SIO
SYSTEMS IMPLEMENTATION OFFICE

STATEWIDE MULTIMODAL ACCESS MANAGEMENT AND TRANSPORTATION SITE IMPACT

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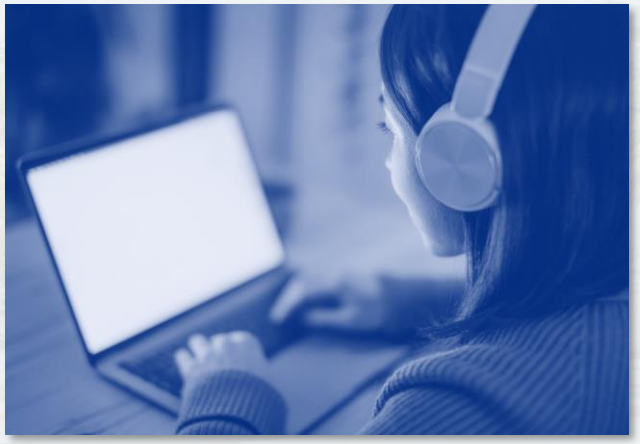
WEBINAR SERIES 2023-2024

FDOT

Agenda



CREDITS AND WEBINAR MATERIAL

TRIP GENERATION RESEARCH ON HIGH-VOLUME FAST-FOOD RESTAURANTS AND COFFEE SHOPS

CONTACT INFO

Webinar Staff

FLORIDA DEPARTMENT OF TRANSPORTATION

Gina Bonyani

Systems Implementation Office
SYSTEMS IMPLEMENTATION OFFICE
Gina.Bonyani@dot.state.fl.us

850-414-4725

FLORIDA DEPARTMENT OF TRANSPORTATION

Drew Roark, PE, CTL

ALEX ROARK ENGINEERING
Drew@alexroarkeng.com

FLORIDA DEPARTMENT OF TRANSPORTATION

William E. Oliver, PE, PTOE

ALEX ROARK ENGINEERING
Bill@weo-pe.com

Credits Information

Certificates will be distributed through email.

Your participation will be recorded by GoToWebinar.

- You will need to attend to the entire webinar with the unique link provided by GoToWebinar.

STATEWIDE MULTIMODAL ACCESS MANAGEMENT AND TRANSPORTATION SITE IMPACT WEBINAR SERIES 2023-24

FLORIDA DEPARTMENT OF TRANSPORTATION

This certifies that

Name Last Name

has successfully completed the

Webinar #1

Course Number: XXXX
FBPE Provider number: XXXXXXX
Presented on: XX/XX/XX

And has qualified for 1.5 CE credits

SIO SYSTEMS IMPLEMENTATION OFFICE

Signature of approval authority

FDOT

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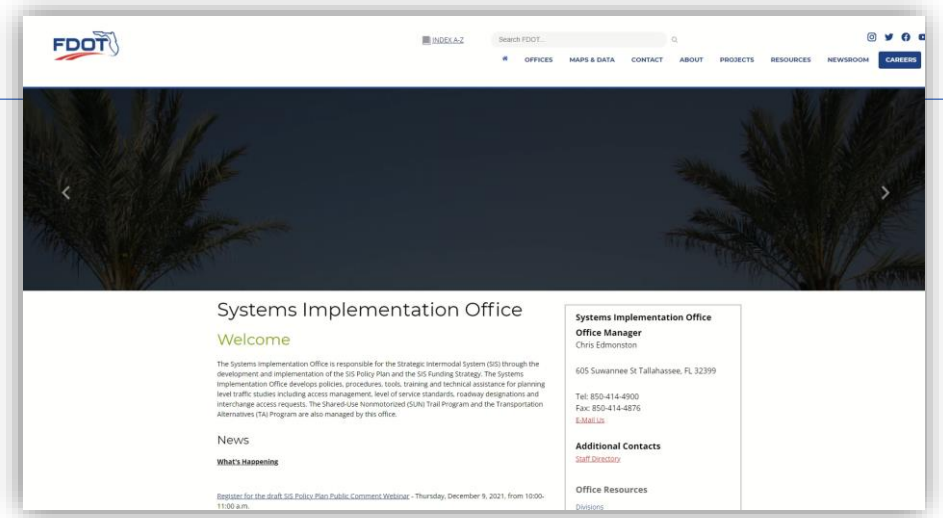
Webinar Material

Recorded webinars and presentation material will be posted on the Systems Implementation Office website:

https://www.fdot.gov/planning/systems/systems-management/trainings-webinars



What organization do you represent?

FDOT

Local Government

Private Firm

Other

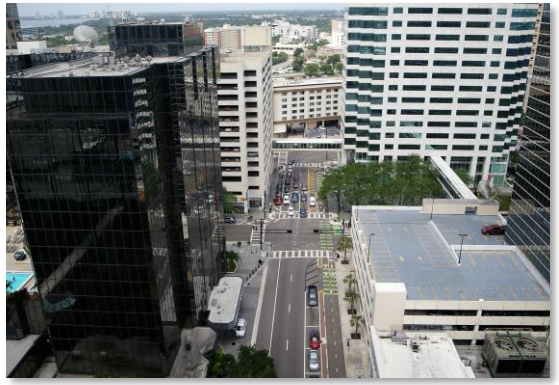
Statewide Multimodal Access Management And Transportation Site Impact

WEBINAR SERIES 2023-2024

Webinar #1

Multimodal Site Impact Analysis

Tuesday, August 15, 2023



Webinar #2

Multimodal Quality Level of Service

Tuesday, November 14, 2023

Webinar #3

Multimodal Access Management

Tuesday, February 20, 2024

Webinar #4

Trip Generation Research on High-Volume Fast-Food Restaurants and Coffee Shops

Tuesday, May 21, 2024

Important: Next Webinar Series will be announced through Contact Mailer.

Statewide Multimodal Access Management And Transportation Site Impact

WEBINAR SERIES 2023-2024

Today's Webinar

Trip Generation Research on High-Volume Fast-Food Restaurants and Coffee Shops

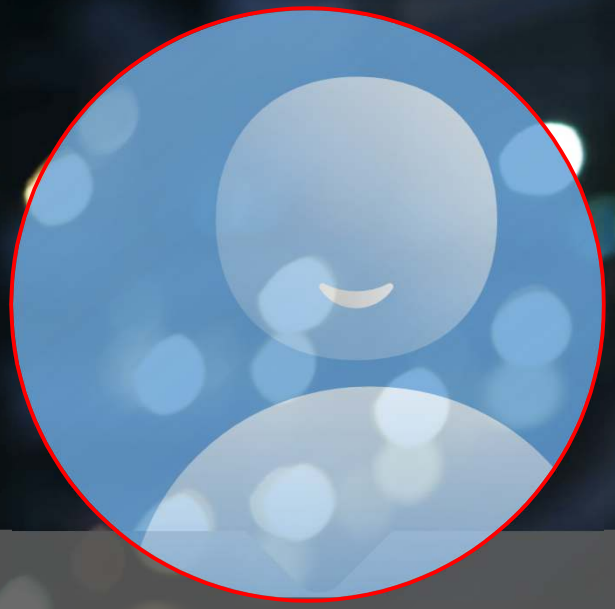
Tuesday, May 21, 2024
2:00PM – 3:30PM

How familiar are you with the Institute of Transportation Engineers (ITE) Manual?

VERY FAMILIAR

SOMEWHAT FAMILIAR

NOT FAMILIAR



TRIP GENERATION STUDY FOR COFFEE SHOP WITH DRIVE-THROUGH AND FAST FOOD WITH DRIVE-THROUGH

UPDATE

- PM: Gina Bonyani – FDOT
- PI: Drew Roark, PE, CTL, *Alex Roark Engineering*
- Bill Oliver, PE, *W.E. Oliver, P.E., LLC*

- Contract Number: BEF47

Presentation Outline

- Background/Objectives
- Benefits
- Scope
- Tasks 1-6
- Updates & Lessons (so far)
- Timeline
- Questions

