2018 Transportation Conformity

Appendix 12.7: Travel Model Validation and DFX
DFX 2010 ROADWAY VALIDATION

Travel Model Development and Data Management

May 2014
INTRODUCTION
Data Preparation Steps

- Transfer traffic counts to the SQL database
- Perform corridor-level temporal and spatial checks
- Summarize to match the model time periods
- Generate validation measures
- Identify reasons for major inconsistencies
- Transfer speed data to the SQL database
- Transfer speed data to TCAD roadway network
- Create performance segments for freeways and major arterials
- Generate travel times along performance segments
- TMCs come with their own link layer that does not match our model network

Data Acquisition, Storage, and Quality Control

- Data Summarization
- Data Transfer
- MOE Calculation
- Outlier Review

2009 TxDOT saturation counts and other sources

Perform manual and automated link-level checks

Identify reasons for major inconsistencies

Generate travel times along performance segments

Identify reasons for major inconsistencies

Summary to match the model time periods

MDDM
Known Data Issues

Traffic Count Data

The available traffic counts are inconsistent and do not satisfy the conservation of flow.

- Freeway A: 9,000 vpd (forward from A)
- Freeway B: 25,000 vpd (backward from B)
- Freeway C: 10,000 vpd (Model Matches Counts)
- Freeway C: 9,000 vpd (Counts)
- Freeway C: 12,000 vpd (Model)

MDDM
Known Data Issues

Traffic Count Data

The traffic count on a link changes from day to day. An understanding of its mean and variance is required for a better evaluation of the model performance.

Note: Six month average of Tuesdays to Thursdays from 2008 until 2011

MDDM
Known Data Issues

Travel Time Data
There are unreasonably high variances between the provided travel times in different time periods for some segments.

Travel Speeds for TMC 111P16224 on Southlake Boulevard at Randoll Mills Avenue

Average Minimum Maximum
Known Data Issues

Validation Data
The count and travel time data has been used in the validation process with no corrections for the known issues.

Demographic Data (Mobility 2035)
The demographic data used in the model does not account for the economic downturn and loss of employment in the region that occurred in 2009.

There is an over-estimation of the employment in the outer counties in 2009.
TxDOT Saturation Counts

Collected every 5 years

Performed in two stages:
  TxDOT Fort Worth District in Spring/Summer
  TxDOT Dallas District in Fall/Winter

Received 2-2.5 years later

Covers 20-30% of the coded links in each county
  - 5-10% F1
  - 10-20% F2
  - 20-30% F3
  - 30-40% F4
  - 5-20% F6
  - 0-5% F7
Closer observation of count locations with higher differences with model volumes indicates that non-freeway counts are often times collected close to access points of larger developments (shopping centers, Walmart, Home Depot, Lowes). This creates major problems when there are multiple counts on a link and the development’s access pattern is not symmetrical.
TxDOT Saturation Counts

Not collected with model validation in mind. Some MPOs collect select traffic counts specifically for their validation process.
TxDOT Saturation Count Links
VALIDATION RESULTS (REGIONAL)
# Model %RMSE Comparisons by FUNCL

<table>
<thead>
<tr>
<th>FUNCL</th>
<th>DFWRTM 1999</th>
<th>EXPANDED 2004</th>
<th>2010 Daily Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE</td>
<td>% F/C</td>
<td>#OBS</td>
</tr>
<tr>
<td>1</td>
<td>15.36</td>
<td>2.09</td>
<td>885</td>
</tr>
<tr>
<td>2</td>
<td>30.8</td>
<td>-0.16</td>
<td>1,156</td>
</tr>
<tr>
<td>3</td>
<td>38.46</td>
<td>-13.55</td>
<td>2,630</td>
</tr>
<tr>
<td>4</td>
<td>55.07</td>
<td>-24.47</td>
<td>2,087</td>
</tr>
<tr>
<td>6</td>
<td>49.05</td>
<td>-13.07</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>55.18</td>
<td>-11.58</td>
<td>308</td>
</tr>
<tr>
<td>ALL</td>
<td>32.28</td>
<td>-6.87</td>
<td>7,099</td>
</tr>
</tbody>
</table>

Note: 1999 and 2004 calibrations were performed in 2003 and 2008, accordingly.
## Model %RMSE by Area Type

