

A Primer for Dynamic Traffic Assignment Workshop

Yi-Chang Chiu, Ph.D.
Dept. of Civil Engineering and Engineering Mechanics
University of Arizona

The 89th Annual Meeting of Transportation Research Board
January 10-14, 2010





History

- **Goals**
 - A language neutral and model-independent source guide for practitioners to understand various issues related to dynamic traffic assignment (DTA)
- **Volunteering effort by TRB ADB30 Network Modeling members**
 - January 08 – project started
 - January 09 – 1st draft ready, reviewed by TRB ADB30
 - May 09 - reviewed by practitioners
 - August 09 – reviewed by technical reviewers
 - January 2010 – 1st edition released by TRB ADB30



Collaborative Authorship

- ADB30 Committee Chair: Srinivas Peeta, Purdue Univ.
- Authors:
 - Yi-Chang Chiu, University of Arizona, USA
 - Jon Bottom, Steer Davies Gleave, Inc., USA
 - Michael Mahut, INRO Inc. Canada
 - Alex Paz, University of Nevada at Las Vegas, USA
 - Ramachandran Balakrishna, Caliper Inc., USA
 - Travis Waller, University of Texas at Austin, USA
 - Jim Hicks, Parsons Brinkerhoff, Inc., USA



Table of Contents

1	Why Dynamic Traffic Assignment	1
1.1	From a Transportation Planning Perspective	1
1.2	From a Traffic Engineering Perspective	2
1.3	Static versus Dynamic Models	3
2	Dynamic Traffic Assignment in a Nutshell	6
2.1	Defining Quality of DTA Model Outputs	9
2.2	Static and dynamic assignment in a one-shot simulation	12
2.3	Instantaneous and Experienced Travel-Times	14
2.4	Disequilibrium versus Non-convergence	19
3	Decision Making for Applying DTA Tools	20
3.1	What Applications Find DTA Models Advantageous?	20
3.2	What to Expect from DTA Models	21
3.3	Cautions for using DTA Models	21
3.4	Decision Making in Selecting DTA Models	23
3.5	Planning for DTA Modeling Activities	24
4	General Modeling Process	26
4.1	Dataset Preparation	26
4.2	Characterizing a DTA Solution	30
4.3	Model Validation and Calibration	31
4.3.1	Qualitative Analysis (Preliminary Validation)	32
4.3.2	Quantitative Analysis	33
4.3.3	Calibration Methods	34
4.4	Scenario Analysis	40
4.5	Continual System Monitoring and Re-Calibration	41
5	Concluding Remarks	42
6	Acknowledgements	43
7	References	44
8	Index	48
9	Endnote	50



Disclaimers

- Dynamic traffic assignment (DTA) encompasses many problem formulation and solution methods
- Discussions lean toward:
 - Trip-based (vs. activity-based)
 - Fixed trip tables (vs.. variable trip tables, departure time choice)
 - Simulation-based network loading (vs. analytical network loading)
 - Dynamic equilibrium-based (vs. individual choice based or one-shot simulation)
 - Experienced travel time (vs. instantaneous travel time)
- Today's discussions are *sufficient* conditions, but not *necessary* conditions for qualifying DTA



State of Dynamic Traffic Assignment (DTA) Survey

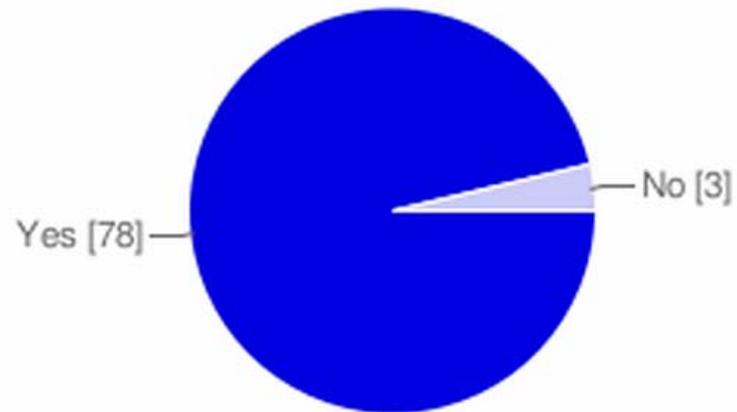


Purposes of the Survey

- Objectives
 - Are practitioners interested in using DTA?
 - But how much do they know about DTA?
 - Do they have applications in mind?
 - What are the technical barriers in adopting DTA?
 - What are the institutional barriers in adopting DTA?
- Conducted in April 2009
- 85 respondents from FHWA TMIP listserv



Have you heard about Dynamic Traffic Assignment (DTA)? If not, some of the following questions may not be relevant to you. Please feel free to scroll down to answer whichever you feel comfortable.

