>
<td></td>
</tr>
<tr>
<td>Over $20,000</td>
<td>51%</td>
<td>49%</td>
<td>56%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td>X² = 8.959, 1 d.f.</td>
<td>p &lt; 0.01</td>
<td>X² = 8.024, 1 d.f.</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>White / Caucasian</td>
<td>40%</td>
<td>60%</td>
<td>49%</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>50%</td>
<td>50%</td>
<td>56%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>X² = 3.759, 1 d.f.</td>
<td>p &gt; 0.05</td>
<td>X² = 0.065, 1 d.f.</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>Male</td>
<td>53%</td>
<td>47%</td>
<td>53%</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>59%</td>
<td>41%</td>
<td>53%</td>
<td>47%</td>
<td></td>
</tr>
</tbody>
</table>
Logistic Regression

Bus 2013

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>% of Total Sample</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.461</td>
<td>0.099</td>
<td>-</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Black / African American</td>
<td>-0.327</td>
<td>0.088</td>
<td>69%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>40 Years Old and Below</td>
<td>-1.262</td>
<td>0.082</td>
<td>56%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Employed and/or Student</td>
<td>-0.925</td>
<td>0.094</td>
<td>72%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Income Over $80,000</td>
<td>-0.503</td>
<td>0.262</td>
<td>3%</td>
<td>0.0551</td>
</tr>
</tbody>
</table>

Bus 2012

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>% of Total Sample</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.432</td>
<td>0.133</td>
<td>-</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Black / African American</td>
<td>-0.100</td>
<td>0.117</td>
<td>66%</td>
<td>0.3892</td>
</tr>
<tr>
<td>40 Years Old and Below</td>
<td>-1.335</td>
<td>0.111</td>
<td>55%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Employed and/or Student</td>
<td>-0.620</td>
<td>0.124</td>
<td>70%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Income Over $80,000</td>
<td>-0.517</td>
<td>0.300</td>
<td>3%</td>
<td>0.085</td>
</tr>
</tbody>
</table>
Mobile Technology Availability

- Age is a major contributor to smartphone application availability
- Riders who are not Black / African Americans need an alternative technology for real-time information
- Confirmation riders employed and/or students more likely to have smartphone applications
- No clear trend regarding income
- Gender has no influence
Trend Analysis & Alternative Technology Access
Adoption Pattern, St. Louis Metro, 2007 - 2013

Technology Adoption Pattern
(Nelson and Phelp 1966, Blackman 1978)
Trend Analysis

National Transit Ridership Trend, 2005 - 2012


Technology Adoption Trend, St. Louis, 2007 - 2013
Predicted number of riders with smartphone access in a particular year

\[
\text{Predicted number} = \text{number of riders in base year} \times (\text{percent increase in transit ridership for an age group} - \text{population growth rate in that age group}) \times \text{number of years} \times \text{technology penetration rate in that age group for that year}
\]

Assuming St. Louis Metro has 100 riders in 2013, in 2018:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Ridership Change Rate</th>
<th>Population Change Rate</th>
<th>Total Riders</th>
<th>Technology Penetration Rate</th>
<th>Number of Riders with Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 44</td>
<td>1.00</td>
<td>-0.10</td>
<td>550.00</td>
<td>94.58</td>
<td>520.19</td>
</tr>
<tr>
<td>&gt; 44</td>
<td>1.80</td>
<td>0.30</td>
<td>750.00</td>
<td>87.20</td>
<td>654.00</td>
</tr>
</tbody>
</table>
Implications

• For age group <44 years, smartphone based applications may have a sufficient coverage

• For age group >=44 years, smartphone based applications do not have a good coverage and:
  – Clubbing all age groups blankets the 65+ age group
  – Technology has a saturation – it will never capture all riders

Therefore, there has to be an additional technology platform beside smartphone based application
## Alternative Technology Access

