SCENARIO PLANNING TOOLS

White Paper

June 1, 2021

National Capital Region
Transportation Planning Board

ORGANIZATIONAL AWARENESS AND UNDERSTANDING OF SCENARIO PLANNING TOOLS
Prepared by ICF for Metropolitan Washington Council of Governments/ National Capital Transportation Planning Board (COG/TPB)

Approved by COG/TPB Oversight Committee on Scenario Planning Understanding and Awareness on: June 1, 2021

ABOUT THE TPB
The National Capital Region Transportation Planning Board (TPB) is the federally designated metropolitan planning organization (MPO) for metropolitan Washington. It is responsible for developing and carrying out a continuing, cooperative, and comprehensive transportation planning process in the metropolitan area. Members of the TPB include representatives of the transportation agencies of the states of Maryland and Virginia and the District of Columbia, 24 local governments, the Washington Metropolitan Area Transit Authority, the Maryland and Virginia General Assemblies, and nonvoting members from the Metropolitan Washington Airports Authority and federal agencies. The TPB is staffed by the Department of Transportation Planning at the Metropolitan Washington Council of Governments (COG).

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Introduction

Project Purpose and Context

The Metropolitan Washington Council of Governments (COG) is an independent, nonprofit association, with a membership of 300 elected officials from 24 local governments in the Metropolitan Washington region. The Transportation Planning Board (TPB) focuses on significant challenges like roadway and transit congestion, efficient freight movement, and safety. A travel demand model forecasts future vehicle travel and transit ridership on regional highway networks. It is a tool that simulates trip generation, distribution, mode choice, and route assignment using aggregate socio-economic data by travel zone. Travel demand models have not traditionally been designed to enable consideration of broader issues and metrics associated with the values and aspirations identified in the initial direction-setting phase of performance-based planning and programming. Supporting the analysis phase with a performance-based scenario planning process can complement the traditional modeling approach and enhance community engagement and perspectives on transportation investment needs by incorporating a broader array of issues and considering a variety of different future conditions beyond the trend-based forecast.

COG/TPB is seeking to increase organizational awareness and understanding of scenario planning. Toward this end, the agency has embarked upon a study to explore scenario planning processes and tools that could complement its travel demand modeling capabilities, enabling the agency to generate and evaluate alternative possible futures quickly and efficiently across a broad range of categories. This is the third of three white papers outlined in the study scope. The study documents the state of the practice of scenario planning tools for regional transportation decision making, with recommendations for investments in COG/TPB staff training and technical capacity.

This white paper summarizes research conducted on twelve scenario planning tools. Three tools were explored in-depth. Nine tools are highlighted with snapshot profiles. After an overview of the process used to select the tools evaluated, the white paper includes a matrix with a snapshot of all twelve tools reviewed (Tables 2 and 3). A final matrix of the tools (Tables 4 and 5) is included to give a side-by-side comparison of tool attributes.

Following the research phase of the study, the consulting team and the Oversight Committee hosted two workshops to increase COG/TPB staff familiarity and comfort with using scenario planning methods to inform the COG/TPB's decision-making process in the future. The Oversight Committee consists of COG/TPB staff subject matter experts who are involved in or whose work relates to scenario planning. The project concluded with a summary report of findings from the research and workshop, including recommended next steps. The report serves as an in-house resource for COG/TPB agency business planning and work programs that involve scenario planning applications and associated investments in tools, data, and staff capabilities.

PURPOSE AND CONTEXT

The purpose of this white paper is to review the state of the practice of scenario planning tools and share data collected and research findings. Although COG/TPB staff has developed rigorous travel demand modeling processes in support of regional transportation planning activities such as updating the Long-Range Transportation Plan and conducting the Air Quality Conformity analysis of the plan, COG/TPB is also interested in exploring scenario planning processes and tools that may

support an analysis of transportation issues on a broader scope and in a faster manner. In the Fall of 2020, the consultant collaborated with the project Oversight Committee to select tools to review and then began tool investigation.The information was supplemented in the Spring of 2021 through an in-depth survey of scenario planning experiences at peer MPOs.

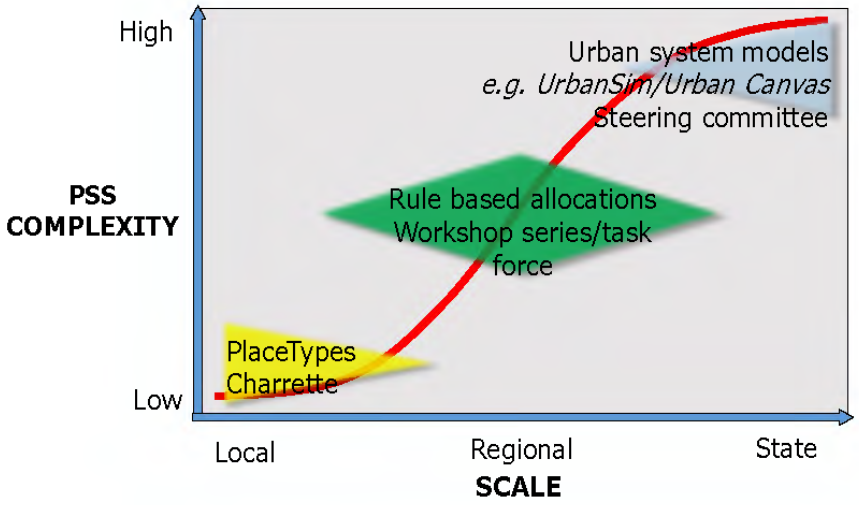
This white paper outlines the scenario planning tools selection process, includes three in-depth profiles of tools and snapshots of nine additional tools. It concludes with side-by-side comparisons of tools in matrices.