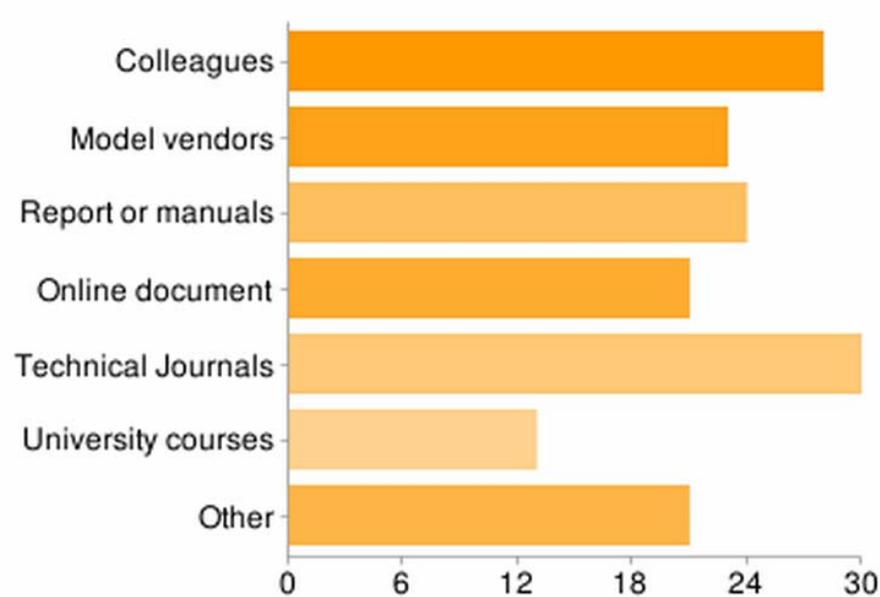


Yes	78	96%
No	3	4%

- **Observations:**
 - DTA is well heard by the industry



Who explained the DTA concept to you?



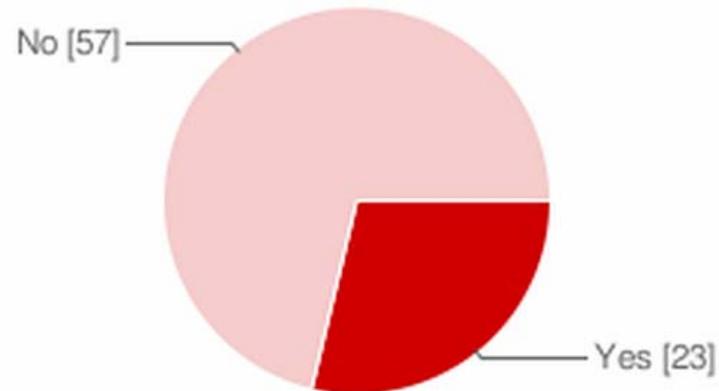
Source	Count	Percentage
Colleagues	28	36%
Model vendors	23	29%
Report or manuals	24	31%
Online document	21	27%
Technical Journals	30	38%
University courses	13	17%
Other	21	27%

People may select more than one checkbox, so percentages may add up to more than 100%.

- **Observations:**
 - Rather diversified information sources
 - Systematic training opportunities desirable



Do you consider yourself an experienced DTA model user?

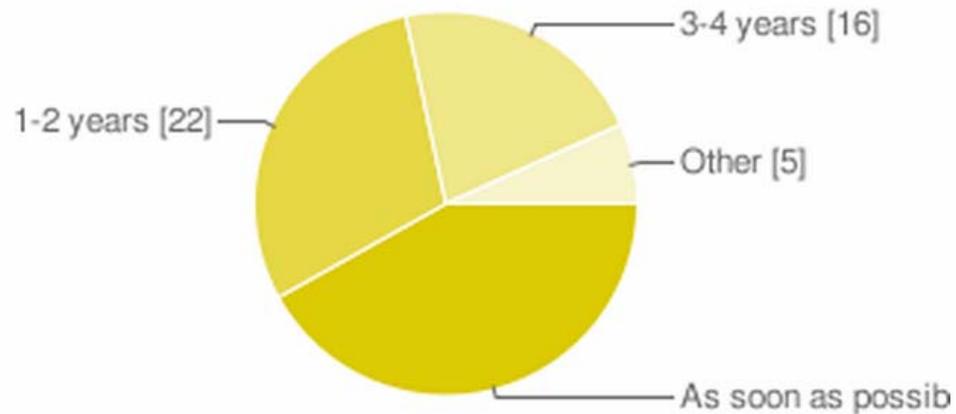


Yes	23	29%
No	57	71%

- **Observations:**

- Less 30% considered themselves an experienced DTA user
- These include those who actually have false understanding of DTA, examined through other questions in the survey aimed at understanding their knowledge about DTA

Are you interested in applying DTA in the future? If so, what is the time frame of application? If not, you don't need to answer this question.



