North Carolina Statewide Model

Recent and Upcoming Enhancements

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RSG the science of insight

Agenda

- Introductions
- Status of Study
- Short Term Enhancements
- Long Term Enhancements
- Q & A / Discussion

Introductions

Who We Are

- CDM Smith
  - Roberto Miquel, AICP
- RSG
  - Vince Bernardin, Ph.D.

Status of the Study

Tasks Completed

- Project Kick-Off
  - The project kick-off meeting was held March 1, 2017 at the NCDOT Highway Building
  - Representatives from the Transportation Planning Division and the SPOT Office were present
- Model Replication
  - Consultant team acquired NCSTM Gen 2.3
  - A number of projects from P4.0 were run to ensure that the model was being run correctly

Tasks Completed (cont.)

- Model Review
  - NCSTM Gen 2.3 was thoroughly reviewed for opportunities for short-term (during the P5.0 evaluation cycle) enhancements
  - Suitable enhancements were identified
  - Recommended enhancements were presented to NCDOT
- P5.0 Project Analysis Preparations
  - CDM Smith attended three P5.0 Workgroup meetings in the Spring of 2017
  - An updated E+C highway network was coded
  - Traffic growth rates were developed from the model and submitted to NCDOT Congestion Management

Tasks Completed (cont.)

- Short Term Enhancements
    - The enhancements identified during model review were approved by NCDOT and implemented into the model
    - This includes converting the model to TransCAD 7 Build 12375
    - Additional enhancements detailed later in this presentation

Tasks in Progress

- P5.0 Project Evaluations
  - P5.0 Carryover Projects have been run and are undergoing internal QA/QC
  - P5.0 submittals have been completed and are being assessed by the SPOT Office

Upcoming Tasks

- P5.0 Project Evaluations
  - Run and analyze submitted P5.0 projects
- Long Term Road Map
  - Assess model enhancement needs suitable for longer-term implementation
  - Develop a multi-year model improvement roadmap that will take the NCSTM through P6.0 and beyond

Short Term Enhancements

Streamline Macro Calls to Reduce Runtime

- Converting Skims from Matrix to CSV
  - Was running in every iteration for long distance
  - Will now run only in the first iteration
- Similarly converting the long distance trips from CSV to Matrix was also being repeated
  - Will now happen only in first iteration
- There were cases where only partial long distance files were being read from the CSV when converting to matrix form
  - This has now been corrected
- The long distance trucks macro now updates the messages on screen and waits for only the necessary amount of time to read outputs from external JAVA model

Robust JAVA – TransCAD Handshake

- Critical components of the NCSTM written in JAVA instead of GISDK

- JAVA would write out files and GISDK would begin scanning for this file periodically before advancing to the next model step

- On occasion, the JAVA output files would be written but incomplete when GISDK scanned for the files and found them

Robust JAVA – TransCAD Handshake (cont.)

- A more robust handshake protocol was introduced

- JAVA now writes out a "working file" while it is running and deletes it when complete; TransCAD waits to proceed while this file still exists

- This allows GISDK to continue only when certain that the JAVA components of the model have successfully completed

- Additional checks have been introduced to make sure JAVA outputs are converted in entirety from CSV to matrix form

Traffic Assignment Algorithms

- Several changes were made to the traffic assignment procedure
  - Parallel processing of four time periods (two at a time) to save run time
  - Using tri-conjugate Frank-Wolfe algorithm
  - Using relative gap = 10^{-6} and 500 iterations to ensure the assignments converges
  - Using VOT based vehicles classes
- The long distance trucks and autos are always preloaded while the short distance trucks are assignment with remaining trips
- The GISDK scripts were edited to properly model toll roads and were tested on Triangle Expressway for validation

