

# Application of CMAP's Pricing Model for IL-53/120

Matt Stratton

Parsons Brinckerhoff

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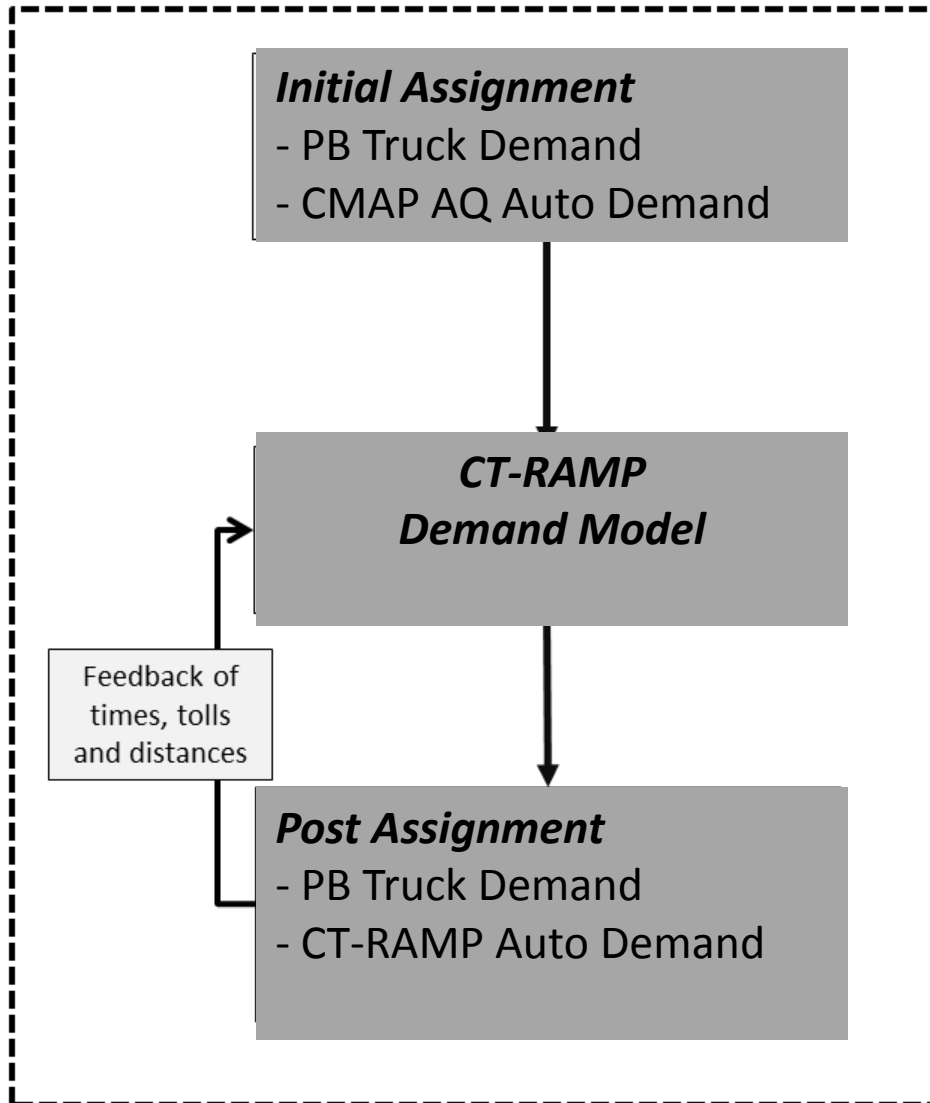
# IL-53/120 Extension

- Context
- BRAC (2011-2012)
  - Blue Ribbon Advisory Council
- Feasibility Study
  - 2013-2015
  - Modeling Task
    - *Traffic and Revenue forecasts for Bonding Capacity*