Project Objectives

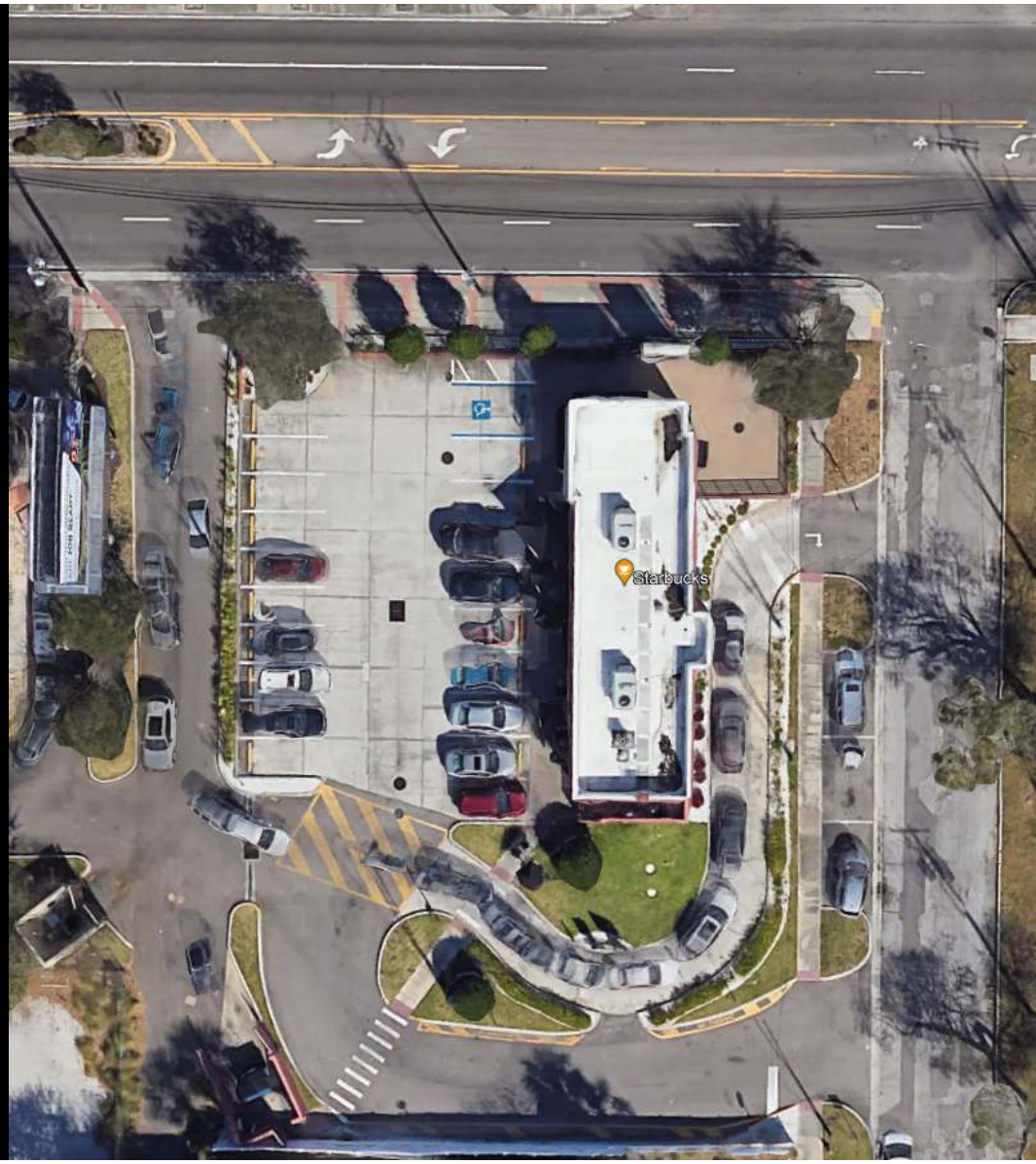
Project Benefits

Qualitative

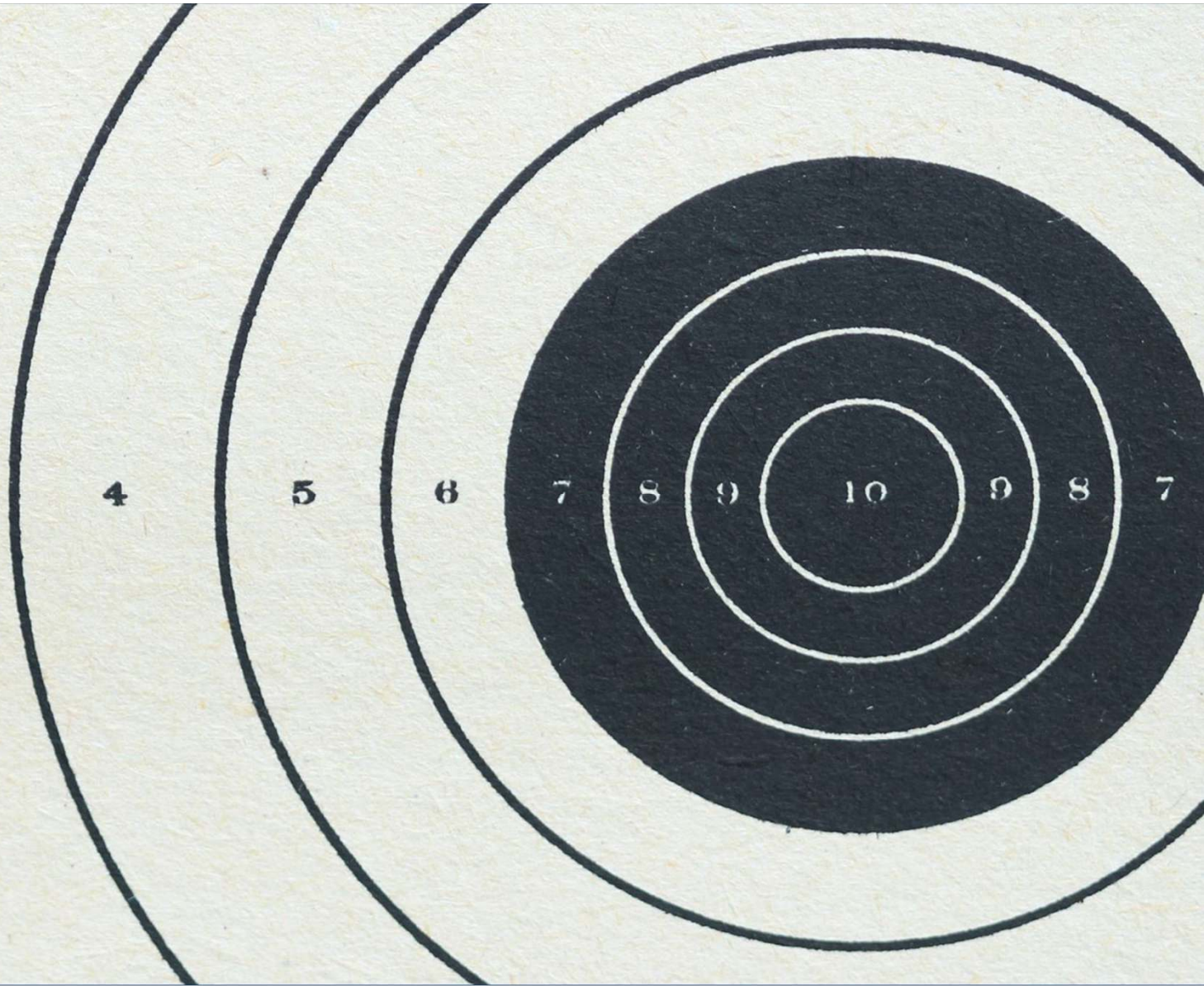
- A better understanding of trip generation and operational characteristics of these land uses in varying situations.

Quantitative

- Specific requirements for approval (or denial) of new driveway permits for these land uses.