Traffic Assignment Algorithms

NCSTM v. 2.3 (5 x 10^{-4})
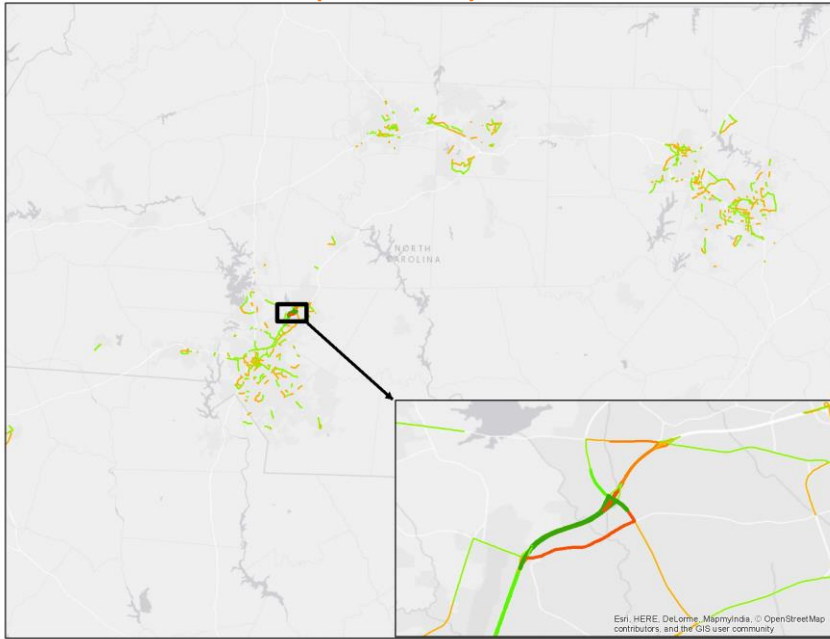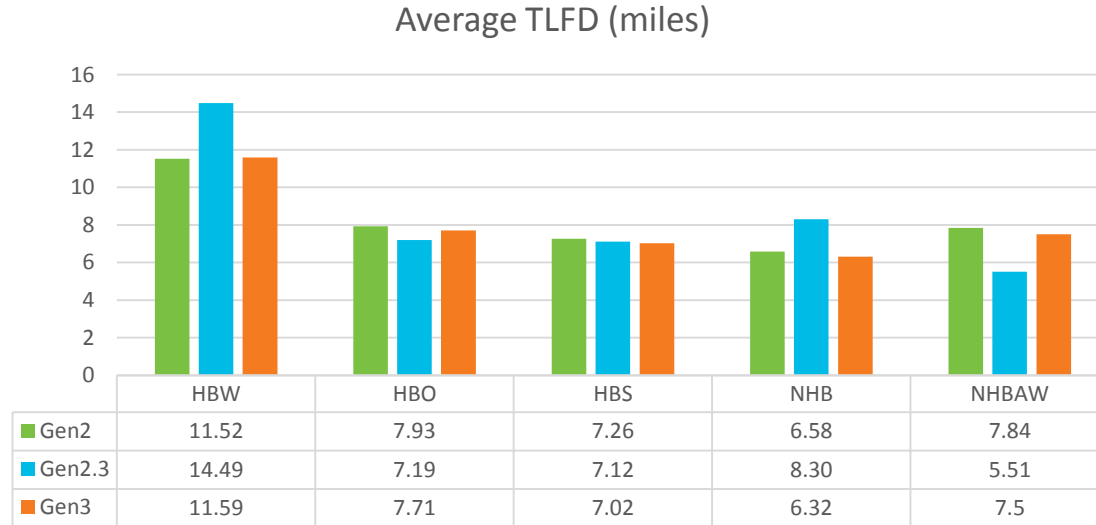
NCSTM v. 2.3 (1 x 10^{-6})
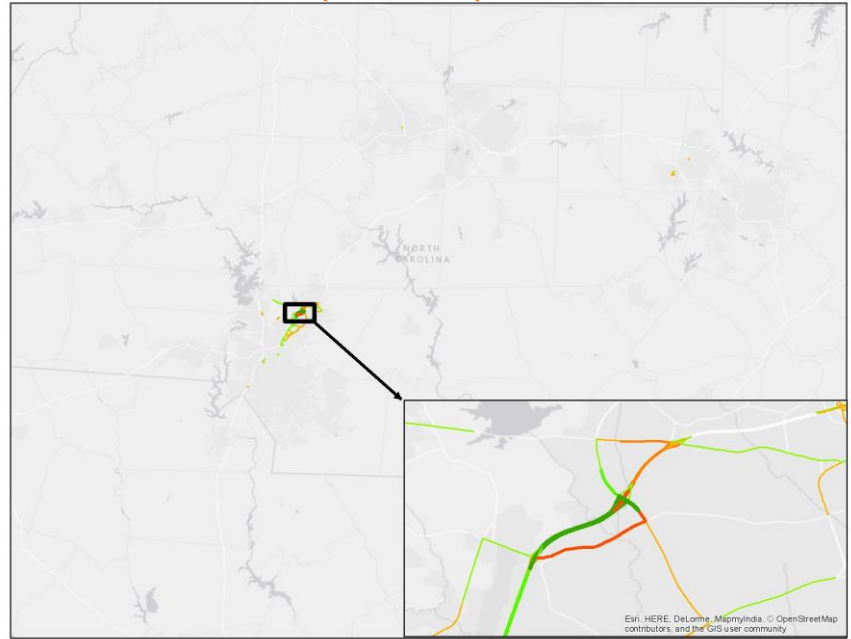
Destination Choice Enhancements