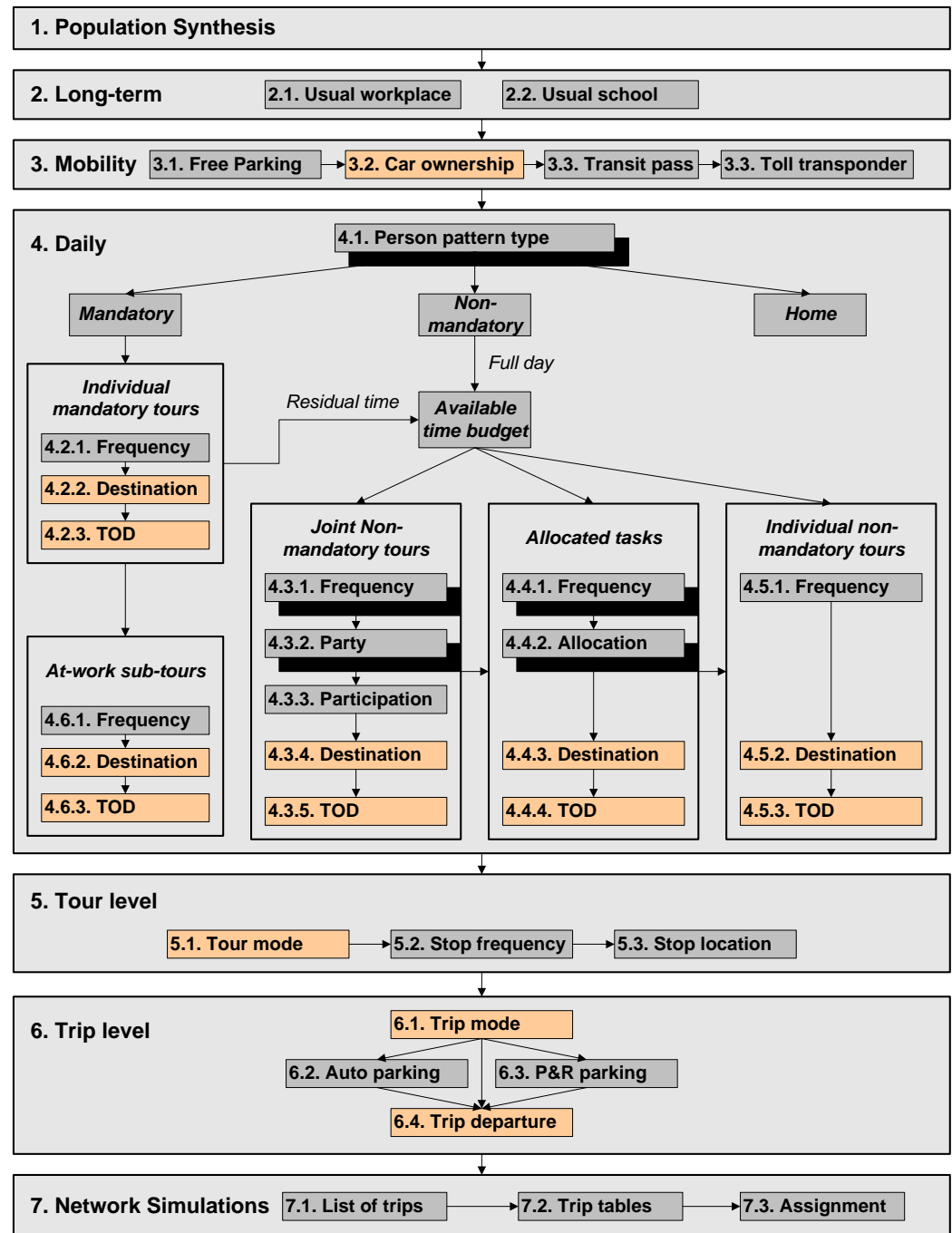
# Model Background

- CMAP Pricing Model (2011)
  - Integrated Model System
    - CT-RAMP demand model
      - Coordinated **T**ransport **R**egional **A**ctivity-based **M**odeling **P**latform (Java)
    - Highway Assignments & Skimming
      - Handles route choice for trucks, externals, & airport traffic (EMME)
  - Previous applications
    - CMAP Congestion Pricing Campaign (2012)
    - I-90 Tollway (2012)



Model Re-estimated for  
CMAP Pricing Model

- Auto ownership model
- Destination choice models
- Time-of-day choice models
- Mode choice models