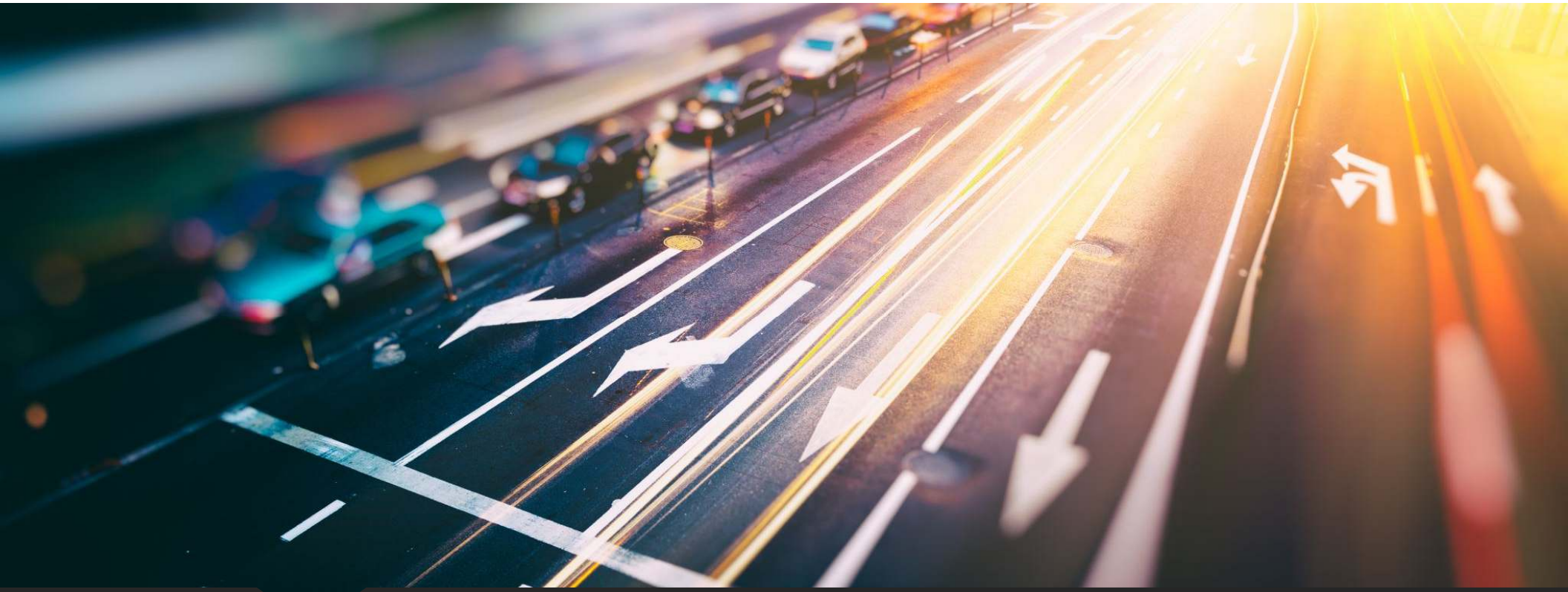


Scope



Task 1 – Literature Review

Task 2 – Site Selections



Task 3 – Traffic Data Collection

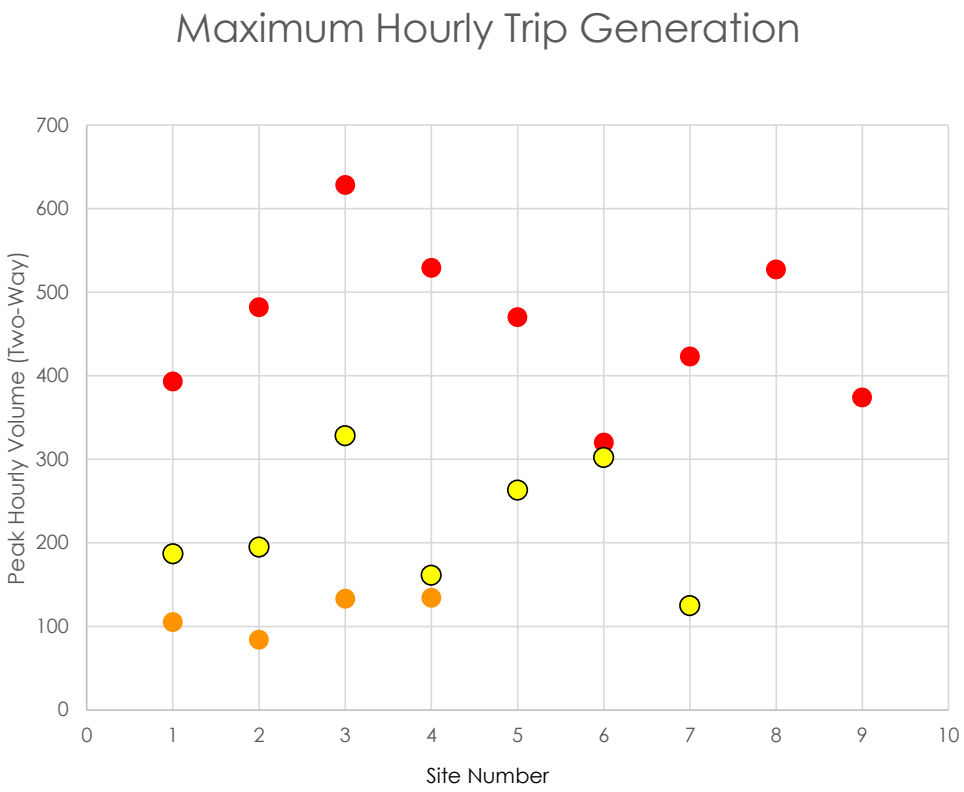
Just the Facts

- For fast food restaurants we sampled 2,347 vehicles utilizing the drive through
- A total of approximately 24,000 vehicles (roughly 10%)
- Coffee shops included 1,157 samples in the drive through
- Generally recorded information:
  - Time of arrival at order station
  - Time order was completed
  - Time vehicle arrived at payment station (if applicable), and if the vehicle was "inhibited" by a vehicle ahead
  - Time payment transaction was completed (if applicable)
  - Time of arrival at pickup station (in some cases, this would be the time an attendant brought the order to the vehicle), and if the vehicle was "inhibited" by a vehicle ahead
  - Time of departure from the pickup lane

Task 4 – Data Analysis

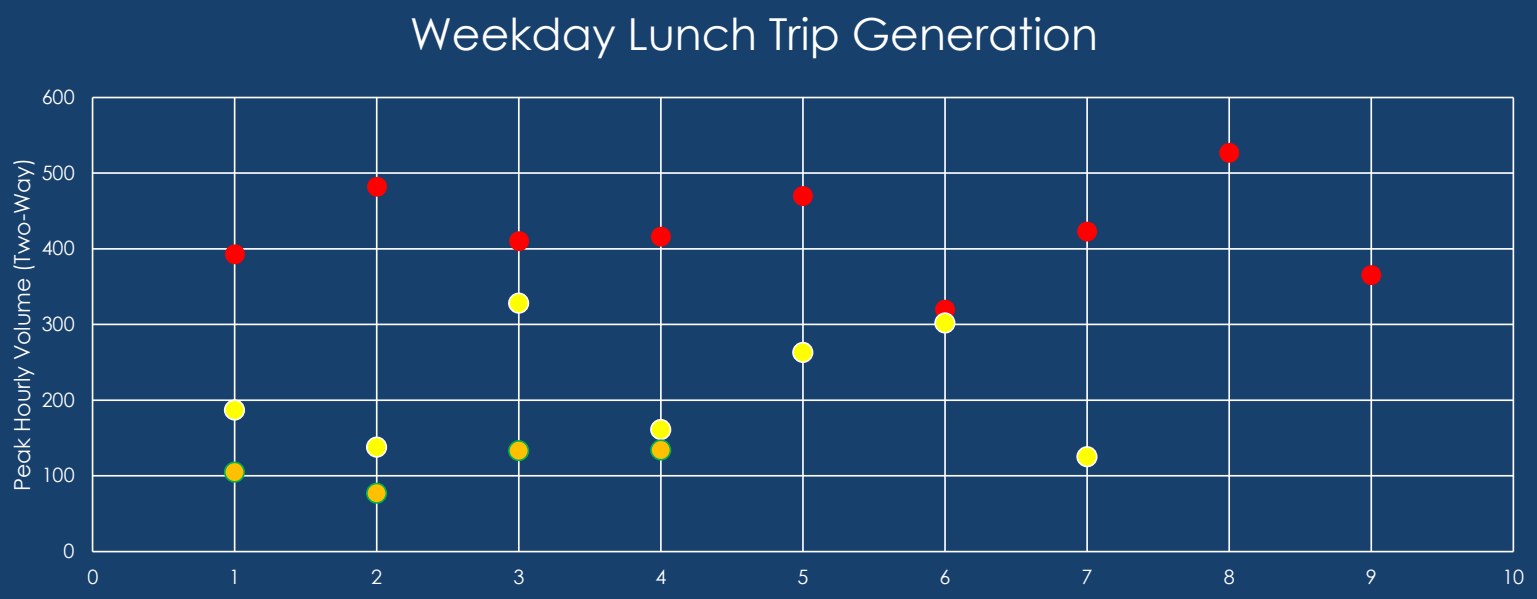
Conditions We Saw

- Demands are higher than historically seen.
- At Fast-Food average 60% (range 25% to 95%) of entering vehicles use drive-through.
- At Coffee/Donut Shops average 62% (range 26% to 85%) of entering vehicles use drive-through .
- Some use of internet ordering in advance.
- Multi-lane ordering, multi-lane pickup operations.