- Focus on runtime improvements (15min down to 3min)
- Validation of trip length frequency distribution

Average TLFD (miles)

|	HBW	HBO	HBS	NHB	NHBAW
■ Gen2	11.52	7.93	7.26	6.58	7.84
■ Gen2.3	14.49	7.19	7.12	8.30	5.51
■ Gen3	11.59	7.71	7.02	6.32	7.5

Toll Choice Modeling

- Three stated preference surveys were combined to estimate value-of-time distributions
- A mixed logit model was estimated and scaled using a multinomial logit model

Average Peak Period VOT by Income and Distance

Income Category Midpoint	Trip Distance (miles)					
	10	20	30	40	50	60
$12,500	$8.97	$10.26	$11.02	$11.57	$11.99	$12.34
$37,500	$11.01	$12.59	$13.53	$14.20	$14.72	$15.15
$62,500	$11.96	$13.68	$14.70	$15.43	$15.99	$16.46
$87,500	$12.58	$14.39	$15.47	$16.23	$16.83	$17.32
$125,000	$13.24	$15.15	$16.28	$17.09	$17.71	$18.23
$175,000	$13.87	$15.86	$17.05	$17.89	$18.55	$19.09
$250,000	$14.53	$16.62	$17.86	$18.75	$19.44	$20.00
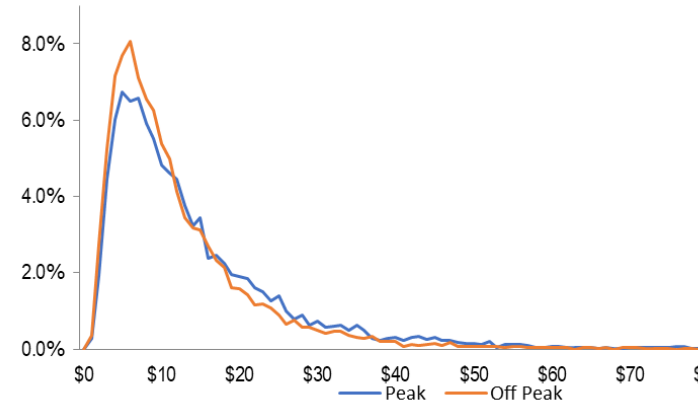
Toll Choice Modeling

- This VOT distributions estimated from the surveys were applied to the NCSTM and used to divide auto trips in to five market segments with the following average VOTs:

PeakVOT	OffPeakVOT	Avg. Auto VOT
3.28	3.22	3.24
7.15	7.08	7.11
12.29	12.21	12.24
19.53	19.41	19.46
38.58	36.37	37.28

Toll Choice Modeling (cont.)

