

Future Uncertain: Research and Tools for Transportation Planning under Deep Uncertainty

Description

Future Uncertain introduces Decision Making Under Deep Uncertainty (DMDU) and contrasts it with traditional Predict-Then-Act approaches in transportation planning. Participants will experience considering and mitigating uncertainty through a collaborative planning game with evolving future conditions. An expert panel will then use game results to challenge current practices and discuss strategies to better incorporate deep uncertainty in planning tools and practices. The workshop will conclude with a group discussion to synthesize key takeaways and initiate further research and practice developments.

- Moderator: Marty Milkovits, Director of Modeling and Analytics, Boston Region MPO
- Game Lead: Flavia Tsang, Metropolitan Transportation Commission
- Panelists:
 - Prateek Bansal, Assistant Professor, National University of Singapore
 - Chandra Bhat, University Distinguished Teaching Professor, University of Texas at Austin
 - Rachel Copperman, Vice President, Cambridge Systematics
 - Naomi Stein, Vice President, EBP
 - Tara Weidner, Climate Impact Analysis Program Lead, Oregon DOT-Climate Office

Summary

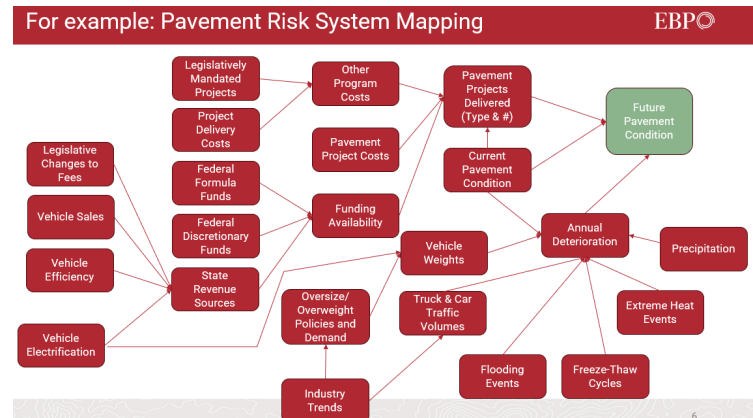
Welcome and Background

Attendees were asked to identify which uncertainties concern them the most, captured in the following word cloud.

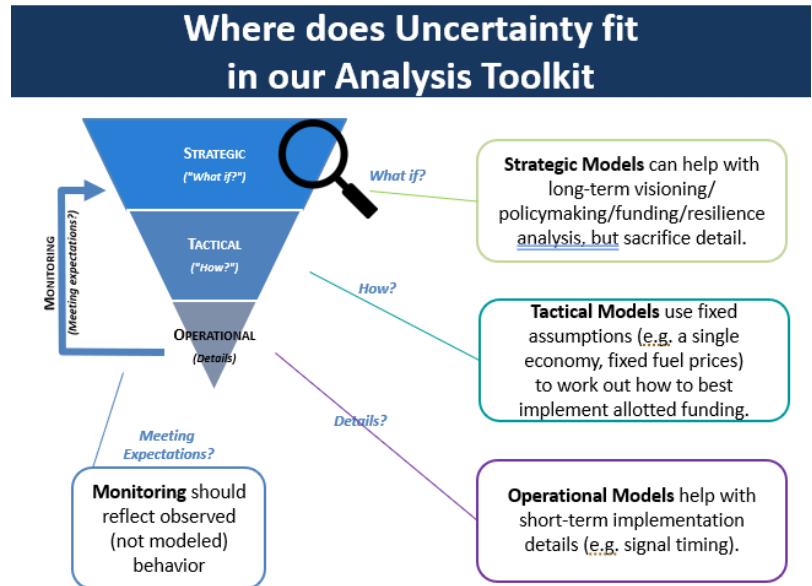
these areas, a traditional predict-then-act approach becomes less useful for supporting decisions.

Panel Presentations on State and Future of the Practice

Naomi Stein opened the panel presentations with an update on the [NCHRP 08-154 to incorporate uncertainty into long-range planning](#) study that she is leading. Naomi, the panel's planning expert, advocated for engaging decision-makers and the public in discussions about uncertainty. She emphasized that planning for uncertainty doesn't necessitate overly complicated processes or tools; in fact, simpler approaches can be more effective. The most important thing is to be clear about the questions being asked and the factors that influence those questions. Naomi provided a good example of how to track the risks and factors that affect future pavement conditions.

