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Transportation Planning for Uncertain Times

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Defining the Nature of Uncertainty

- Epistemic Uncertainty
  - may be due to limited and inaccurate data, measurement error, incomplete knowledge and limited understanding
  - can be reduced by more knowledge
- Variability uncertainty
  - may result from inherent variability in the system such as random errors in sampling, inherent randomness such as weather, 'non-rational' and 'non-standard' human behavior, unpredictable nature of social, economic and culture dynamics and technological randomness (novelty of technology development)
  - cannot be reduced completely by more knowledge

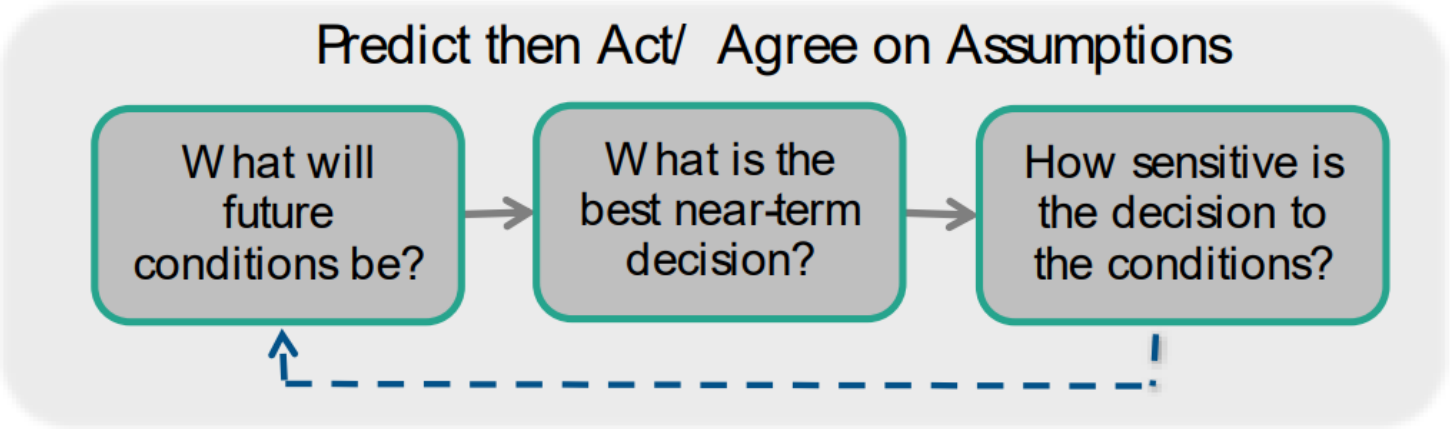
Source: Agusdinata, 2008, page 36

Travel Forecasting Uncertainty

- Travel forecasting uncertainty has both (with the weight tilting more toward variability uncertainty now).
- In the past several decades, travel forecasting practice
  - has been operating under the premise that we could forecast travel demand with certain degree of confidence;
  - has been employed to support traditional predict-then-act planning.

Predict Then Act

- Traditional predict-then-act planning begins by seeking consensus on how the future will unfold and uses this information to rank alternative plans.