- Similarly, five market segments were developed for muti-unit trucks and three for single unit trucks.

Single Unit Truck VOT	Multi Unit Truck VOT
20.52	12.57
38.79	31.12
56.75	49.54
-	67.95
-	88.34

Toll Choice Modeling

- The toll model was calibrated for volumes on the Triangle Expressway by adding a calibration constant to scale up the travel time savings of toll roads to account for travel time reliability, and other factors ignored in this version of the model

- The final adjustment was a 50% increase in the benefit of toll roads, which is reasonable and broadly consistent with the contribution of reliability in other toll models

Re-Calibration

- NCSTM v. 2.3 was out of calibration, substantially different from documented v. 2.0 results

- Whole model was re-calibrated to 2011 base year (in addition to toll model calibration to Triangle Expressway in 2015)

- Adjustments to free-flow speeds changed (mostly reduced)

- Weight on length term in generalized cost adjusted

- Trip rates had to be adjusted by area type and region

- Destination choice had to be recalibrated to reproduce TLFDs

- Posted speeds, ramp coding, etc., corrected near Triangle

User Benefit Calculations

- NCSTM uses select link analysis on the project links to identify project benefits

- Original method uses select link volumes
  - Select link analysis is used to build a critical link matrix
  - The matrix shows origins-destinations of trips using the project
  - Select link volumes are compared against build vs. no-build travel time matrices to identify savings

- Select link volumes are not a unique solution
  - This could lead to potentially misleading results

User Benefits Calculations (cont.)

- New method still uses select links, but in a different way
  - Select link analysis is used to identify project origins-destinations
  - Actual select link volumes are disregarded
  - All trips are analyzed if they possess an origin and destination identical to those revealed by the select link analysis
  - Captures the direct and some indirect benefits of the project
  - Still restricts the set of beneficiaries to those who could reasonably benefit, less strictly than before, but still excluding some legitimate beneficiaries
  - Still avoids spurious benefits due to model noise

Usability Enhancements

- Converted project-level evaluation and post-processing out of R and into GISDK

- Manual interventions (updating files paths in scripts, changing properties tokens) have been either eliminated or transferred to TransCAD interfaces

- All project analysis conducted via a new interface in the NCSTM

Long Term Enhancements

Long Term Enhancements

- Implement method to better analyze potential freight diversion from non-NC ports to NC ports

- Accounting for inter-commuting phenomenon

- Use of HERE data. Other speed data?

- Reduce reliance on STI normalization

- Other needs?

Questions/Discussion

Contact Information:

Calibration –Trip Generation Adjustments

- Trip generation rates were adjusted by:
  - Region
  - Area type

Region	Area Type	Adjustment
Coastal	Urban	0.91
Piedmont	Suburban	1.16
Piedmont	Rural	1.59
Mountain	Urban	0.88
Mountain	Rural	1.15

Calibration Steps –Adjustments to FF Speed

- The table used to adjust free flow speed was also edited by region and area type:

AreaType	CTP_CD	Old	New
1	1	3	4
1	2	3	2
1	3	-5	-4
1	4	-5	-4
1	5	-5	-4
1	6	-5	-4
1	7	-5	-2
2	1	5	2
2	2	5	2
2	3	-3	-2
2	4	-3	0
2	5	-3	-1
3	1	3	1
3	2	3	0
3	5	0	2
3	6	0	4
3	7	0	4

Calibration Steps – Other Adjustments

- During calibration, in addition to changes listed above, some additional things were adjusted and are listed below.

  - Several missing ramps were coded in the master network for Triangle Expressway;

  - The posted speeds on Triangle Expressway and parallel roadways were adjusted to match the correct information from Google street view;

  - The centroid connector near Triangle Expressway were adjusted in length to calibrate the volumes on the toll roadway;

  - During network setup, the length penalty for calculating Fixed Toll (impedance) was reduced by 20%.