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Tech Brief

Alternative Performance Measures for Evaluation of Congestion – Congestion Analysis Model Update and Maintenance

FHWA-NJ-2007-006 June 2008

BACKGROUND

In order to quantify traffic congestion and its impacts on New Jersey's motorists, the New Jersey Institute of Technology (NJIT) developed the NJIT Congestion Analysis Model (NJITCAM), a computer software tool that estimates congestion costs, congestion related travel delay, and mobility indicators for New Jersey highways. In 2003 and 2004 the NJITCAM was used to develop quantitative measures of congestion presented in the final report for the study titled "*Alternative Performance Measures for Evaluating Congestion*".[1,2] This research product enabled NJDOT to evaluate congestion in New Jersey and use the measures of effectiveness generated by the model to guide the NJDOT Capital Investment Strategy.

OBJECTIVE

The main objective of this project was to further improve the calculation methodology, outputs, and user interface of the NJITCAM in order to better assist NJDOT staff in evaluating congestion.

[1] "Mobility and the Costs of Congestion in New Jersey – 2003 Update", Report to Governor McGreevey's Blue Ribbon Commission on Transportation, New Jersey Institute of Technology, September 2003.

[2] Spasovic, L. and J. Rowinski, "Alternative Performance Measures for Evaluating Congestion", Final Report to the New Jersey Department of Transportation, New Jersey Institute of Technology, April 2004.

SUMMARY OF SOFTWARE REVISIONS AND IMPROVEMENTS

The calculation methodology was modified or re-defined for the following measures:

- Vehicle recurring delay;
- Vehicle non-recurring delay;
- Person-hours of delay (recurring and non-recurring);
- Fuel consumption and cost of wasted fuel;
- Travel Time Index (TTI) (new performance measure);
- Unproductive time for the traveling public; and
- Cost of congestion for trucks.

In response to the feedback from NJDOT users of NJITCAM, the user interface was redesigned to enable more user-friendly data-entry and importing of data-tables from the New Jersey Congestion Management System (NJCMS). The new interface also gives users more flexibility with choosing the value of analysis parameters and the types of reports to be generated. Sample screens of the new, improved user interface are presented in Figures 1-4 on the next page.

The process flow has been revised to streamline the analysis and reporting functions. In particular, the calculation procedure has been separated from the aggregation procedure and reporting function. This change allows users to generate different levels of reports without repeating the calculations.

Modifications of the calculation methodology and inclusion of additional NJCMS tables in the congestion analysis model database increased the complexity of the data flow and the application itself. The revised process flow accommodates these revisions, improves users' flexibility in interacting with the model, and eliminates unnecessary or redundant steps in the analysis.

The reporting function of the NJITCAM has been completely redesigned. The new report format, exported into Excel spreadsheets or DBF files, provides a more detailed and more readable breakdown of congestion measures. In addition, summary report charts are provided in an MS Excel output file (see Figure 5, Page 4).