<table>
<thead>
<tr>
<th>Area Type</th>
<th>DFWRTM 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE</td>
</tr>
<tr>
<td>1</td>
<td>66.07</td>
</tr>
<tr>
<td>2</td>
<td>53.06</td>
</tr>
<tr>
<td>3</td>
<td>39.46</td>
</tr>
<tr>
<td>4</td>
<td>46.21</td>
</tr>
<tr>
<td>5</td>
<td>48.06</td>
</tr>
</tbody>
</table>
Freeway Volume Comparison

2010 Model Validation (Freeways)

R^2 = 0.86
%RMSE = 23.49%
%F/C = 7.4%

Notes: Volumes are in vehicles per day (vpd).
Freeway Volume Comparison

2004 Model Calibration

2010 Model Validation

Note: Volumes are in vehicles per day (vpd).
Model Volume Comparison

2010 Model Validation (All Links)

\[ R^2 = 0.86 \]
\[ \%RMSE = 43.62\% \]
\[ \%F/C = 3.4\% \]

Note: Volumes are in vehicles per day (vpd).

MDDM
Model Volume Comparison

2010 Model Validation

1999 Model Calibration

2004 Model Calibration

Note: Volumes are in vehicles per day (vpd).
## Link %RMSE Comparisons by Volume

<table>
<thead>
<tr>
<th>Daily Traffic Count (VPD)</th>
<th>%RMSE 1999</th>
<th>% RMSE 2004 Expanded</th>
<th>% RMSE 2010 Daily Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 50,000</td>
<td>14.38</td>
<td>14.92</td>
<td>19.15</td>
</tr>
<tr>
<td>25,000 &lt;= X &lt; 50,000</td>
<td>24.92</td>
<td>28.20</td>
<td>31.24</td>
</tr>
<tr>
<td>10,000 &lt;= X &lt; 25,000</td>
<td>36.78</td>
<td>40.37</td>
<td>47.60</td>
</tr>
<tr>
<td>5,000 &lt;= X &lt; 10,000</td>
<td>52.72</td>
<td>53.41</td>
<td>70.64</td>
</tr>
<tr>
<td>X &lt; 5,000</td>
<td>94.95</td>
<td>125.94</td>
<td>102.41</td>
</tr>
<tr>
<td>ALL</td>
<td>36.90</td>
<td>37.22</td>
<td>43.62</td>
</tr>
</tbody>
</table>
Model Cut Lines
Model Cut Lines

- No. of Links: 46
  - Total flow: 608,409
  - Total count: 633,825
  - %RMSE: 40.94%
  - Error: 4%

- No. of Links: 46
  - Total flow: 1,005,653
  - Total count: 962,545
  - %RMSE: 36.73%
  - Error: 4%

- No. of Links: 87
  - Total flow: 1,959,645
  - Total count: 1,920,595
  - %RMSE: 43.58%
  - Error: 2%

- No. of Links: 59
  - Total flow: 1,153,630
  - Total count: 1,081,148
  - %RMSE: 44.90%
  - Error: 7%

- No. of Links: 8
  - Total flow: 220,845
  - Total count: 197,617
  - %RMSE: 33.37%
  - Error: 12%

Legend:
- East
- US75
- US67
- Airport
- I-35 West
- US575

MDDM
Model Cut Lines
Error Comparisons
Model Cut Lines Error Comparisons

No. of Links: 44
Total flow: 1,124,298
Total count: 948,744
%RMSE: 42.6%
Error: 19%

No. of Links: 42
Total flow: 1,424,298
Total count: 948,744
%RMSE: 42.6%
Error: 18%

No. of Links: 16
Total flow: 426,623
Total count: 390,588
%RMSE: 26.6%
Error: 9%

No. of Links: 15
Total flow: 268,142
Total count: 246,044
%RMSE: 39.81%
Error: 9%

No. of Links: 17
Total flow: 182,836
Total count: 170,190
%RMSE: 33.08%
Error: 7%

No. of Links: 80
Total flow: 1,586,587
Total count: 1,467,462
%RMSE: 43.77%
Error: 8%

No. of Links: 7
Total flow: 199,623
Total count: 170,190
%RMSE: 30.95%
Error: 9%

No. of Links: 16
Total flow: 268,142
Total count: 246,044
%RMSE: 39.81%
Error: 9%
Model Screen Lines
Model Screen Lines % Error

Screen Line Absolute % Error

Cumulative Percentage

Absolute % Error

~30% ABS(%ERROR) < 10%
~60% ABS(%ERROR) < 20%
~75% ABS(%ERROR) < 30%
## Freeway Corridors