# CT-RAMP Person Types

PERSON-TYPE	AGE	WORK STATUS	SCHOOL STATUS
Full-time worker	18+	Full-time	None
Part-time worker	18+	Part-time	None
Non-working adult	18 – 64	Unemployed	None
Non-working senior	65+	Unemployed	None
College student	18+	Any	College +
Driving age student	16 – 17	Any	Pre-college
Non-driving student	6 – 16	None	Pre-college
Pre-school	0 – 5	None	None

# Route Type Choice

- Binary choice
  - Toll vs. non-toll
- Explicit modeling of toll users at OD level
- Accounts for toll bias
- Allows for VOT variation/segmentation beyond 12 assignable classes

# Multi-Class Assignment

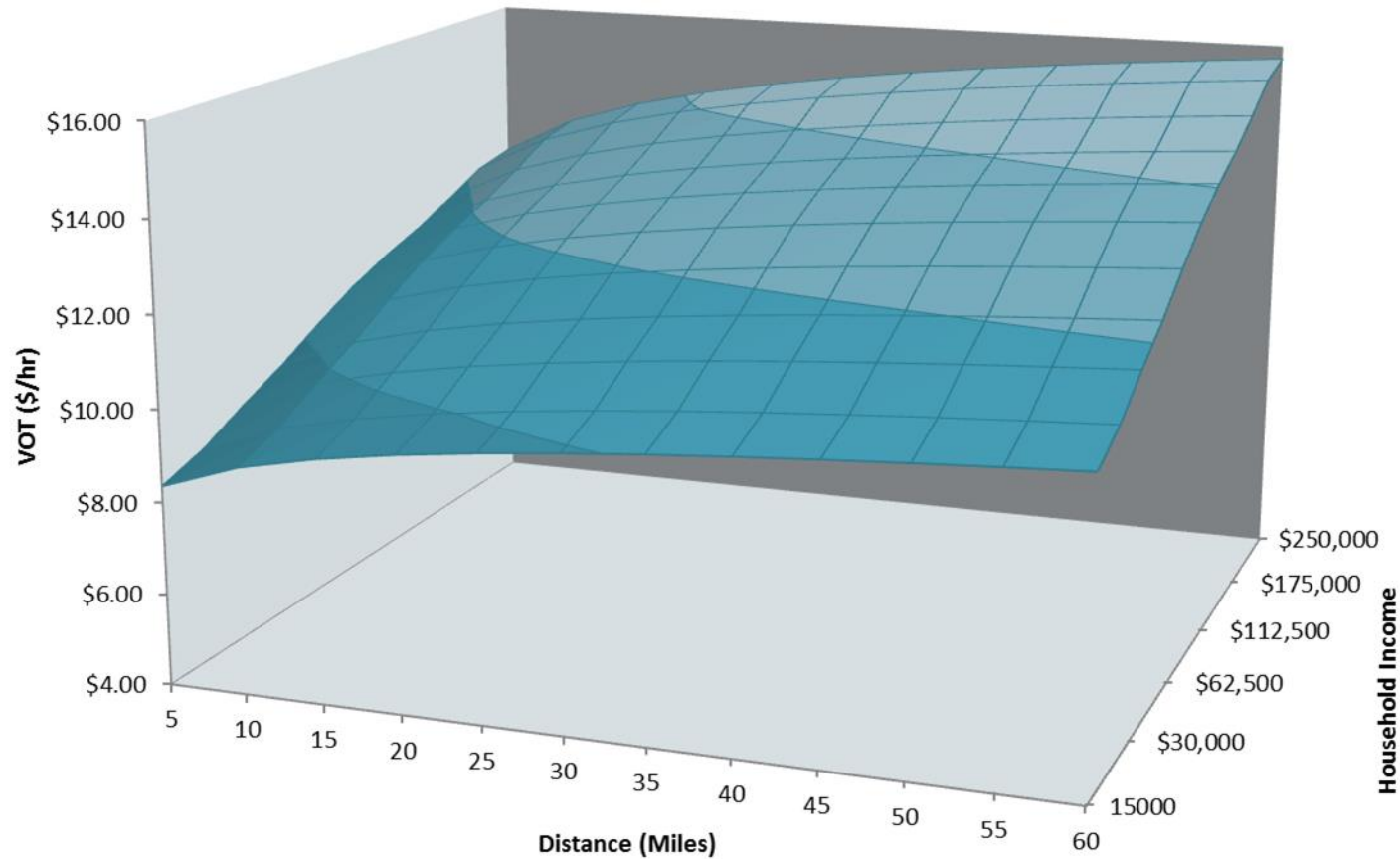
Vehicle Type & Value-Of-Time	Non-toll SOV	Non-toll HOV2	Non-toll HOV3+	Toll SOV	Toll HOV2	Toll HOV3+
Auto + external + airport low & high VOT	1	3	5	2	4	6
Commercial + light truck	7			8		
Medium truck	9			10		
Heavy truck	11			12		