As soon as possible	31	42%
1-2 years	22	30%
3-4 years	16	22%
Other	5	7%

- **Observations:**

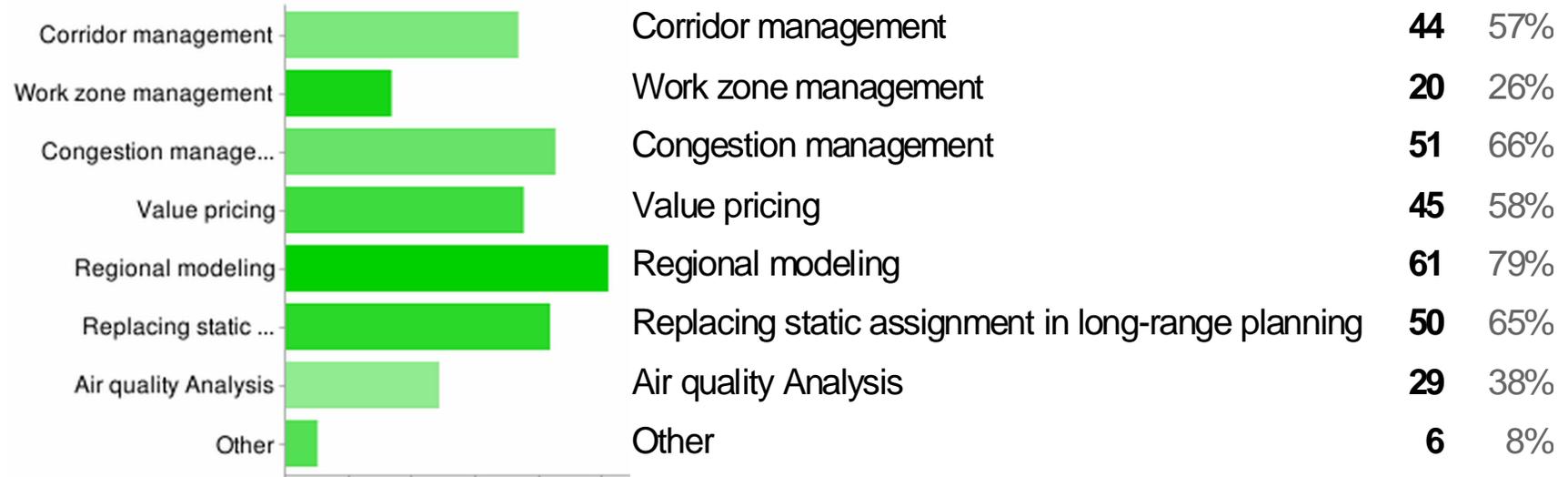
- More than 70% wish to apply DTA in 2 years
- More than 90% wish to apply DTA in 4 years

- **Things to consider:**

- How to help the 70%+ interested in DTA to be equipped with proper knowledge in 4 years?



What applications would you consider using DTA for?