### Methodology

<table>
<thead>
<tr>
<th>Alternative Technology Access</th>
<th>Bus Riders</th>
<th>Rail Riders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Riders</td>
<td>Riders without Smartphone Applications</td>
</tr>
<tr>
<td>IVR</td>
<td>Yes 91% 9%</td>
<td>74% 26%</td>
</tr>
<tr>
<td>Mobile-Based Website</td>
<td>Yes 71% 29%</td>
<td>24% 76%</td>
</tr>
<tr>
<td>SMS</td>
<td>Yes 82% 18%</td>
<td>61% 39%</td>
</tr>
<tr>
<td>Computer-Based Website</td>
<td>Yes 76% 24%</td>
<td>61% 39%</td>
</tr>
</tbody>
</table>
Overlap of Technology Availability among Riders Without Smartphone Applications
MetroBus, 2013

Alternative Technology Access

<table>
<thead>
<tr>
<th>Alternative Technology</th>
<th>Have Access to this AND another Technology</th>
<th>ONLY have Access to this Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVR</td>
<td>67%</td>
<td>7%</td>
</tr>
<tr>
<td>Mobile Website</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>SMS</td>
<td>44%</td>
<td>15%</td>
</tr>
<tr>
<td>Computer</td>
<td>49%</td>
<td>12%</td>
</tr>
<tr>
<td>None (Signage)</td>
<td>15%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Summary

• Strong trend toward internet-based applications over traditional methods of communication
  – Trip planning behavior – shifting toward convenience, accessibility, immediacy of electronic information

• Dramatic increase in bi-modal cell phone use and access to the internet

• Increasing smartphone adoption
  – Growing potential for service improvements such as mobile tech apps (RTI) and revenue enhancements (smartphone integrated fare collection).
What is the Best Alternative Technology?

- Based on goals and resources of agency
- Subjective answer—technology preferences differs between users
- Our recommendations: In addition to smartphone apps,
  - Interactive Voice Response (IVR)
  - Computer-Based Website
Questions?
Alternative Technology Availability

Internet Access on Mobile Device

LAC MTA
2012
76%
24%

St. Louis Metro Agency
2012
72%
28%

United States
2012
56%
44%

Yes
No
Alternative Technology Availability

Text Messaging on Mobile Device

- **CTA**
  - 2009: 70% Yes, 30% No

- **St. Louis Metro Agency**
  - 2012: 88% Yes, 12% No

- **United States**
  - 2012: 80% Yes, 20% No

**National Trends**
Alternative Technology Availability

Internet Access on Computer

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2012</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTA</td>
<td>93%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>St. Louis Metro Agency</td>
<td>81%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>United States</td>
<td>77%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Background

Trend Analysis

National Trends

Technology Utilization

Trend Analysis

Implications
Mobile Technology Trend

Cell Phone Ownership

<table>
<thead>
<tr>
<th>Year</th>
<th>Bus</th>
<th>Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>68%</td>
<td>81%</td>
</tr>
<tr>
<td>2008</td>
<td>70%</td>
<td>84%</td>
</tr>
<tr>
<td>2012</td>
<td>92%</td>
<td>95%</td>
</tr>
<tr>
<td>2013</td>
<td>91%</td>
<td>94%</td>
</tr>
</tbody>
</table>

- **Background**
- **Trend Analysis**
- **Technology Utilization**
- **Implications**
Cell Phone Owners with Internet on Device

- **2012**: 71% (Bus), 72% (Rail)
- **2013**: 77% (Bus), 78% (Rail)

**Technology Utilization**: The data shows an increasing trend from 2012 to 2013, with a 7% rise in the usage of internet on mobile devices for both public transportation modes. The implications of this trend could include increased efficiency in public transportation systems, as well as potential changes in travel behavior and public spending.
Mobile Technology Trend

Cell Phone Owners with Text Messaging on Device

Year

- 2008: 64% Bus, 49% Rail
- 2012: 88% Bus, 88% Rail
- 2013: 90% Bus, 92% Rail

Background

Technology Utilization

National Trend

Trend Analysis

Implications