%RMSE Comparisons

<table>
<thead>
<tr>
<th>Freeway</th>
<th>% RMSE 1999</th>
<th>% RMSE 2004 Expanded</th>
<th>% RMSE 2010 Daily Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>IH 30 WB</td>
<td>9.22</td>
<td>18.29</td>
<td>17.38</td>
</tr>
<tr>
<td>IH 30 EB</td>
<td>9.30</td>
<td></td>
<td>17.95</td>
</tr>
<tr>
<td>IH20 WB</td>
<td>27.14</td>
<td>22.80</td>
<td>23.96</td>
</tr>
<tr>
<td>IH20 EB</td>
<td>25.01</td>
<td></td>
<td>20.75</td>
</tr>
<tr>
<td>IH35W SB</td>
<td>17.44</td>
<td>21.80</td>
<td>18.14</td>
</tr>
<tr>
<td>IH35W NB</td>
<td>15.98</td>
<td></td>
<td>15.36</td>
</tr>
<tr>
<td>IH35E SB</td>
<td>8.84</td>
<td>17.82</td>
<td>17.42</td>
</tr>
<tr>
<td>IH35E NB</td>
<td>10.38</td>
<td></td>
<td>20.95</td>
</tr>
<tr>
<td>US75 SB</td>
<td>22.98</td>
<td>11.11</td>
<td>14.13</td>
</tr>
<tr>
<td>US75 NB</td>
<td>22.78</td>
<td></td>
<td>14.23</td>
</tr>
<tr>
<td>IH635 WB</td>
<td>11.57</td>
<td>11.82</td>
<td>14.51</td>
</tr>
<tr>
<td>IH635 EB</td>
<td>11.59</td>
<td></td>
<td>11.33</td>
</tr>
<tr>
<td>IH635 SB</td>
<td>5.73</td>
<td></td>
<td>10.66</td>
</tr>
<tr>
<td>IH635 NB</td>
<td>8.96</td>
<td></td>
<td>11.69</td>
</tr>
<tr>
<td>SH360 SB</td>
<td>17.42</td>
<td>17.84</td>
<td>11.49</td>
</tr>
<tr>
<td>SH360 NB</td>
<td>19.15</td>
<td></td>
<td>8.99</td>
</tr>
<tr>
<td>IH45 SB</td>
<td>26.53</td>
<td>18.51</td>
<td>36.67</td>
</tr>
<tr>
<td>IH45 NB</td>
<td>26.53</td>
<td></td>
<td>36.00</td>
</tr>
</tbody>
</table>
All Travel Time Segments

571 UniDirectional Segments
(Freeway and Major Arterials)
Freeway Travel Time Segments

214 UniDirectional Segments
~ 900 centerline miles
Freeway Travel Time Comparison - AM

%RMSE: 27.24
%F/C: 15.24
Freeway Speed Comparison - AM

~50% ABS(DELTA) < 5.0 mph
~70% ABS(DELTA) < 10.0 mph
~85% ABS(DELTA) < 15.0 mph
Freeway Travel Time Comparison - PM

%RMSE: 21.37
%F/C: 11.87

Model Travel Time (min)

NAVTEQ Travel Time (min)
Freeway Speed Comparison - PM

- ~50% ABS(DELTA) < 5.0 mph
- ~80% ABS(DELTA) < 10.0 mph
- ~90% ABS(DELTA) < 15.0 mph
Major Arterial Travel Time Segments

357 UniDirectional Segments
~1,500 centerline miles
Arterial Travel Time Comparisons - AM

\[ R^2 = 0.85 \]
Arterial Travel Time Comparisons - PM

R^2 = 0.88
VALIDATION RESULTS
(HOVS)
HOV Volume Count Locations
HOV Daily Volumes

South R.L. Thornton/Marvin D. Love Freeway (IH35E/US67)

- NB count
- SB count
- NB model 2011
- SB model 2011

HOV Daily Volumes

MDDM
HOV Daily Volumes

Stemmons (IH35E)

- NB count
- SB count
- NB model 2011
- SB model 2011

HOV Daily Volume

MDDM
HOV Daily Volumes

Tom Landry Freeway (IH30)

- EB count
- WB count
- EB model 2011
- WB model 2011

HOV Daily Volume

- EB count
- WB count
- EB model 2011
- WB model 2011

MDDM
HOV Daily Volumes

East R.L. Thornton Freeway (IH30)

HOV Daily Volumes

EB count
WB count
EB model 2011
WB model 2011

HOV Daily Volume

0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000

MDDM
HOV Daily Volumes

West LBJ (IH635)