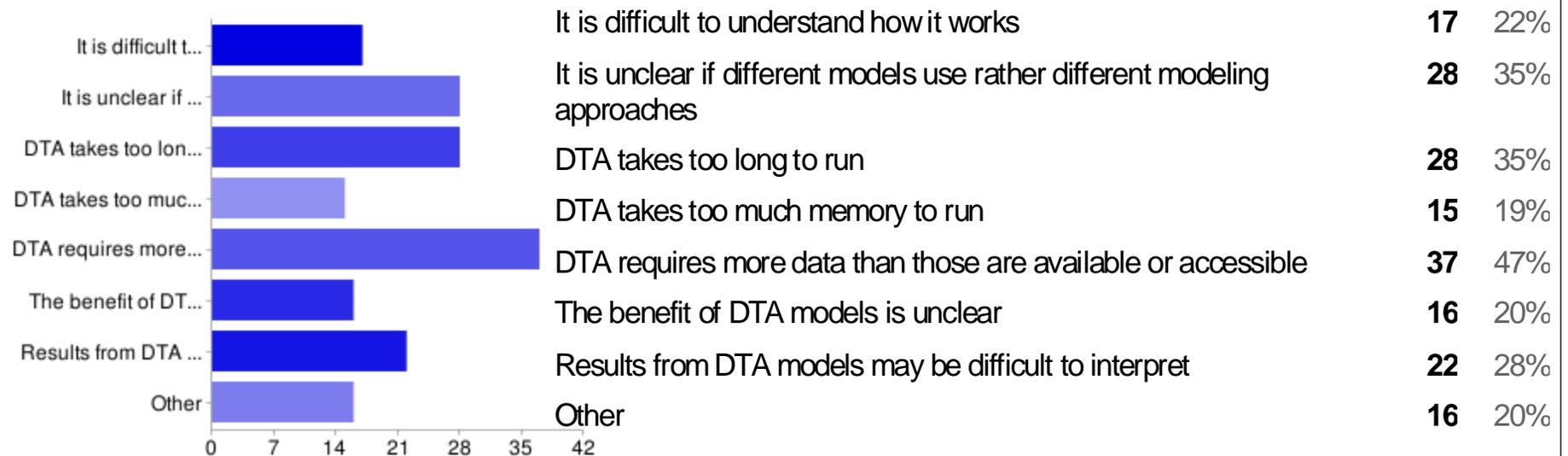


● Observations

- Congested corridors are the drivers
- Both operations and planning issues are emphasized
- Emerging policy issues (e.g. pricing)



What do you consider as the technical barrier for applying DTA?



- **Observations**

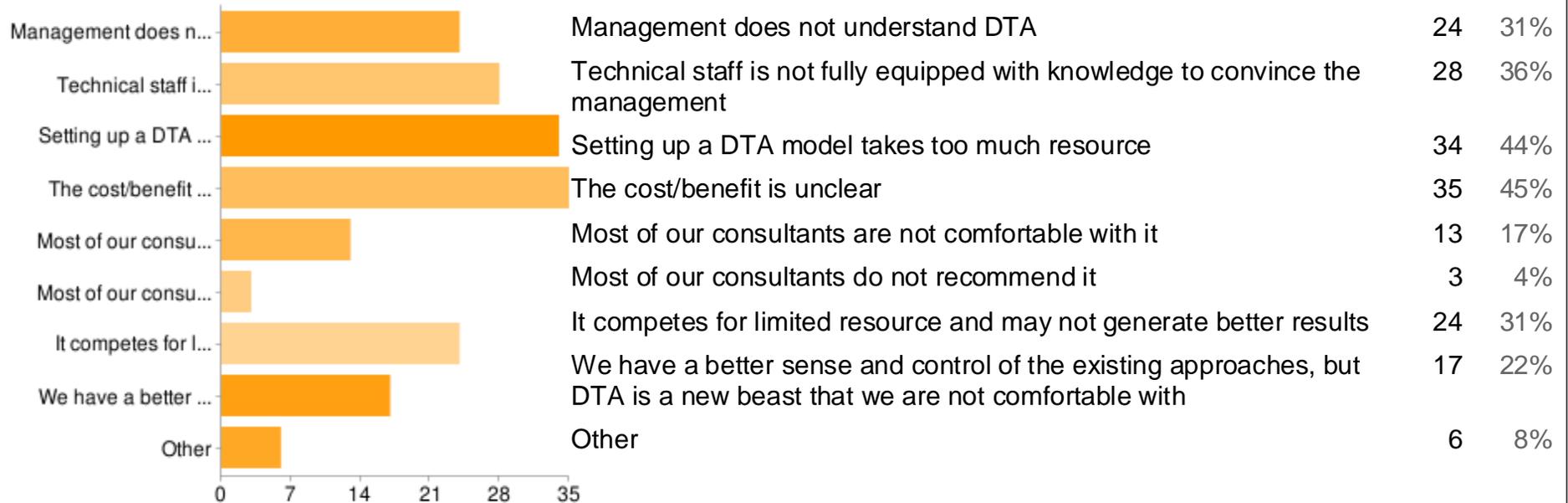
- Data # 1 concern
- Modeling approaches unclear
- Wide spread confusion in different aspects

- **Things to consider**

- How to help the 70+% interested practitioners to better grasp various aspects of DTA modeling capabilities and limitations?



What do you consider as the institutional barrier for adopting DTA?