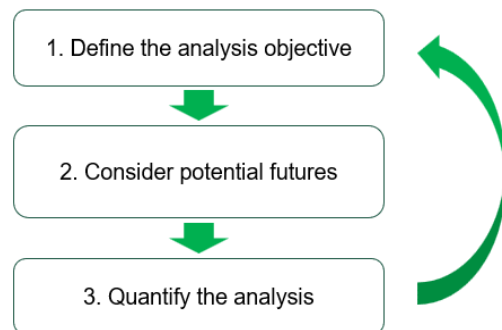


Tara Weidner presented examples of exploratory modeling in practice using TMIP-EMAT to generate models across a wide range of futures with both VisionEval and the ODOT ABM model. She explained how Oregon DOT is working to standardize this practice. Tara described the Oregon DOT Analysis Toolkit and how strategic modeling can incorporate uncertainty and acknowledge that too much is changing to assume 'business as usual' in our strategies. Building on Naomi's presentation, Tara explained the importance of taking the time to tease out the story from the model results, as these stories are much richer than what can be said from a single or small number of point predictions. This practice also increases confidence in the model sensitivities and performance for when they are used to produce the best estimate projection.

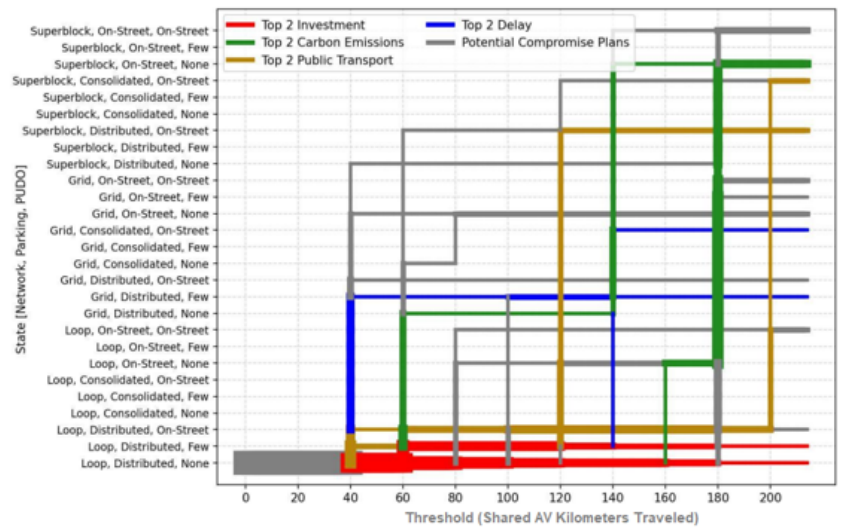


Rachel Copperman stressed the importance of starting with a good scoping exercise, where all the XLRM are identified, to get the most out of the uncertainty analysis process, guiding new users impressed by Tara's example of using TMIP-EMAT in an uncertainty practice. Having a clear analysis objective from the outset is crucial for ensuring that the effort is worthwhile and that the right tools are used, even if it means not using the available model or any quantitative model. The scoping process itself is valuable because it prioritizes the analysis purpose, which can lead to a better understanding of current and future quantitative needs.

TMIP-EMAT Scoping Workflow



Prateek Bansal discussed how the next generation of tools can assist in exploring uncertainty spaces and designing adaptive pathways that incorporate new information. His research applies DMDU-type techniques to address the challenges of planning for AVs, using surrogate models and multi-objective optimization to explore and identify pathways that balance different values given constraints on plan transitions and uncertainty in metrics. These approaches provide alternatives to traditional single-future planning and show how monitoring can trigger different courses of action.



Lastly, **Chandra Bhat** broadened our discussion by explaining how the disciplines of physics, mathematics, and literature have dealt with uncertainty. He also touched on the cultural differences in how uncertainty is perceived and addressed. Chandra emphasized the importance of adapting the process rather than focusing on a specific outcome and encouraged the research community to adopt a multifaceted approach, utilizing the strengths of various methods to gain a deeper understanding of future activity and travel behaviors. Chandra closed by extolling the community to embrace humility and remain open to diverse perspectives.

Decisions for the Decade

The workshop's focus was on the [Decisions for the Decade](#) game, originally created by the World Bank and the Red Cross to enhance understanding of planning with uncertainty. **Flavia Tsang**, assisted by Marty and **Jinghua Xu**, guided participants

in making decisions to either mitigate crises or invest in new development. As the game progressed and uncertainty increased, players were presented with the option to choose a robust solution, but at a significant cost.

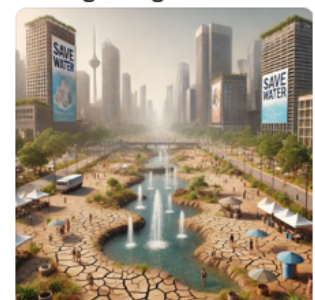
A key part of this game is that there is no right answer. Players

However, your mission faces challenges from natural disasters...