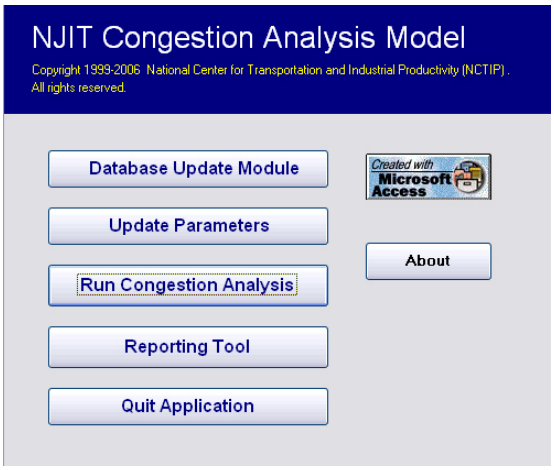

Figure 1. Main screen of the NJIT Congestion Analysis Model

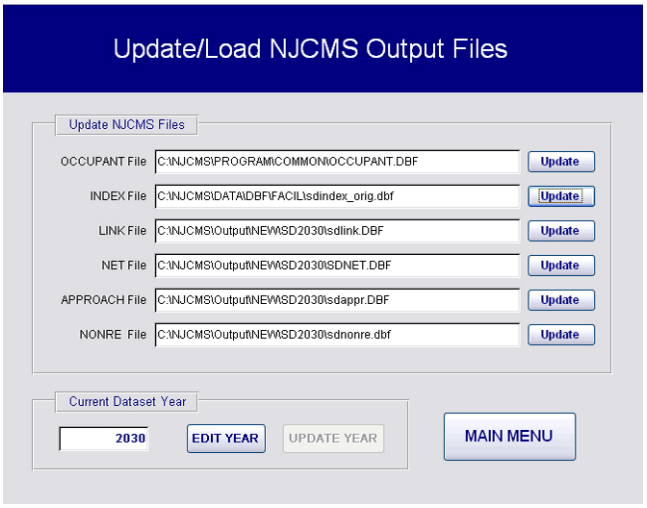

Figure 2. Roadway network database update screen

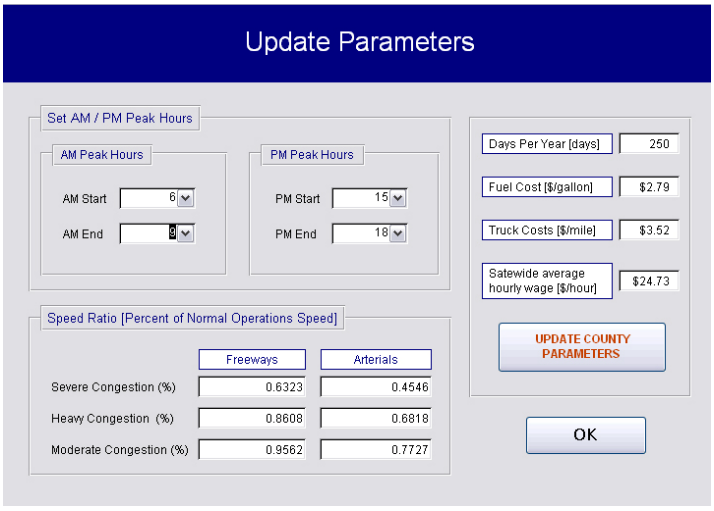

Figure 3. Parameters and analysis settings update screen

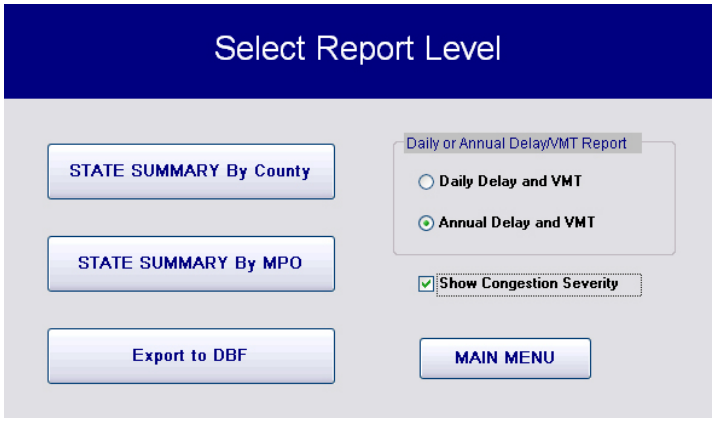

Figure 4. Report selection screen

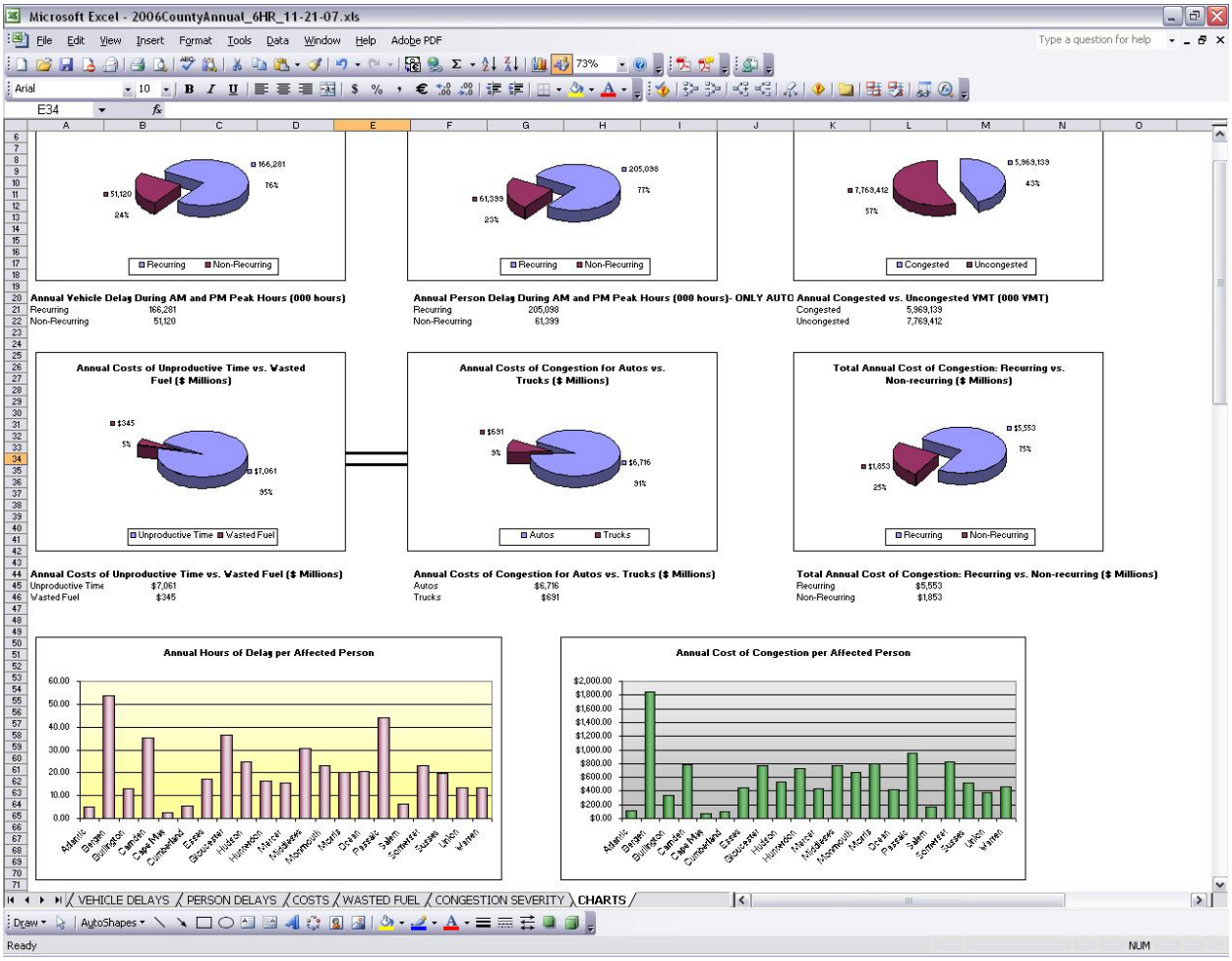

Figure 5. Summary report charts are provided in an MS Excel output file

IMPLEMENTATION AND TRAINING

As part of the implementation and training phases of the project, a case study was developed to demonstrate the new version of the NJITCAM and revised calculation methodology. The analysis was conducted for model year 2006, using the corresponding NJCMS outputs, as well as demographic and socio-economic statistics for New Jersey on the county level. The highlights of the case study results are shown in Table 1 (next page). The table summarizes the results of analysis for the three-hour versus four-hour a.m. and p.m. peak periods. In the case study, only delays during the peak periods are analyzed.

The analysis implies that it is reasonable to consider a four-hour, rather than three-hour peak period, since the intensity of travel (as measured by VMTs) remains significant in the fourth hour of the peak periods. The accumulated annual vehicle delay is 14% greater during the 4-hour a.m. and p.m. peak periods as compared to the 3-hour peak

periods (an increase from 217.4 to 247.4 million vehicle-hours a year). Similarly, the accumulated person delay increased by 15% (from 266.5 to 307.3 person-hours a year); and the total cost of congestion, by 16% (7.4 to 8.6 billion dollars). These results validate the hypothesis that existing travel patterns in effect expand the 3-hour peak periods to 4 hours, based on the observed VMT and congestion indicators.

Table 1. Summary of the results for the two case studies: first, assuming 3-hr a.m. and p.m. peak periods; and second, assuming 4-hr a.m. and p.m. peak periods. All results are annual summaries of the peak periods only, for 250 weekdays.[3]

Performance Measures	Case Study with 3-hr Peak Periods (6-9 a.m. and 3-6 p.m.)	Case Study with 4-hr Peak Periods (6-10 a.m. and 3-7 p.m.)
Total annual vehicle delay [million vehicle hours]	217.4	247.4