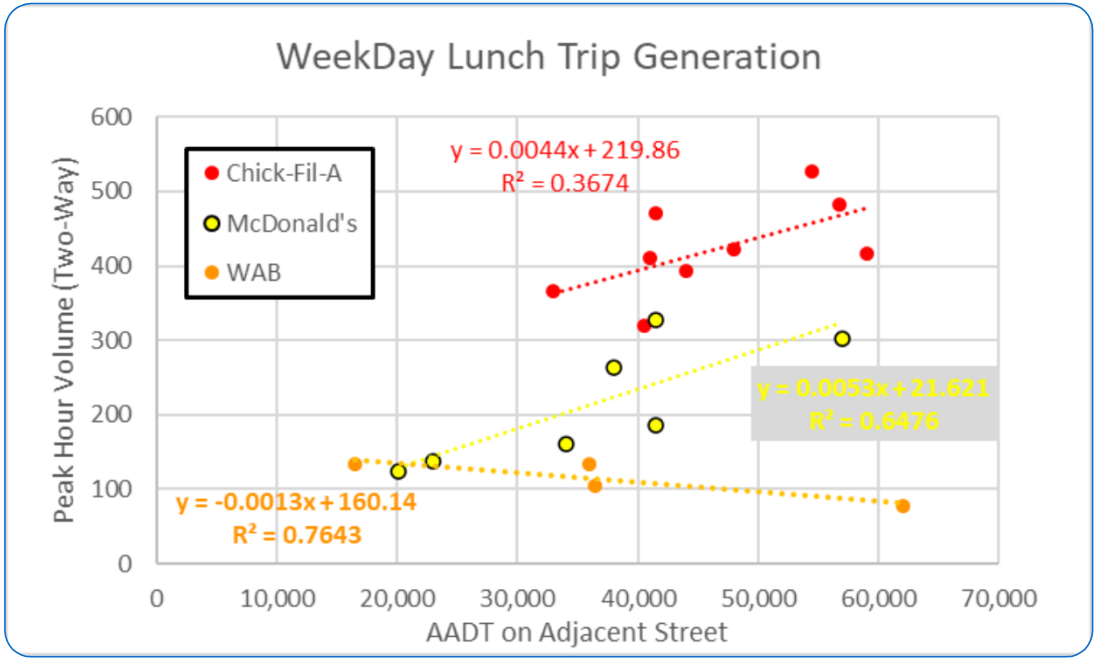


Actual Trip Generation

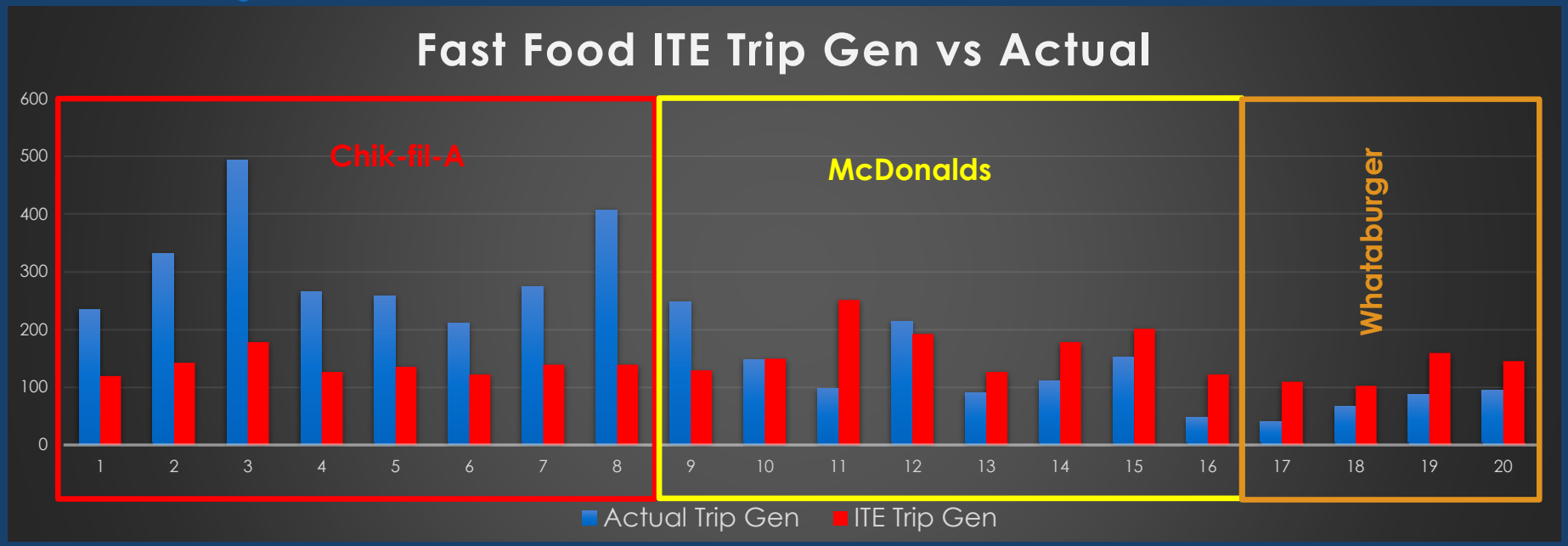
Weekday Lunch (highest) Trip Generation



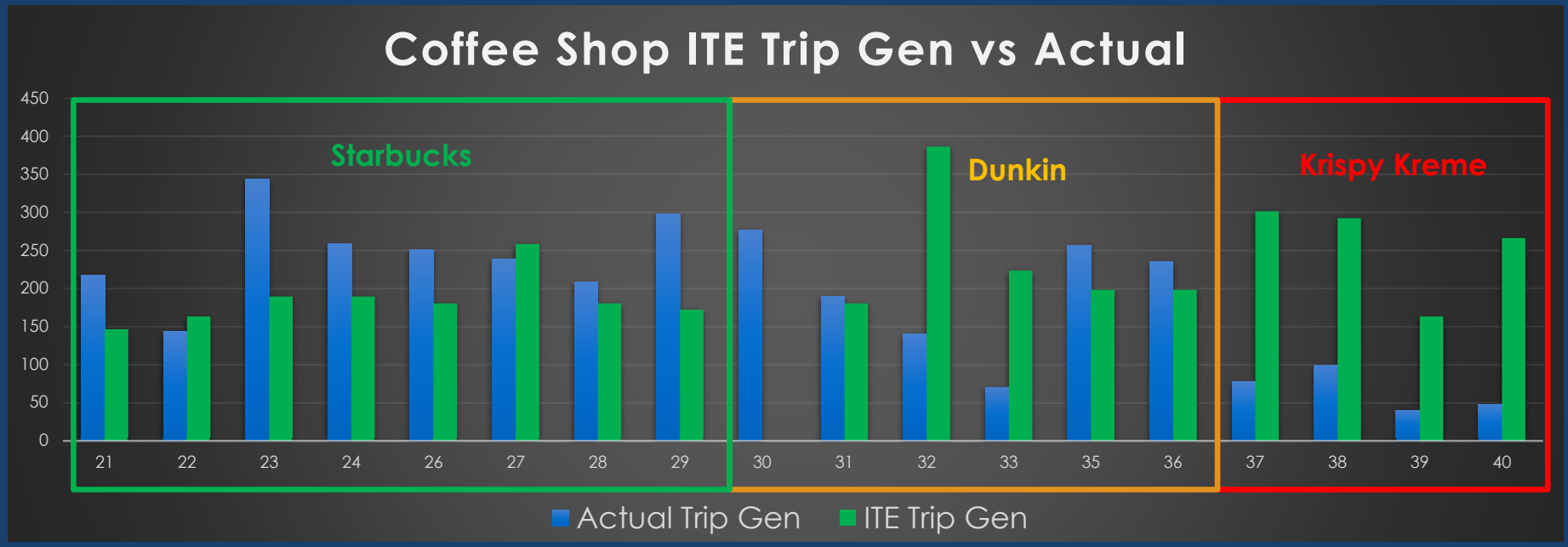
Weekday Lunch (highest) Trip Generation



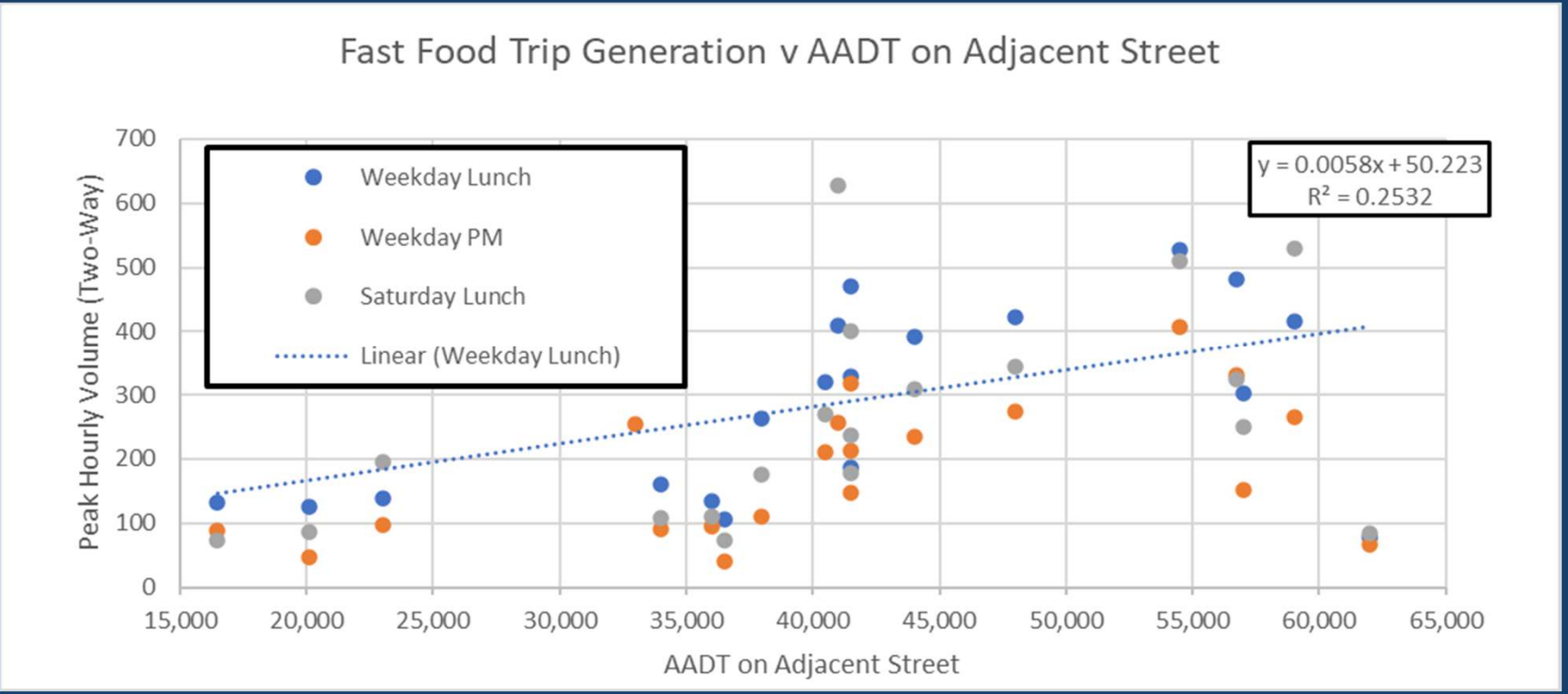
ITE vs. Actual – Fast Food



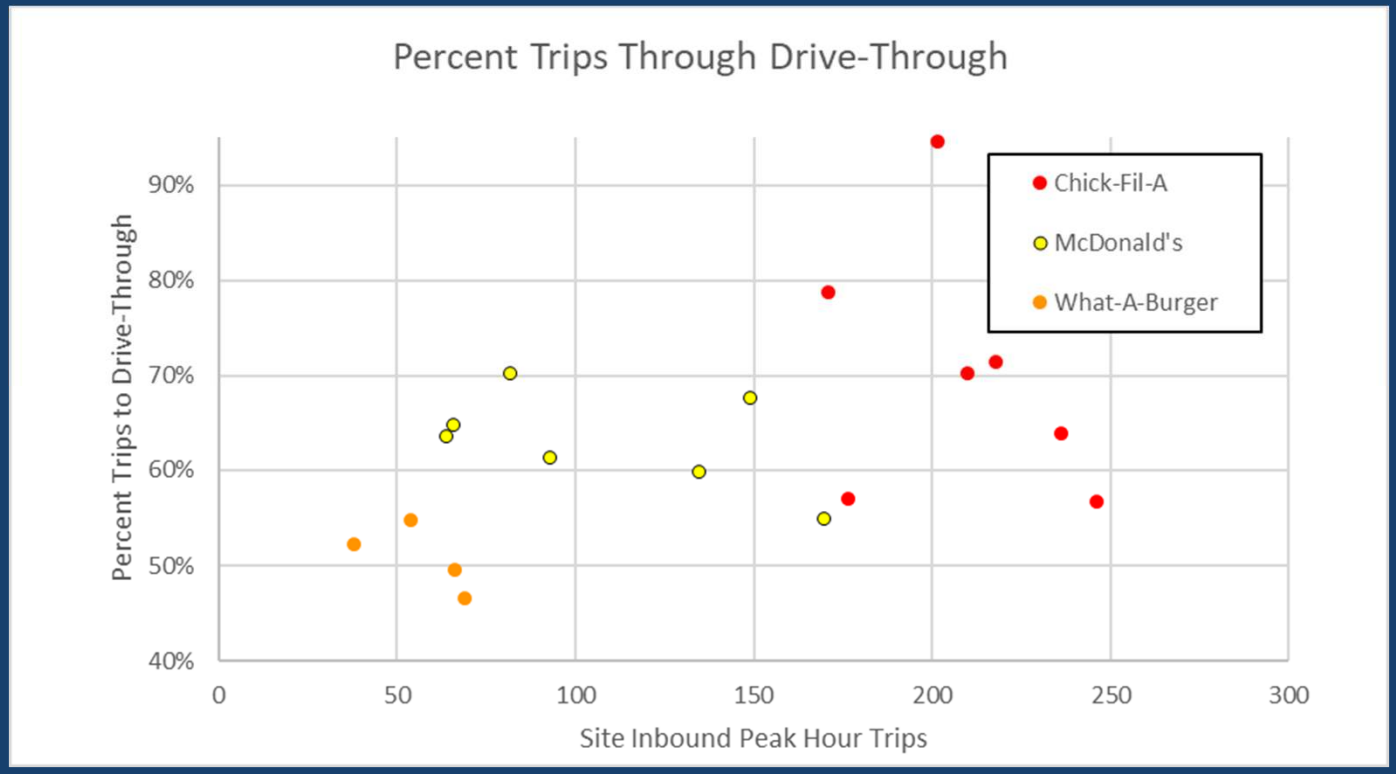
ITE vs. Actual – Coffee Shop



Is Adjacent Street Volume a Better Independent Variable?



Queueing – Drive-Through Usage



How To Estimate Queue Length

Queue lengths depend on three factors:

- Rate and duration of arrivals (e.g. trip generation). More arrivals, longer queues.