# Value of Time

- VOT by travel purpose & person type
- Car occupancy accounts for cost sharing
  - $VOT(HOV2) = 1.6 * \max(\text{individual VOT})$
  - $VOT(HOV3+) = 2.3 * \max(\text{individual VOT})$
- Static assignment & VOT
- RSG Tollway User Survey

# RSG Tollway User Survey



# Study Area Validation

Volume Range (AADT)	# of Records	Observed Traffic	Modeled Traffic	Ratio Modeled / Observed	PRMSE
0-10,000	4,628	21,493,850	30,427,702	1.42	0.89
10,000-20,000	1,589	22,247,950	26,761,036	1.20	0.45
20,000-30,000	189	4,253,550	4,765,018	1.12	0.40
30,000-40,000	53	1,848,000	2,023,678	1.10	0.29
40,000-50,000	34	1,560,150	1,441,106	0.92	0.26
50,000-70,000	115	7,000,150	6,613,894	0.94	0.31
70,000-100,000	81	6,213,200	5,636,560	0.91	0.29

# Traffic Validation by Toll Plaza

Toll Facility	Plaza ID	Location	Type	Traffic (2010)			
				Observed Auto	Modeled Auto	Observed Truck	Modeled Truck
TRI	21	Waukegan	Mainline	51,062	54,707	14,193	15,126
TRI	22	Townline Rd IL 6	Ramp	10,527	16,229	396	436
TRI	23	Half Day Rd.	Ramp	10,551	19,871	305	694
TRI	24	Edens Spur	Mainline	46,179	47,181	4,570	5,097
TRI	26	Lake-Cook	Ramp	18,433	24,125	823	496
TRI	27	Willow	Ramp	16,734	23,397	921	839
TRI	28	Golf	Ramp	16,975	27,045	581	771
TRI	29	Touhy	Mainline	80,557	82,361	9,105	10,135
JA	9	Elgin	Mainline	81,121	64,940	13,293	15,047
JA	13	IL 25	Ramp	6,194	5,717	406	185
JA	16	Beverly Rd	Ramp	12,909	3,175	874	123
JA	14	IL 59	Ramp	9,550	20,177	544	904
JA	12	Roselle Rd	Ramp	11,402	11,884	269	426
JA	15	I-290 to IL 53	Ramp	32,735	11,721	3,857	4,591
JA	18	Arlington Heights	Ramp	23,191	24,970	1,933	873
JA	17	Devon	Mainline	86,425	81,316	7,462	3,551
JA	19	River	Mainline	66,365	61,368	3,447	3,327
VM	73	Army Trail	Mainline	108,372	105,529	9,262	6,510
VM	75	North Avenue	Ramp	26,531	32,644	3,634	1,673
VM	77	Roosevelt Rd	Ramp	14,946	16,908	486	895
VM	89	Boughton Rd	Mainline	110,412	116,199	12,168	11,848