Total annual person delay [million person-hours]	266.5	307.3
Annual delay per affected person [person-hours]	30	34
Total Annual cost of congestion [billions $]	$ 7.4	$ 8.6
Annual cost of congestion per affected person [$/person]	$ 822	$ 955
Statewide average RCI[4]	1.01	1.01
Statewide average TRI[5]	1.52	1.47
Statewide average TTI[6]	1.73	1.65
Statewide percent of VMT in congested conditions	43.4	39.3

The documentation for the NJITCAM has been updated to reflect the changes in calculation methodology, process flow, and user interface. The documentation consists of the project final report, description of the methodology (Appendix A of the final report), and the User Manual (Appendix B of the final report).

[3] The case studies were developed using a fuel cost of $2.67 per gallon, a truck cost of $3.00 per mile, and a statewide average hourly wage of $23.18.

[4] The Roadway Congestion Index (RCI) is a measure of vehicle travel density on major roadways in urban areas expressed as number of vehicles per vehicle space. A RCI value exceeding 1.0 indicates an undesirable congestion level on the freeways and principal arterial street system during the peak period.

[5] The Travel Rate Index (TRI) measures the amount of extra time it takes to travel during the peak period, considering only the effect of recurring congestion. A TRI of 1.20, for example, indicates that it will take 20 percent longer to travel to a destination during the peak period than during the off-peak period.

[6] The Travel Time Index (TTI) is similar to TRI, but it considers both recurring and non-recurring delay.

FUTURE STUDY

Future work and potential extensions of this project should focus on the following:

1. Further refinement of the calculation procedure by providing linkages to NJDOT travel demand models;
2. Further refinement/expansion of the fuel consumption model;
3. Development of a GIS module;
4. Adding corridor or facility level analysis;
5. Integration with the NJCMS model;
6. Inclusion of link level output.

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A final report is available online at:
http://www.state.nj.us/transportation/refdata/research/ReportsDB.shtm

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722, or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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