- Rate at which orders are filled and vehicles depart. Faster rate shortens queues.
- Lengths of vehicles in queue.

How to Estimate Queue Length

Arrival Rates

- At Fast-Food Restaurants ranged from 40 To 628 veh/hr, averaged 245
- At Coffee-Donut Shops ranged from 22 To 485 veh/hr, averaged 199

Service Rates

- At Fast-Food Restaurants ranged from 21 To 205 veh/hr, averaged 86
- At Coffee-Donut Shops ranged from 33 To 107 veh/hr, averaged 73

Conclude: Different restaurants have different operating styles. These parameters even vary within store brands. **Cannot generalize**.

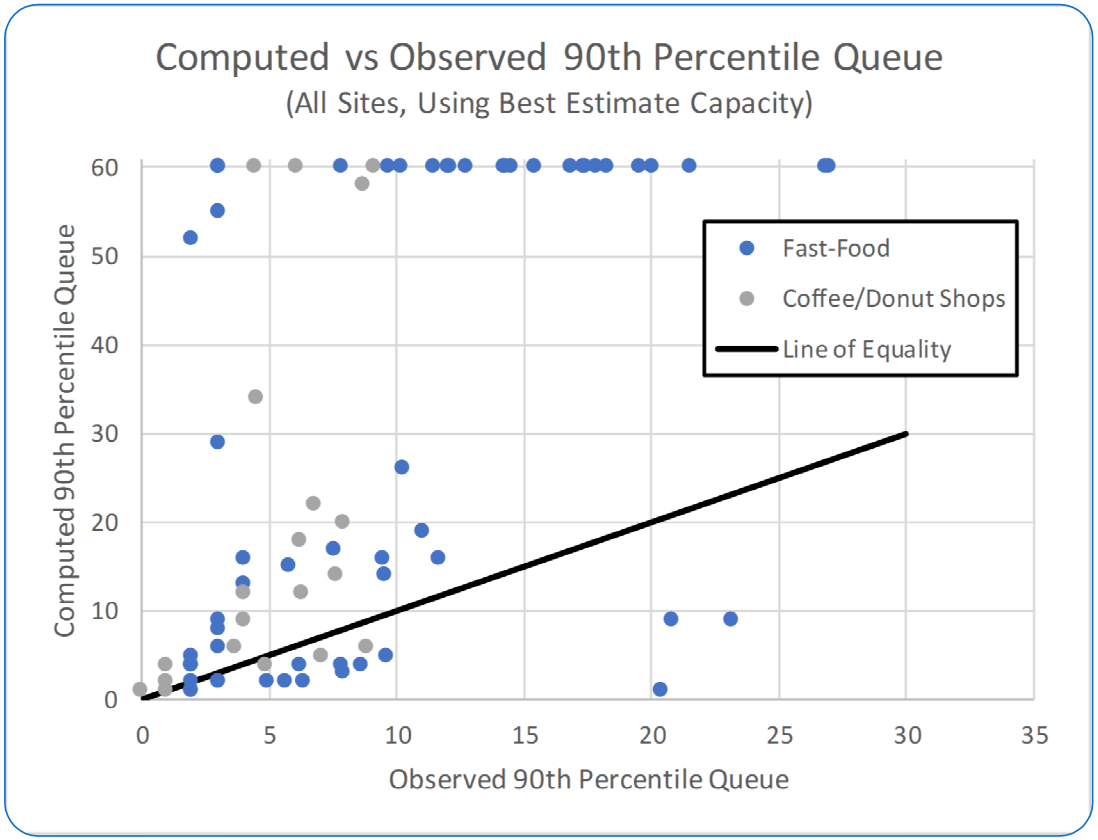
How to Estimate Queues

We tried different methods:

- Applied classical equations
- Applied micro-simulation

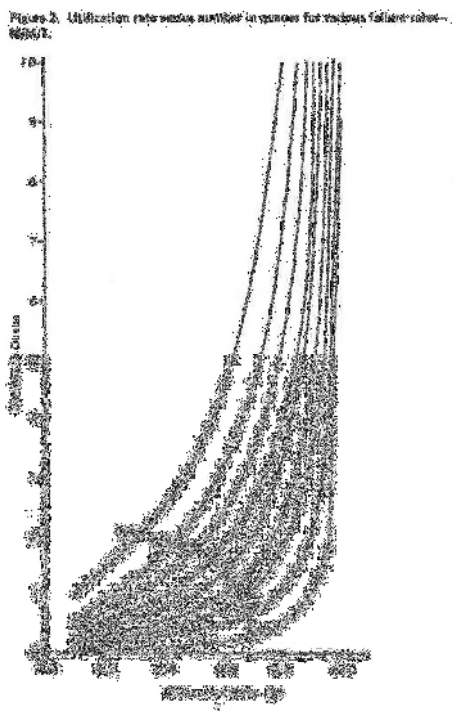
Application of Classical Equations

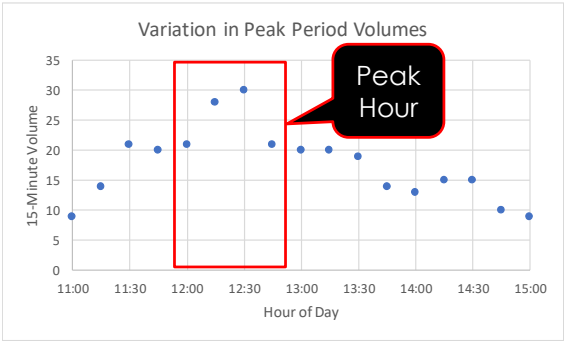
RMS error > 30.24



Classical Equations Don't Do a Good Job

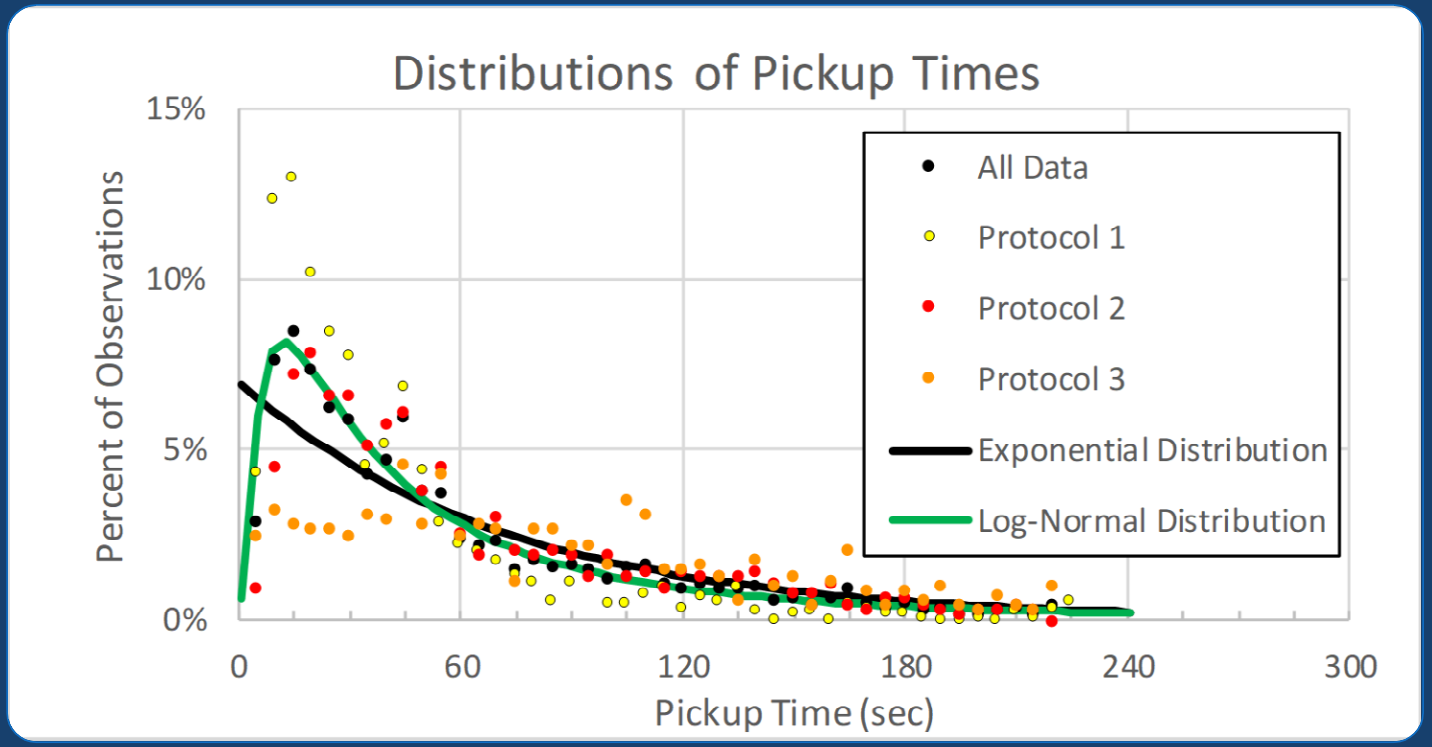
As volume:capacity ratios approach 1.00, queues increase exponentially. For queues to increase exponentially, vehicles need to arrive exponentially. But demands fall off after the peak period, and queues dissipate.