# Revenue Validation by Toll Plaza

Toll Facility	Plaza ID	Location	Type	Revenue (2010 \$)			
				Observed Auto	Modeled Auto	Observed Truck	Modeled Truck
TRI	21	Waukegan	Mainline	\$ 38,297	\$ 41,030	\$ 48,578	\$ 50,077
TRI	22	Townline Rd IL 6	Ramp	\$ 2,632	\$ 4,057	\$ 352	\$ 443
TRI	23	Half Day Rd.	Ramp	\$ 2,638	\$ 4,968	\$ 212	\$ 703
TRI	24	Edens Spur	Mainline	\$ 23,090	\$ 23,591	\$ 9,796	\$ 10,744
TRI	26	Lake-Cook	Ramp	\$ 9,217	\$ 12,062	\$ 1,409	\$ 1,001
TRI	27	Willow	Ramp	\$ 8,367	\$ 11,699	\$ 1,725	\$ 1,679
TRI	28	Golf	Ramp	\$ 8,488	\$ 12,379	\$ 992	\$ 1,414
TRI	29	Touhy	Mainline	\$ 40,279	\$ 41,180	\$ 19,117	\$ 21,309
JA	9	Elgin	Mainline	\$ 32,448	\$ 25,976	\$ 23,315	\$ 26,913
JA	13	IL 25	Ramp	\$ 1,858	\$ 1,715	\$ 445	\$ 226
JA	16	Beverly Rd	Ramp	\$ 3,873	\$ 953	\$ 1,006	\$ 158
JA	14	IL 59	Ramp	\$ 1,433	\$ 4,039	\$ 286	\$ 724
JA	12	Roselle Rd	Ramp	\$ 2,851	\$ 2,971	\$ 205	\$ 434
JA	15	I-290 to IL 53	Ramp	\$ 4,910	\$ 1,758	\$ 2,477	\$ 2,800
JA	18	Arlington Heights	Ramp	\$ 5,798	\$ 6,243	\$ 1,857	\$ 883
JA	17	Devon	Mainline	\$ 34,570	\$ 32,526	\$ 11,926	\$ 5,672
JA	19	River	Mainline	\$ 26,546	\$ 24,547	\$ 4,942	\$ 5,361
VM	73	Army Trail	Mainline	\$ 54,186	\$ 52,764	\$ 17,983	\$ 13,216
VM	75	North Avenue	Ramp	\$ 10,612	\$ 13,057	\$ 5,396	\$ 2,680
VM	77	Roosevelt Rd	Ramp	\$ 5,231	\$ 5,918	\$ 534	\$ 1,298
VM	89	Boughton Rd	Mainline	\$ 55,206	\$ 58,099	\$ 24,713	\$ 24,927

# Network Scenarios

- Alternative 1
  - BRAC Preference
  - 4 lanes @ 45 mph
- Alternative 2
  - 4 lanes @ 55 mph
- Alternative 3
  - 6 lanes @ 45 mph
- Alternative 4
  - 6 lanes @ 55 mph





# Alternative 1 Variants

- Tolls indexed to inflation
- Congestion pricing
- Congestion pricing plus indexing to inflation
- Phased construction schedule
- Toll existing IL-53
- Toll and widen existing IL-53
- Toll east end of IL-120
- 6 lane IL-53 trunk
- Variable speed limit during peak periods
- Variable speed limit during daytime
- Shoulders open during peak periods
- Toll sensitivity runs
- Revenue maximization



# Demand Model Setup

- Sampling
  - Run demand model for <100% of population
  - Reduces run times
  - 20/35/50% sampling scheme



# Debugging

- Solo child travel
- HOV travel
- Mode choice skim references
- Stop location choice sets
- Utility Expression Calculators

# Computing Setup

- Distributed Computing
- Ideal: CMAP Cluster
  - 4 machines with 128GB RAM and 12 processors
    - 1 as Main, 3 as Workers
- Functional:
  - 2 machines
    - Main: 1 machine with 64+GB RAM and 12 processors
    - Worker: 1 machine with 16+GB RAM and 8 processors
- Hyper-threading

# Run Times

- Validation/Calibration Setup
  - 1 Global Iteration
    - Pre-Skim, Demand Model @ 20%, Post-Skim
  - 11 hours using “Functional” Computing Setup
- Application Setup
  - 3 Global Iterations:
    - Pre-Skim, Demand Model @ 20%, Post-Skim
    - Demand Model @ 35%, Post-Skim
    - Demand Model @ 50%, Post-Skim
  - 36 hours using “Functional” Computing Setup

# Lessons Learned

- Validation/Calibration takes a long time; Application takes longer
- Key Levers
  - Value of Time
  - Tour Frequency
  - Destination Choice
- Get more lead time for model runs
  - 6 model runs per week makes for tight schedule
- Build more detailed network and zone system