TRB ITAP Forecasting Uncertainty Workshop

June 4, 2023; 3:30 - 5:30

Moderator:
Marty Milkovits, Boston Region MPO

Presenters / Facilitators:
Tierra Bills, UCLA
Rachel Copperman, Cambridge Systematics
Naomi Stein, EBP
Sarah Sun, FHWA

Facilitators:
Jay Evans, RSG
Greg Macfarlane, Brigham Young University
Tara Weidner, Oregon DOT

Notes / Summary:
Vivek Yadav, Cambridge Systematics

Attendees: ~60 (6 breakout groups of 8-12)

Discussion Questions

Where are we now? State of the practice / references / lessons learned

Uncertainties of Concern

- Land use
    - Local land use policies
    - Variability in population data (e.g. race/ethnicity) from census
    - Economic cycles
    - Generative AI impacts on employment and labor force participation
- Commercial travel
    - Supply chain stability, evolution
    - E-commerce operations and changes
- Technology
    - Electric Vehicles

    - CAV concerns used to be major source of uncertainty, now in ‘trough of disillusionment’
    - Technological adoption and maturation rates
    - Regulation around technological advances
- Travel behavior
    - Work from home
    - Nonwork travel behavior changes
- Environmental changes and climate vulnerability

Challenges to Incorporating Uncertainty

- Existing tools and resources
    - Are not calibrated to nor reflective of latest travel behaviors. Most are calibrated to pre-pandemic travel
    - Limited data to validate, particularly in rural areas and also in local areas
    - Motivation to use intuitive metrics (e.g. LOS), will that intuition be maintained when produced with uncertainty? Should we use simpler methods when things are uncertain (i.e. assert what-ifs/paradigm shifts to explore the potential effects, even when how to get there is unclear)
    - Where to draw the line of uncertainty - upstream models (e.g. land use) are working with 1 number, but could incorporate probabilities
- Understanding and Acceptance
    - Rapidly changing field of available tools, data, and approaches - how to choose?
    - Unclear on time and effort required
    - Resource limitations and difficult to shift into a mode where we can take the time to study uncertainty more deeply
    - Stakeholders (e.g. board members) have a hard time understanding static models, introducing uncertainty and multiple results seems to make it harder
        - Additional challenge of communicating range of outputs (stakeholders want to know if a policy will be met, not what % of time it is met)
    - Can be a push to complete current work with a point forecast. Too often that work just ends up on a shelf anyway. How to justify investing even more time and resources for analysis when people aren’t asking for it
    - How to avoid “analysis paralysis”. Modeling and interpreting more scenarios, and building models to be sensitive to emerging uncertainties, will take time. Customers still expect agencies to deliver during that window. How do we do so while minimizing regrets.
    - Mentality shift - explorative approach complements predictions

Current Practice in Uncertainty

- Undeniably a hot topic with a variety of approaches, but not a consistent and established practice
- Strategic planning is advancing and making progress engaging policy/decision makers

- Variety of receptivity and attitudes towards risk analysis with probabilities versus exploratory analysis where range of outcomes without likelihoods are included
- Current models have “lost their shine” to some degree - could forecasts with uncertainty bring modeling back to the planning process?
- When we run many scenarios, we are able to learn more from the rich relationships in our models.

Where could we go next? Immediate contributions TRB could foster

Definitions and Guidelines

- Definitions
    - Develop industry standard definitions for: scenario planning; exploratory scenario planning; sensitivity testing; exploratory modeling; etc.
    - Highlight the distinction between uncertainty we can improve by more information / more complex models and that we cannot (epistemic vs. variability)
- Guidance: uncertainty identification and definition
    - Range of assumptions and responses to discuss cause/effect with stakeholders
    - Prioritizing and limiting inputs to focus story and reduce confusion, i.e. implementing an incremental approach rather than incorporating all uncertainty. Some agencies have split along the lines of what the agency can/cannot control, often more variation from the latter.
    - COVID - WFH, Transit ridership, changing peak periods [would love to have ranges and understanding of what to think about]
- Guidance: modeling / visualization
    - How to identify and handle “extreme” outcomes / input effects
    - Determination of a model being ‘reasonably’ sensitive to input variable changes
    - Define integration of data-driven (i.e. Big Data-based) for near term forecasts and then leveraged to longer term model-driven forecasts
- Guidance: planning process
    - Using uncertainty to design adaptation for projects
    - Education tools for decision makers
    - Definition of tools/methods/processes for decision makers
    - Improve education on models and application