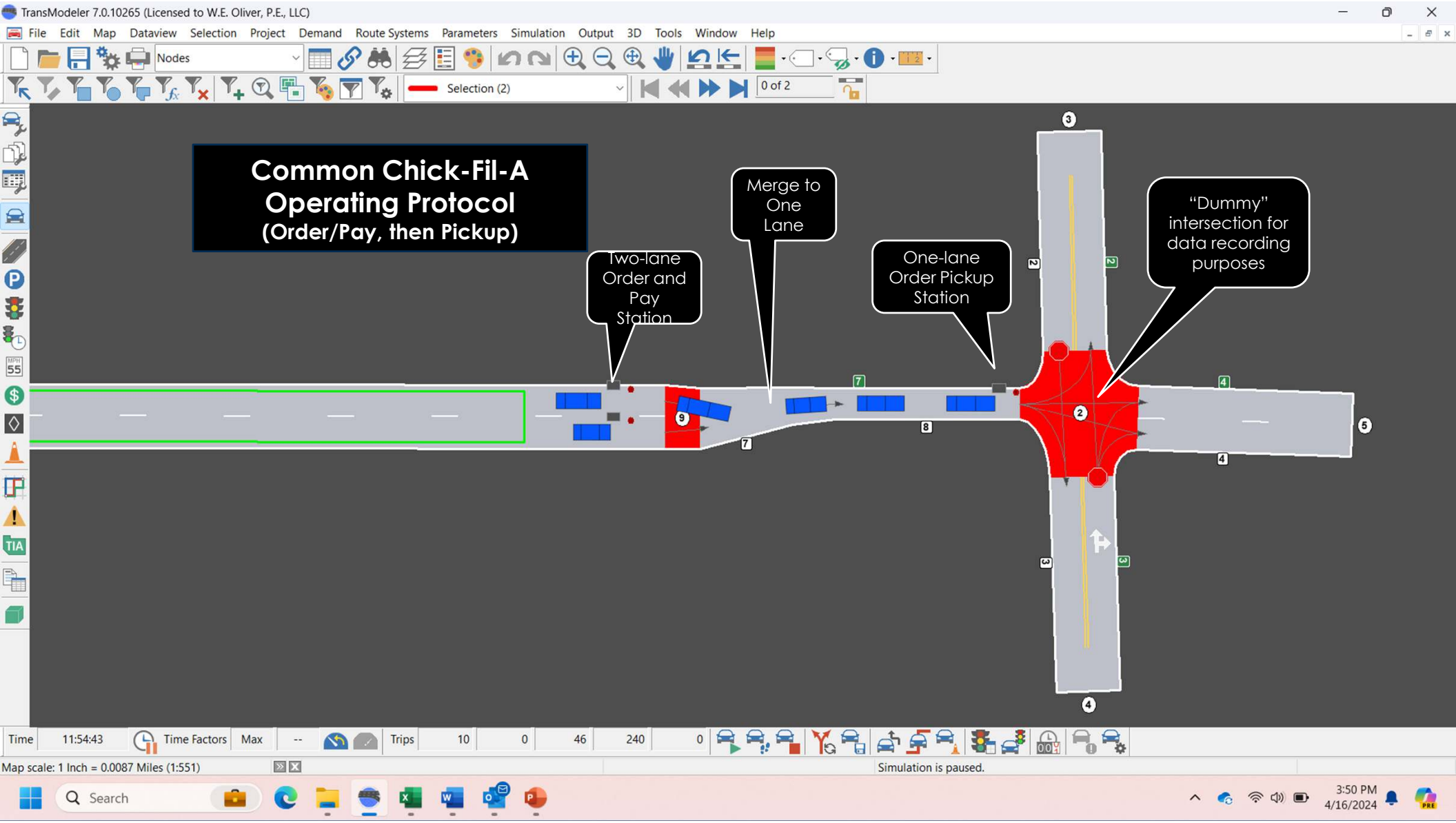


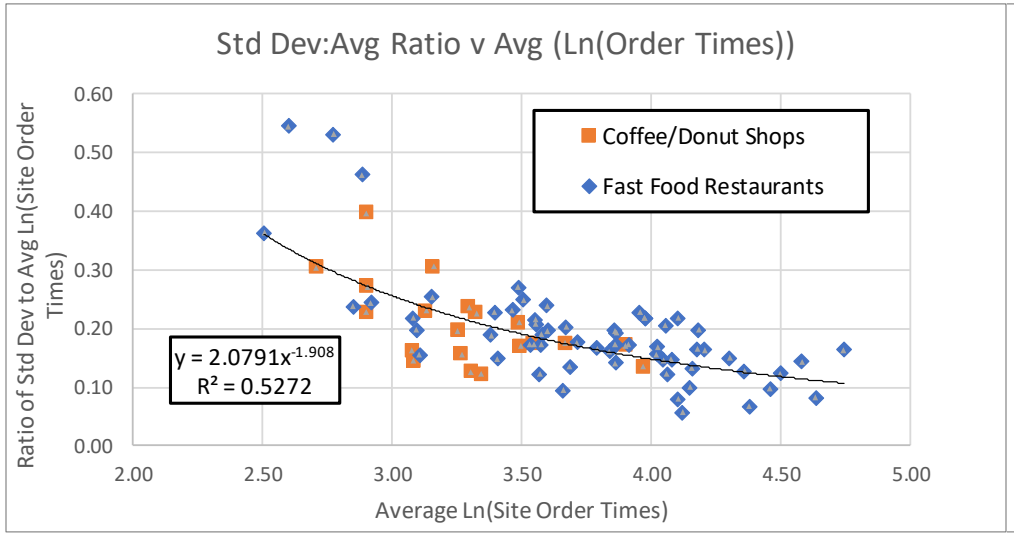


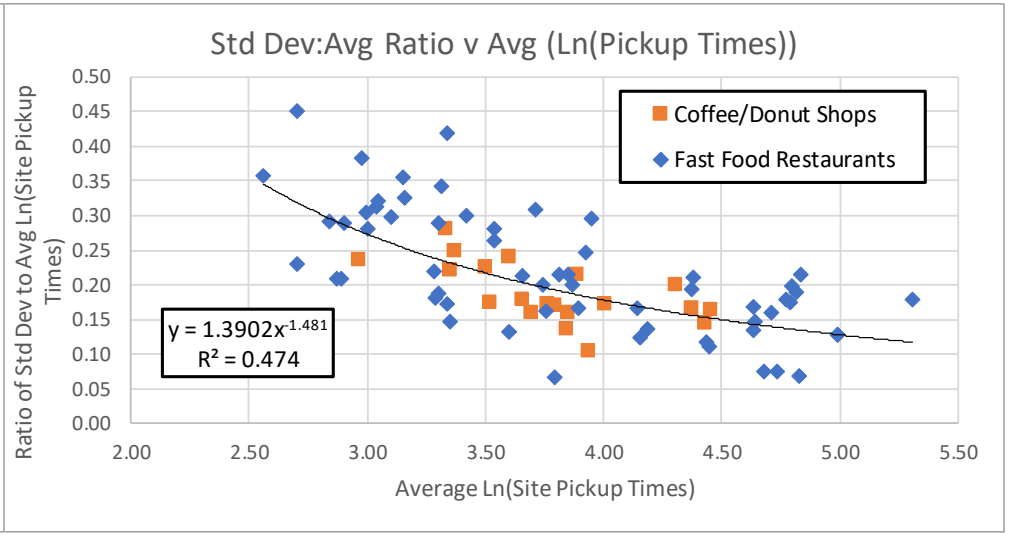
Classical Equations Don't Do a Good Job

- They are based on a "negative exponential" distribution of service times, actual service times follow a "log-normal" distribution.




TransModeler 7.0.10265 (Licensed to W.E. Oliver, P.E., LLC)
File Edit Map Dataview Selection Project Demand Route Systems Parameters Simulation Output 3D Tools Window Help
Nodes
Selection (2)
0 of 2
Common Chick-Fil-A Operating Protocol (Order/Pay, then Pickup)
Two-lane Order and Pay Station
Merge to One Lane
One-lane Order Pickup Station
"Dummy" intersection for data recording purposes
Time 11:54:43 Time Factors Max -- Trips 10 0 46 240 0
Map scale: 1 Inch = 0.0087 Miles (1:551)
Simulation is paused.
Search
3:50 PM
4/16/2024





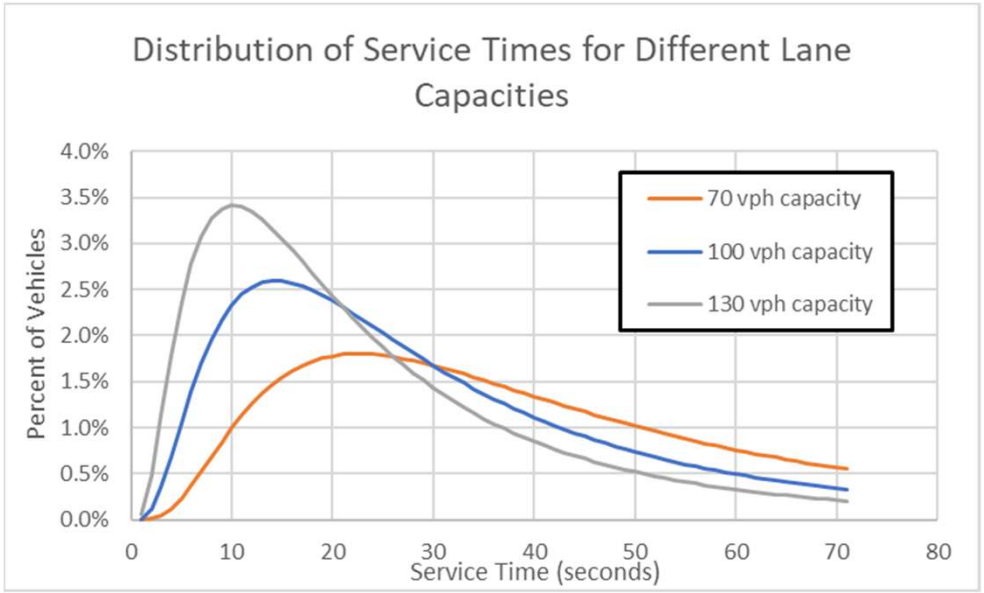
Natural Log Better Fit

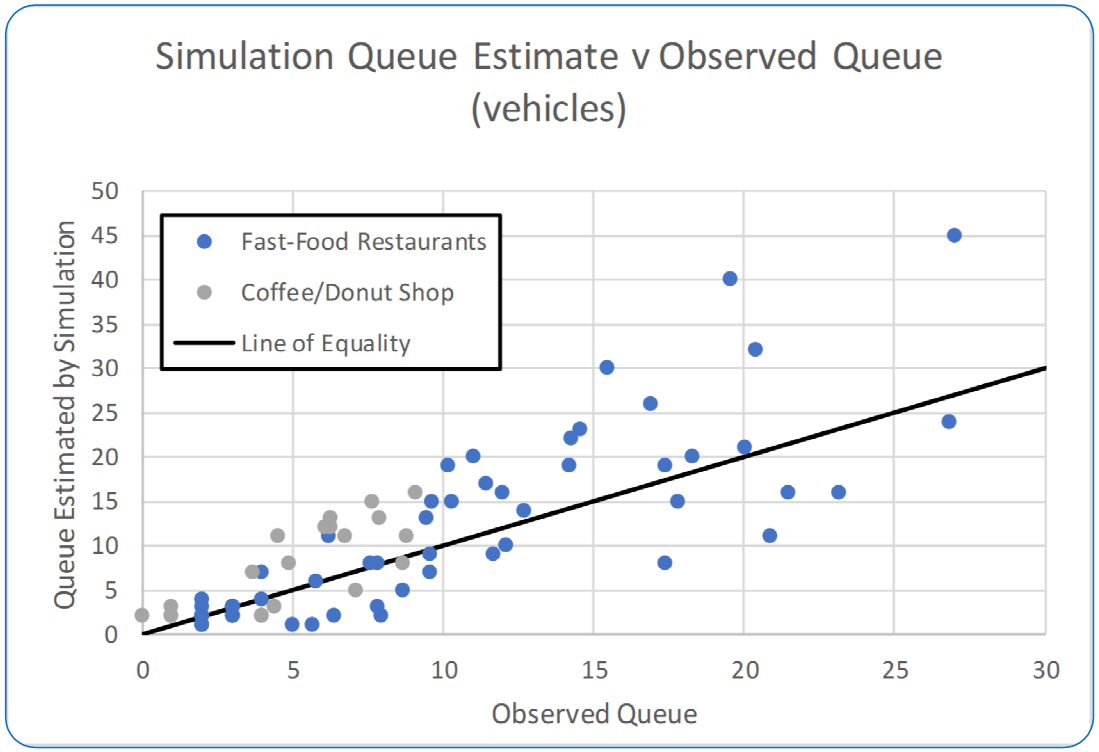
Unique, log-normally-distributed service time distributions can be entered into TransModeler

