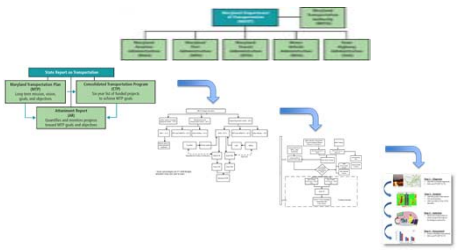
L35-B
Local Methods for Modeling, Economic Evaluation, Justification, and Use of the Value of Travel Time Reliability in Transportation Decision Making

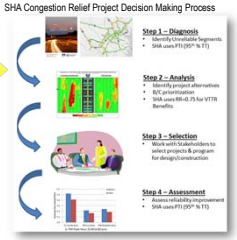
Research Goals

- Select and defend a value or range of values for travel time reliability for the Maryland State Highway network
- Use the VTTR in the Maryland SHA project development process to prioritize operational and capital improvements and determine if (and how) the ranking of projects changes due to the addition of VTTR
- Report for the benefit of others the step-by-step process used to develop, justify, apply, and assess the use of VTTR in the Maryland SHA project evaluation and decision process

Overview of Existing Processes



SHA Congestion Relief Project Decision Making Process



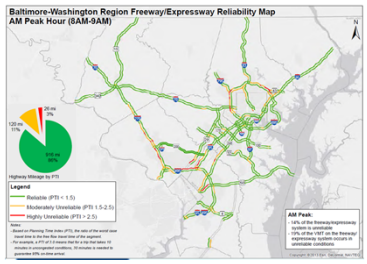
Congestion Relief Project DM

In addition to safety and congestion, transportation system reliability is another key factor to providing our customers with a good travel experience.

From Forward 2013 SHA Mobility Report

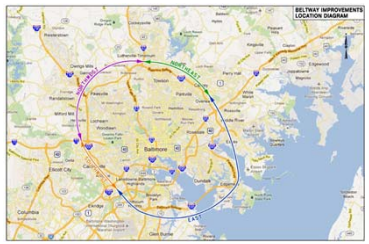
Melinda B. Peters, SHA Administrator

Step 1: Diagnosis



Step 2: Analysis

Review
Simulate
B/C



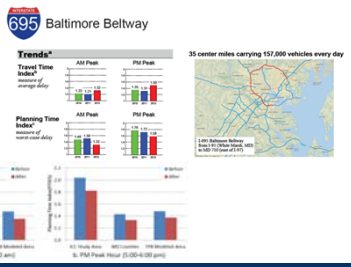
Saving Type	Parameter	Unit	Categories	SHA Value*
Travel time	VOT	$/hr	Passenger	29.82
			Truck driver	20.21
			Cargo	45.40
Travel time reliability	VTTR	$/hr	Passenger	22.36
			Truck driver	15.16
			Cargo	34.05
Fuel cost		$/gal	Gasoline	3.69
			Diesel	3.97

*Parameters used by SHA in project benefit estimation (2012 values)

Step 3: Selection

Location	Project Description	Total Savings	Construction Cost	O&M Cost	Total Cost	B/C
		All Values in (1000's)				
I-695 Outer Loop: MD 144 on ramp continuing to MD 372	Provide additional through lane from on ramp at MD 144 to end of acceleration lane from MD 372. Includes widening and restriping and removal and replacement of retaining wall. Total project length is 2,500ft.	$27,165	$16,500	$1,650	$18,150	150%
I-695 Inner Loop: US 40 Interchange	Extend inner loop aux lane prior to interchange to connect deceleration lane to WB US40. Widen I-695 inner loop to provide exclusive decel lane for EB US40. Includes retaining wall construction. Total length is 2,200ft.	$14,558	$10,900	$1,090	$11,990	121%
I-695 Outer Loop: US 40 Interchange	Extend outer loop aux lane prior to interchange to connect decel lane to eastbound US 40. Widen I-695 outer loop to provide exclusive decel lane for WB US 40. Total length is 2,200ft.	$32,894	$5,000	$500	$5,500	598%
I-695 Outer Loop: I-70/MD 122 to Windsor Mill Rd	Extend I-70 WB to I-695 NB acceleration lane by 500 ft. Extend MD 122 to I-695 NB accel lane by 1,250ft. Requires restriping of I-695, widening to accommodate accel lane and construction of retaining wall.	$26,665	$13,300	$1,330	$14,630	182%

Step 4: Assessment



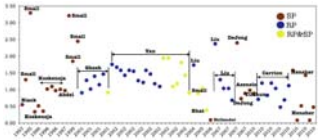
Initial Lessons Learned

- Many Project DM Processes Involved
- Travel Time Reliability Becoming Increasingly Popular Performance Measure
- TTR Used in One Current Project Prioritization Process

Methodology to Select VTTR

- Survey Based Methods
- Literature Review
- Real Options (PSRC, L11, L17)

Source: KiM Netherlands Report (2013)



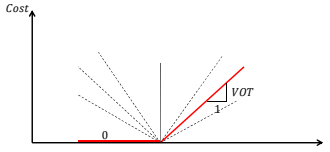
Source: Carrion & Levinson (2012)

Overview of L11

L11	Criticisms
Analogy: Premium set for an insurance policy on guaranteed speed levels	Speed is not directly related to travel cost; therefore **speed can not be discounted**!
Requirement: Speed is log-normally distributed	What if speed/travel time is not **log-normally** distributed?
Solution: Closed form Black-Scholes	Black box approach: • What is the **riskless interest rate** and how it should be set? • Why slowest speed used to specify the **length of option**?

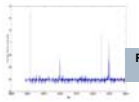
Deviation from ETA

- Cost=max[VOT*(Travel Time – ETA),0]
- Any other function can be adopted!
  - Socio-economic attributes
  - Trip purpose
  - Time of day

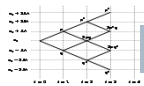


Data Driven Approach

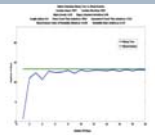
Travel Time from Detectors



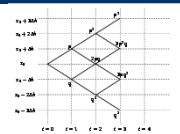
Random Walk – Ups and Downs of TT with binary probabilities

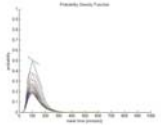


Value of Certainty Equivalent from Convergence of Binary Trees and Black-Scholes

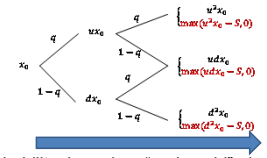


Random Walk & Binary Tree



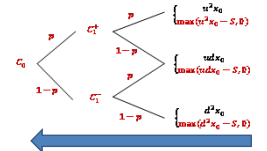


Forward Time Binary Tree Construction



q: probability based on "real-world" observations

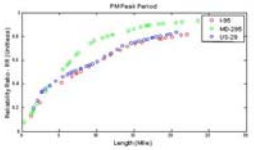
Backward Time Reliability Valuation



p: probability replicating "artificial" riskless/reliable/certain conditions

Case Studies

- US-29/I-95/MD-295
  - Direction
    - Northbound
    - Southbound
  - Peak Period
    - AM
    - PM



The ratio of the Value of Reliability (VOR) to the Value of Travel (VOT) time, known as the Reliability Ratio (RR) ranges from 0.3 to 0.8 for distances of about 2.5 to 25 miles for the PM Peak period – pretty consistent with literature values of about 0.3 to 1.5