- EB count
- WB count
- EB model 2011
- WB model 2011

MDDM
HOV Daily Volumes

East LBJ (IH635)

- EB count
- WB count
- EB model 2011
- WB model 2011

HOV Daily Volume

MDDM
HOV Daily Volumes

Central Expressway (US75)

- NB count
- SB count
- NB model 2011
- SB model 2011

HOV Daily Volume

MDDM
VALIDATION RESULTS
(BY COUNTY)
## Model %RMSE Comparisons by FUNCL by County

<table>
<thead>
<tr>
<th>FUNCL</th>
<th>COLLIN</th>
<th>DALLAS</th>
<th>DENTON</th>
<th>ELLIS</th>
<th>JOHNSON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE</td>
<td>% F/C</td>
<td>#OBS</td>
<td>RMSE</td>
<td>% F/C</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>-8</td>
<td>63</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>5</td>
<td>103</td>
<td>43</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>15</td>
<td>303</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>76</td>
<td>-10</td>
<td>109</td>
<td>65</td>
<td>-21</td>
</tr>
<tr>
<td>6</td>
<td>63</td>
<td>-17</td>
<td>106</td>
<td>63</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
<td>19</td>
<td>49</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>ALL</td>
<td>46</td>
<td>4</td>
<td>733</td>
<td>44</td>
<td>6</td>
</tr>
</tbody>
</table>

**MDDM**
## Model %RMSE Comparisons by FUNCL by County

<table>
<thead>
<tr>
<th>FUNCL</th>
<th>KAUFMAN</th>
<th>PARKER</th>
<th>ROCKWALL</th>
<th>TARRANT</th>
<th>WISE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE</td>
<td>% F/C</td>
<td>#OBS</td>
<td>RMSE</td>
<td>% F/C</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>18</td>
<td>31</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>31</td>
<td>42</td>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>76</td>
<td>8</td>
<td>32</td>
<td>62</td>
<td>-15</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>-43</td>
<td>8</td>
<td>90</td>
<td>-81</td>
</tr>
<tr>
<td>6</td>
<td>122</td>
<td>122</td>
<td>1</td>
<td>63</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>ALL</td>
<td>51</td>
<td>18</td>
<td>114</td>
<td>37</td>
<td>-3</td>
</tr>
</tbody>
</table>

### MDDM
## Model %RMSE Comparisons by Volume by County

<table>
<thead>
<tr>
<th>Daily Traffic Count (VDP)</th>
<th>2010 VALIDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COLLIN</td>
</tr>
<tr>
<td>&gt; 50,000</td>
<td>23.19</td>
</tr>
<tr>
<td>25,000 &lt;= X &lt; 50,000</td>
<td>29.03</td>
</tr>
<tr>
<td>10,000 &lt;= X &lt; 25,000</td>
<td>57.14</td>
</tr>
<tr>
<td>5,000 &lt;= X &lt; 10,000</td>
<td>70.64</td>
</tr>
<tr>
<td>X &lt; 5,000</td>
<td>107.36</td>
</tr>
<tr>
<td>ALL</td>
<td>46.40</td>
</tr>
</tbody>
</table>
### Model %RMSE Comparisons by Volume by County

<table>
<thead>
<tr>
<th>Daily Traffic Count (VDP)</th>
<th>2010 VALIDATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KAUFMAN</td>
<td>PARKER</td>
</tr>
<tr>
<td>&gt; 50,000</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>25,000 &lt;= X &lt; 50,000</td>
<td>6.49</td>
<td>18.34</td>
</tr>
<tr>
<td>10,000 &lt;= X &lt; 25,000</td>
<td>27.44</td>
<td>33.43</td>
</tr>
<tr>
<td>5,000 &lt;= X &lt; 10,000</td>
<td>68.95</td>
<td>60.22</td>
</tr>
<tr>
<td>X &lt; 5,000</td>
<td>104.85</td>
<td>73.71</td>
</tr>
<tr>
<td>ALL</td>
<td>50.51</td>
<td>37.12</td>
</tr>
</tbody>
</table>
Next Steps

**Demographic Data***
Perform the roadway validation after the Mobility 2040 demographics becomes available (12/2014).

**Traffic Count and Travel Time Data***
Develop a systematic method for fixing the data issues (currently working with TxDOT on an method to enhance their counts to accommodate our validation needs).

*Next steps were completed in preparation for Mobility 2040.*