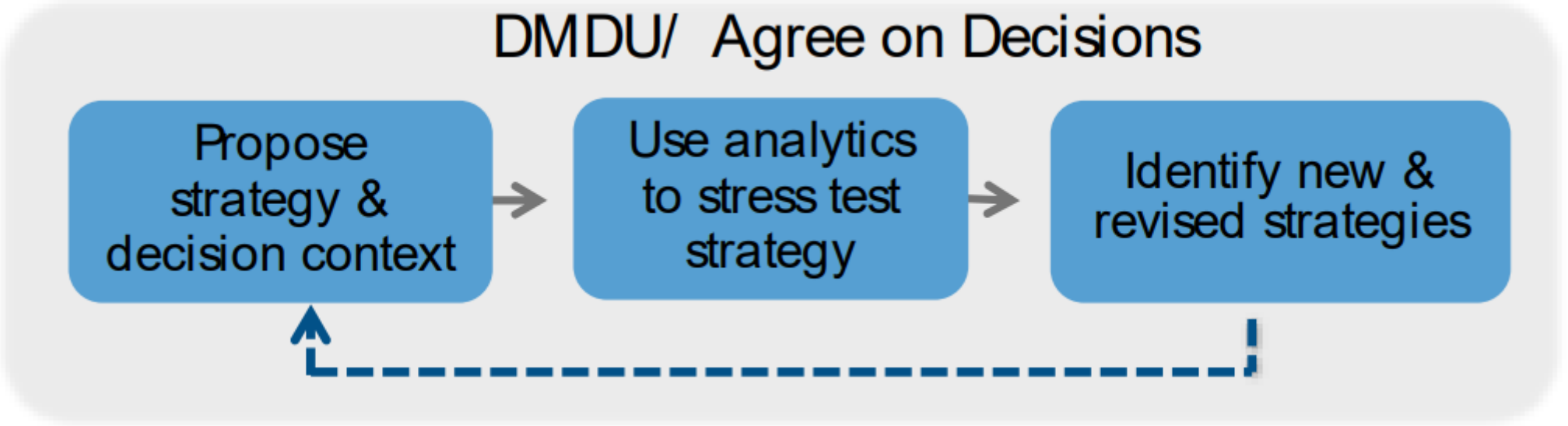
Source: FHWA 2022 p. 10

Disruptive Technologies and Future Mobilities

- Due to disruptive technologies such as e-scooters, digital mobility services, autonomous vehicles, flying taxis, hyperloop, the transportation planning environment is changing.
- MPOs are now facing a future with deep uncertainty.
- Deep uncertainty is defined as “a condition in which analysts do not know or the parties to a decision cannot agree upon (1) the appropriate conceptual models to describe interactions among a system's variables, (2) the probability distributions to represent uncertainty about key parameters in the models, and/or (3) how to value the desirability of alternative outcomes”. Lempert, Popper, and Bankes, 2003, p. xii

Decision Making under Conditions of Deep Uncertainty (DMDU)

- Recently developed methods and analytical tools (known collectively as DMDU) can help agencies to bring more strategic perspective within their planning cycle in today's challenging transportation planning environment.



Source: FHWA 2022 p. 10

XLRM – Facilitating DMDU Analyses

- The XLRM factors are employed in DMDU analyses.

X: Uncertainties	L: Policy Levers
What uncertain factors outside decision makers' control affect their ability to pursue their goals?	What actions might decision makers take to pursue their goals?
R: Relationships	M: Performance measures
How might policy levers (L) and uncertainties (X) be related to decision makers' goals (M)?	What are decision makers trying to achieve?

Source: FHWA 2022 p. 22

Enhancing Transportation Planning for Uncertain Times

- Empowering your agencies with **a suite of purpose-built** transportation planning and travel forecasting tools
- Managing uncertainties by
  - First understanding the types of uncertainty your agency is facing
  - Employing the **applicable** models
  - Then selecting **appropriate** analysis approaches

Decades' Wisdom

"When you construct a model you leave out all the details which you, with the knowledge at your disposal, consider inessential.... **Models should not be true, but it is important that they are applicable**, and whether they are applicable for any given purpose must of course be investigated. This also means that a model is (accepted finally, only on trial." - Rasch, G. (1960), pp. 37–38

All models are approximations. Assumptions, whether implied or clearly stated, are never exactly true. All models are wrong, but some models are useful. So the question you need to ask is not "Is the model true?" (it never is) but "**Is the model good enough for this particular application?**"

- Goerge E. P. Box, Alberto Luceño and María del Carmen Paniagua-Quiñones, 2009 Page 61

There is no single approach to travel forecasting or set of procedures that is 'correct' for all applications or all MPOs. Travel forecasting tools developed and used by an MPO should be appropriate for the nature of the questions being posed by its constituent jurisdictions and the types of analysis being conducted. - TRB Special Report 288, 2007, Page 3

Scientists usually assume that no theory is 100 per cent correct. Consequently, truth is a poor test for knowledge. The real test is **utility**." - Yuval Noah Harari, Sapiens: A Brief History of Humankind, 2011, Page 71

Source: https://en.wikipedia.org/wiki/All_models_are_wrong

TMIP Publications on Uncertainties

- Transportation Planning for Uncertain Times - A Practical Guide to Decision Making Under Deep Uncertainty for MPOs
- Uncertainty in Travel Forecasting: Exploratory Modeling and Analysis TMIP-EMAT: A Desk Reference
- TMIP Exploratory Modeling and Analysis Tool (TMIP-EMAT) Beta Test Results
- Volume 1: Integrated ABM-DTA Methods to Model Impacts of Disruptive Technology on the Regional Surface Transportation System - A Feasibility Study
- Volume 2: Model Impacts of Connected and Autonomous/Automated Vehicles (CAVs) and Ride-Hailing with an Activity-Based Model (ABM) and Dynamic Traffic Assignment (DTA)-An Experiment
- How-to: Quantify Uncertainty in Travel Forecasts