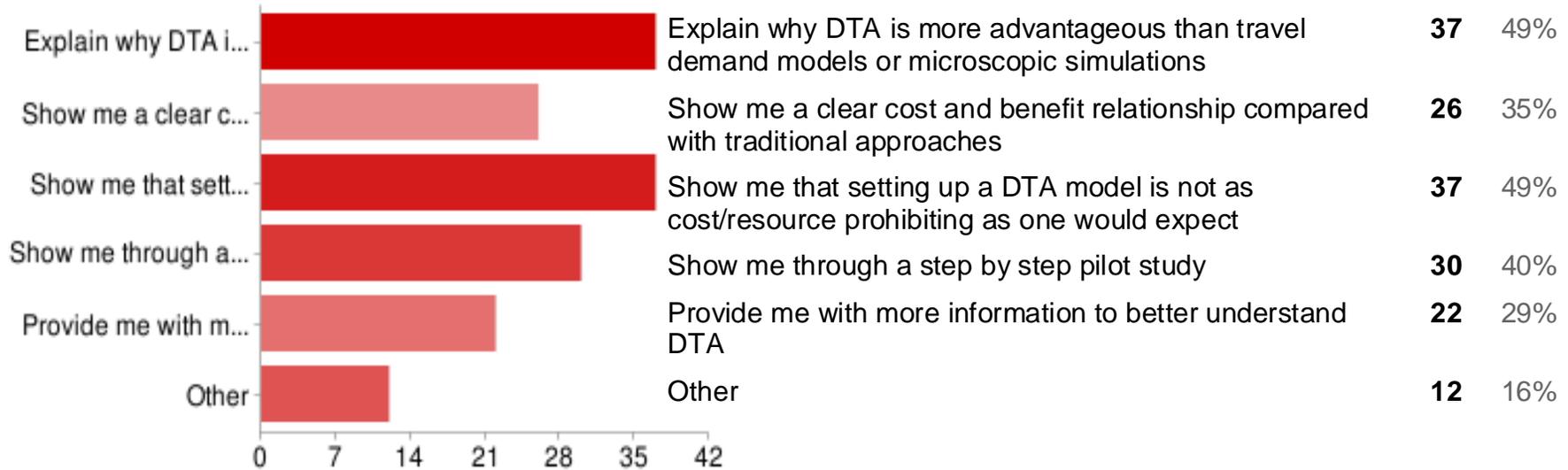


● Observations

- Both technical and management staff are not clear about cost/benefit of DTA
- Resource requirement is primary concern



If someone is to convince you that DTA is a useful tool, what would they have to do to convince you?



- **Observation:**
 - Better explanations of concepts
 - Show and tell of how to do it
 - Get feet wet via pilot studies



Other Survey Summaries

- 90% correct in definition of user equilibrium
- 70% correct in definition of DTA
- 88% knew basic algorithm for static assignment
- 20% correct in convergence criteria
- 30% considered DTA as the multi-copy extension of static assignment
- 22% thought DTA is the recent innovation by software vendors
- 50% equalized microscopic simulation models and DTA
- 70% understood relevancy between dynamic equilibrium and within-day traffic



Respondent Profiles





Conclusions

- Increased awareness and interest in DTA potential
- DTA supplement existing tools
- DTA not comprehended and understood
- Need knowledge in both planning and operations
- Different background and needs from planners and traffic engineers
- 90+% (planning) practitioners want to use DTA in 4 years, but 70+% of them still need to be further informed
- Traffic engineers not represented
- Existing resources
 - DTA Primer – ADB30 website, TRB publication
 - FHWA TMIP DTA webinars – TMIP website
- Continual outreach is needed



Acknowledgements

● DTA Primer

● Technical reviewers

- David Boyce (Northwestern)
- Mike Florian (INRO)
- David Watling (Leeds)

● Practitioner reviewers

- Asa Bergman (Portland Metro)
- Kim Fisher (TRB)
- Sam Granato (Ohio DOT)
- Brian Gardner (FHWA)
- Dong Hu (City of Bellevue, WA)
- Catharine Jensen (SEMCOG, MI)

● Leo Luo (MAG)

● Vassilis Papayannoulis (CS)

● Eric Pihl (FHWA)

● Jeffry Shelton (TTI, TX)

● Aichong Sun (PAG, AZ)

● Chung Tran (FHWA)

● Liang Zhou (Wilbur Smith)

● DTA survey

● Brian Gardner (FHWA)

● Eric Pihl (FHWA)