Extreme floods



Devastating droughts



with the same strategy had very different results: a sweet reward or crisis and no development points. As the game progressed, some participants developed “models” to help with their planning, but even those could not guarantee avoiding an unmanaged crisis and losing all points.

The Decisions for the Decade game is not specific to transportation scenarios nor the traditional planning process, but the experience of needing to make decisions given probabilistic expectations is very much in line with our practice. It becomes quickly obvious that simply following the expected distribution is not a robust strategy.

We invited workshop participants to provide feedback on the game experience, workings, and connections to the practice, these are reported below:

How would you briefly describe your feelings while playing the game?

<i>Out of the Norm</i>	<i>Strategic</i>	<i>Panicky</i>
<i>Responsible</i>	<i>Uncertain</i>	<i>Politically Competitive</i>
<i>Worried</i>	<i>Concerned</i>	
<i>Despair</i>	<i>Doomed</i>	
<i>Risk Averse</i>		

What analogy would you draw between the game and your work?

- *Accept that disasters will likely occur*
- *Revisit assumptions often*
- *Have different models and use exploratory analysis to help find blind spots*
- *Need to control for risk at a higher degree*
- *Severe consequences lead to risk aversion*
- *It's very difficult to instill confidence in any predictive method for balancing risk with prosperity*
- *The future is unknown, but possible futures will likely fall within predictable ranges*
- *Uncertainty in how other agencies will behave*

What would the robust option of the game look like in transportation planning?

- *Limit projects and take time to evaluate effects of disruptions*
- *Substantially controlling / limiting development in high risk areas*
- *Focus on Climate Change impacts with DMDU process for LRTP*
- *Invest in overcapacity and resilience in sustainable modes*

What role could travel modeling play?

- *Investing in risk assessments to inform decisions.*
- *Use models to evaluate potential possibilities*
- *Understanding connectivity better, even if land use decisions are fundamentally sound*
- *Emergency planning as a buffer and potentially instead of over-building protection*

Feedback for Running Decisions for the Decade

- *Incentive to get prosperity points to make it harder to be overly conservative. Potentially only moving the highest scoring teams forward.*
- *With larger groups, engaging participants with the facilitator and hearing all instructions is critical.*

Panel Q & A

The panel discussion focused on the existence of crises and how to better incorporate the possibility of a crisis in the transportation planning process. The workshop's timing, shortly after the outbreak of the LA wildfires, highlighted the immediate need for the discussion. The panelists contrasted reality with the Decisions for the Decade game play, where crises could be experienced, but players remain to plan for another decade.

Audience questions sparked a discussion on how to effectively communicate during a crisis, particularly to encourage good decision-making. The panel stressed the importance of a team approach. The team should include people with diverse expertise, values, and interests. Broader engagement will help to anticipate and understand potential crises.





A representative from Cape Town, South Africa, commented on how DMDU has been used in their planning process. They encouraged us to focus on the narratives our tools generate instead of debating specific mathematical structures.



Other questions from the audience, ordered by number of upvotes, are listed below and provide a rich starting point for future Research Needs Statements.

- *Tail risks need better appreciation, at least even in qualitative terms in every model we provide. Any examples of communicating these "black swan" events?*
- *Methods for communicating uncertainty in a productive way to elected officials and the general public? Tools, graphics, etc?*
- *Any comments on the differences between a group's perspective on risk vs the individual? I was quite risky in the game but in my personal life often choose the 'robust' option*
- *How do you plan for uncertainty without catastrophizing?*
- *How to handle uncertainty in the model itself? For example, TRB's Highway Capacity Manual has an equation for capacity of a roundabout, but the research behind that equation shows large conf. Intervals*
- *Naomi's presentation suggested systems dynamics and using visual tools. I think that can become more widely used. Any insights or experiences using SD?*
- *What guidance or references might be available to start widening the awareness in our public planning process of uncertainty?*
- *What about uncertainty and causality, which is mentioned increasingly in the literature. Are there diverging development even in terms of definition. How can causality be used with all the uncertainty*
- *What role does communication play in emphasising the importance of risk aversion, especially given that its success often means simply maintaining the status quo and preventing worse outcomes?*
- *Question for Prateek: is it feasible to produce a large number of outcomes at that multi-dimensional level with models that take several days to run even for one set of inputs?*
- *Have we had any experiences to use the same Xs, Ls, and Ms but use different Rs?*

Closing Quote

We respectfully ended the workshop with a quote from President Carter (emphasis added):

“Failure is a reality; we all fail at times, and it's painful when we do. But it's better to fail while striving for something wonderful, challenging, adventurous, and *uncertain* than to say, “I don't want to try because I may not succeed completely.”

Jimmy Carter, Sources of Strength: Meditations on Scripture for a Living Faith