Service Time Distributions for TransModeler

			Order Times				Pickup Times			
		Average:	47.0	42.5	54.3	75.1	27.9	40.3	55.7	144.0
		Standard Dev:	34.47	41.22	38.10	65.42	25.60	37.46	45.14	118.49
		Capacity:	77	85	66	48	129	89	65	25
Trans-Modeler Table Row	Percentile	% to which Applicable	Order Time 1	Order Time 2	Order Time 3	Order Time 4	Pickup Time 1	Pickup Time 2	Pickup Time 3	Pickup Time 4
1	2%	3.5%	6.9	2.0	12.0	2.0	3.0	3.0	7.0	12.9
2	5%	4.0%	9.2	3.0	13.8	4.0	5.0	5.0	9.0	26.6
3	10%	4.5%	13.0	6.0	17.0	8.0	7.0	9.0	14.0	37.3
4	14%	5.5%	15.0	10.0	20.0	20.0	8.0	11.0	16.2	43.0
5	21%	5.5%	19.0	16.0	24.0	28.0	10.2	15.0	21.0	52.0
6	25%	6.0%	21.0	18.5	27.0	32.0	12.0	16.0	24.0	61.0
7	33%	6.5%	26.0	24.0	32.0	42.0	14.0	21.0	30.0	77.7
8	38%	5.5%	30.0	29.0	35.1	47.0	16.0	23.0	34.0	88.0
9	44%	6.0%	34.0	32.0	40.0	54.0	18.0	25.8	38.0	100.0
10	50%	6.0%	37.0	35.0	46.0	60.0	20.0	29.0	42.0	109.0
11	56%	6.0%	41.0	39.0	51.0	67.0	23.0	35.0	49.0	125.0
12	62%	5.5%	48.0	43.0	55.9	74.0	26.0	39.0	53.9	142.3
13	67%	5.5%	54.0	48.0	60.0	84.0	29.0	42.8	59.0	158.0
14	73%	5.5%	60.1	55.0	68.0	100.0	35.0	47.0	68.0	180.0
15	78%	5.0%	67.0	60.0	75.5	109.5	39.3	52.6	80.5	209.0
16	83%	5.0%	77.0	69.0	84.0	124.0	44.5	61.0	92.0	237.2
17	88%	5.0%	90.0	79.6	96.0	142.5	53.0	78.0	106.2	269.4
18	93%	4.5%	105.0	96.1	114.8	174.0	65.0	102.0	126.6	340.4
19	97%	3.0%	133.4	122.7	140.7	225.4	89.0	135.9	169.5	419.6
20	99%	2.0%	161.6	176.1	203.5	310.2	134.6	191.0	238.0	592.2
		100.0%								

As capacity increases, distribution of service times "tightens up"



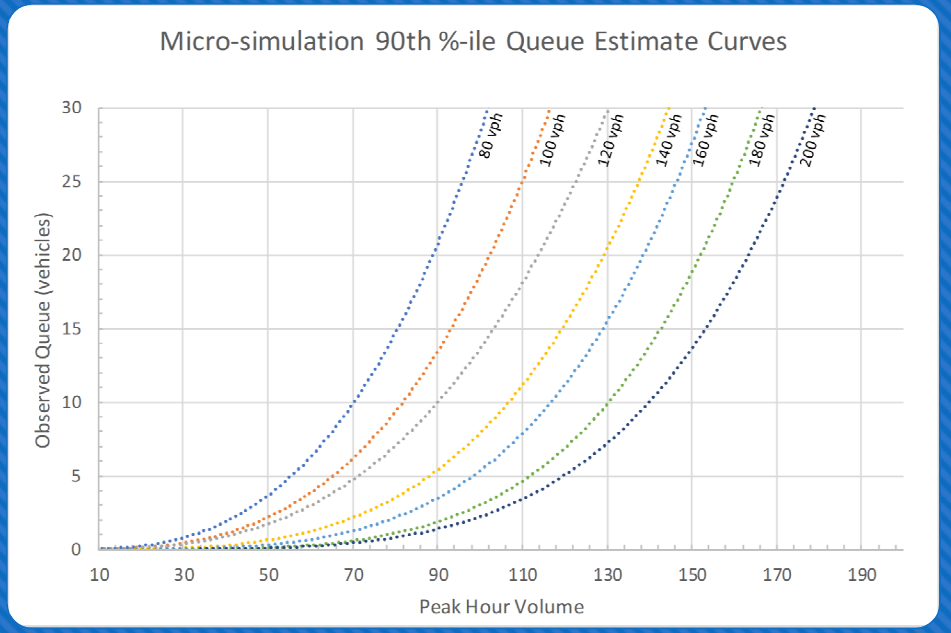


Application of Micro-Simulation

RMS error = 5.5 veh (compared to >30.24)

Queue Length in Vehicles as a Function of Peak Hour Volume and Service Rate

Peak Hour Volume	Service Rate (veh/hr)>>>>>>>									
	2	1.5	1.2	1	0.86	0.75	0.67	0.6	0.55	0.5
	30	40	50	60	70	80	90	100	110	120
20	0	0	0	0	0	0	0	0	0	
40	12	3	0	0	0	0	0	0	0	
60	61	32	11	5	1	0	0	0	0	
80	113	77	49	26	12	7	2	0	0	
100		131	96	65	43	21	13	8	3	0
120				115	83	60	38	20	15	10
140					135	100	78	55	33	22
160						153	118	94	72	49



Queue Length based on Volume and Service Rate

Tasks 5&6 – Teleconference and Report

Updates and Lessons (so far)

- Popularity among different brands varies dramatically, therefore trip generation rates vary dramatically.
- Using ITE Trip Generation for estimates may not be accurate by brand
- Peak hours for fast food are weekday lunch hour, however traffic impact analysis is typically weekday PM Peak Hour

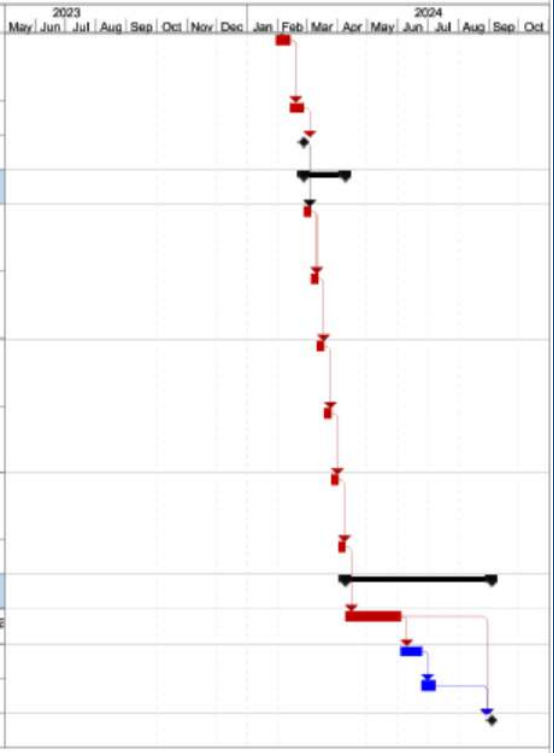
Updates and Lessons (so far)

- Through the pandemic, drive-throughs have seen dramatic changes (increased usage)
- No updates in traffic engineering queuing theory since the 70s. Queueing equations focused on roadway/intersections.
- Performance in drive throughs (service times) vary dramatically
- Different restaurant chains have different operating procedures

Project Timeline

TRIP GENERATION STUDY FOR COFFEE SHOP WITH DRIVE-THROUGH AND FAST FOOD WITH DRIVE-THROUGH
DOT-RFP-23-9054-SJ

ID	Task Name	Duration	Start	Finish	Predecessors	Successors
20	NDS Returns To The Field To Collect Any Missing, Incomplete Or Erroneous Data	10 days	Tue 1/30/24	Mon 2/12/24	19	21
21	ARE Team Review of the Data	10 days	Tue 2/13/24	Mon 2/26/24	20	22
22	Deliverable 3: ARE Team Submits Data To Research Center	0 days	Mon 2/26/24	Mon 2/26/24	21	24
23	**TRIP GENERATION DATA EVALUATION**	**30 days**	**Tue 2/27/24**	**Mon 4/8/24**		
24	Evaluate Trip Generation Comparison Between Sites and Groupings Of Sites	5 days	Tue 2/27/24	Mon 3/4/24	22	25
25	Evaluate Drive Through Design Comparison Between Sites and Groupings Of Sites	5 days	Tue 3/5/24	Mon 3/11/24	24	26
26	Evaluate Queue Lengths Comparison Between Sites And Groupings Of Sites	5 days	Tue 3/12/24	Mon 3/18/24	25	27
27	Develop Summary Of Methodology Of Analysis For Each Evaluation Of The Sites	5 days	Tue 3/19/24	Mon 3/25/24	26	28
28	Develop Summary Of Recommendations For Permitting Driveways For Future Fast Food And Coffee Shop Sites	5 days	Tue 3/26/24	Mon 4/1/24	27	29
29	Deliverable 4 – Report of Recommendations to Research Center	5 days	Tue 4/2/24	Mon 4/8/24	28	31
30	**FINAL REPORT PREPARATION**	**106 days**	**Tue 4/9/24**	**Tue 9/3/24**		
31	Deliverable 5a: Draft Final Report	40 days	Tue 4/9/24	Mon 6/3/24	29	32,34FS+66 da
32	Deliverable 5b: Closeout Teleconference (Powerpoint Presentation)	15 days	Tue 6/4/24	Mon 6/24/24	31	33
33	Deliverable 6 – Final Report	10 days	Tue 6/25/24	Mon 7/8/24	32	34
34	Contract End Date	0 days	Tue 9/3/24	Tue 9/3/24	31FS+66 days	



Project: Trip Generation
Date: Mon 3/13/23
2 of 2

Task | Critical Task | Milestone | Summary | Project Summary

TRIP GENERATION STUDY FOR COFFEE SHOP WITH DRIVE-THROUGH AND FAST FOOD WITH DRIVE-THROUGH

UPDATE

QUESTIONS?

FDOT

PM: Gina Bonyani – FDOT

PI: Drew Roark, PE, CTL, *Alex Roark Engineering*

drew@alexroarkeng.com or 850.567.2044

ARE

CONTACT INFO

Gina.Bonyani@dot.state.fl.us

Karla.Matos@dot.state.fl.us

THANK YOU!