Peer Exchanges / Community Building

- Peer exchange topics
    - Case studies of uncertainty applications

    - Focus on how to best to talk with stakeholders about uncertainty in results
    - Develop ‘wish list’ from applications to identify future areas of improvement
- Effectively engage experts from other fields to complement our transportation expertise
- Maintain a consolidated list of uncertainties
    - Living list - know what others are trying and how they are doing it
    - AV, EV, WFH; range, guidelines, how was it actually implemented?

Motivate / Support New Practices

- Move from the current practice of optimizing best guess towards minimized regrets, maximize best case scenarios
    - Understanding of risks to optimizing the expected value vs. varying optimizations based on questions
- Where inputs have uncertainty that could have an informed probability distribution, describe process to develop metrics with confidence intervals with associated probabilities
- Reviewing how existing/older models have performed
    - Process to use backcasting, reviewing previous forecasts to build/enhance awareness and understanding of the existing uncertainty in our current tools and data. For example, conducting an examination of where modeling accuracy was off as a way of informing driving forces and sources of uncertainty
    - Supporting a discussion around accuracy evaluations by modeling purpose (corridor accuracy in short term vs. regional travel behavior in longer term)
- Build excitement back to models with a renewed purpose and commitment to travel demand modeling; identify ways to mitigate the long development process that makes modeling practice lag too much behind important questions
    - Test ‘what if’ paradigm type shifts
    - Guidance on prioritizing scarce resources for long term investments
- Identify approaches that are simple and focus on basic relationships as a good place to start

Where do we want to be in 3-5 years? Longer term needs for research to promote

- A common architecture of open source tools that can be used for uncertainty analysis
    - Platform to facilitate sharing of technology
    - Working groups to support this
- Framework for process / facilitation with topics of uncertainty
- Guidance on addressing uncertainties that are hard to analyze quantitatively
- Phased implementation of projects that explicitly depend on updated information before advancing
    - Where does uncertainty shape implementation,

    - How to manage a portfolio of projects for evaluation with uncertainty
    - How to group projects, optimized way to approach
    - Guidelines on intermediate checks, monitoring for adaptive strategies (using the RDM framework)
    - How to update/redo the analysis when there is new information
- Guided by rules and policies at the federal level that promote/require incorporation of uncertainty: if uncertainty is in the regulations, then it will become the state of the practice
- Adaptive plans, where we set signposts and conditions to watch, noting when conditions unroll in a way that may threaten our current plan ("triggers"), prompting us to re-think and potentially adapt our plans to the more likely conditions. Need education, guidance, and examples of this.

Does the initiative structure work? Other areas that should be highlighted?

Define a vision for uncertainty practice to work towards.

Potential Research Needs Statements

Structure of RNS:

- Objective (exploratory vs. implementation)
- Potential Benefits
- Relevant Background
- Problem Statement (tasks, timeline, budget)

Proposed RNS Areas

- Research into decision maker's understanding of models / uncertainty
    - Are there examples of where incorporating uncertainty has affected decisions?
    - What would be needed to bring uncertainty into decision making conversations?
- Restatement of value and purpose of long term travel demand models
- Effective communication of uncertainty

    - Stakeholders (e.g. board members) have a hard time understanding static models, introducing uncertainty and multiple results seems to make it harder
    - Additional challenge of communicating range of outputs (stakeholders want to know if a policy will be met, not what % of time it is met)
    - Have exchanges on how to best to communicate
- Capturing what has been done in modeling/planning for uncertainty
- How could the practice design and program incremental or flexible infrastructure planning, both on the design side and within the project development timeline, such that new information could be incorporated that refines original uncertainty ranges.