DEFINITION OF A SCENARIO PLANNING TOOL

For the purposes of this study, scenario planning has been defined as a practice by which organizations or communities plan for an uncertain future by exploring multiple possibilities of what might happen. A scenario depicts a potential future generated by external forces beyond an agency's control combined with actions within its purview.[1] Therefore a scenario planning tool is defined as any planning support system (PSS) or method used to build these scenarios and work with stakeholders to assess their impacts.

Detailed GIS spatial analysis tools and spreadsheet-based fiscal calculators are appropriate for locally scaled scenario planning initiatives such as development sites, neighborhoods, towns, and smaller cities. Regional and statewide scenario planning initiatives usually call for more sophisticated modeling tools that can calculate results of policy decisions (e.g., zoning and fiscal incentives for compact development, parking fees) and capital investments (e.g., transportation capacity projects, water and sewer systems), and typically involve technical committees and advisory groups as well as broader public engagement methods (Figure 1).

Figure 1: Scenario Planning Tools and Engagement Methods in Relation to Geographic Scale



Source: Sketch Tools for Regional Sustainability Planning. NCHRP 08-36 Task 117. 2016.
PSS = Planning Support Systems

[1] This description is drawn from the definition of scenario planning developed by the Oversight Committee for this project. A more detailed version of the definition is available as a separate document.

Scenario Planning Tools Selection Process

The process of selecting scenario planning tools for review occurred collaboratively between the consultant team and the Oversight Committee. An initial list of fifteen tools was developed by the consulting team and the Committee, including three tools identified in the study scope of work that were of particular interest to COG/TPB staff. A preliminary review of the initial list was conducted to gather base level data and insight for the Oversight Committee to read and inform tool selection. The following information was gathered for each tool in the preliminary review: tool description by company or organization, subject matter addressed by the tool, assessment if the tool is open access, cost estimate of tool, and which MPOs have used the tool. The research was added to a table for review by the Oversight Committee.

Information gathered in the preliminary review was shared with the project Oversight Committee. The Oversight Committee members represent different subject matter teams in COG's Department of Transportation as well as the Department of Community Planning and Services. The COG/TPB staff project manager asked each Oversight Committee member to collaborate with their team and complete a worksheet to indicate which tools were of the greatest interest to them. This input was used to select twelve tools for further research. Three tools were identified for in-depth reviews (these were also noted in the scope of work), nine were selected for standard or snapshot reviews, and three were not reviewed. Table 1 lists the scenario planning tools considered and the review type for the selected tools.

Table 1: Scenario Planning Tools Considered for Review

Scenario Planning Tool*	Review Type
Travel Model Improvement Program's Exploratory Modeling and Analysis Tool (TMIP EMAT)	In-Depth
Trip Reduction Impacts of Mobility Management Strategies (TRIMMS)	In-Depth
VisionEval Suite: GreenSTEP, Regional Strategic Planning Model (RPSM), and Rapid Policy Analysis Tool (RPAT)	In-Depth
CityEngine	Snapshot
CommunityViz	Snapshot
Cube Land	Snapshot
Envision Tomorrow (ET)	Snapshot
Remix	Snapshot
TDM+ (Fehr & Peers)	Snapshot
Uplan	Snapshot
UrbanFootprint / RapidFire	Snapshot
UrbanSim / UrbanCanvas	Snapshot
Conveyal	Not Selected
MATSim/Beam	Not Selected
Transit Boardings Estimation and Simulation Tool (TBEST)	Not Selected
* INDEX was initially considered for inclusion in the study, but was dropped after the consulting team determined it is no longer commercially available.	

Research Approach

Two steps were used to investigate the tools in this white paper. In the Fall of 2020, the consultant performed online research and contacted vendors. Online research consisted of visiting tool websites, extracting information related to attributes, and watching one webinar per in-depth profile tool.

In the Spring of 2021, more information was gleaned about these tools through an in-depth survey of peer MPO scenario planning experiences. Fifteen MPOs were contacted and 13 responded. These agencies have sophisticated in-house technical capabilities similar to those of TPB, and had conducted one or more recent scenario planning initiatives. Once the in-depth profiles were prepared, the profiles were sent to industry experts knowledgeable on the tool and to MPOs that have used the tool for a final review and to collect any missing information.

Key Findings

This section is divided into three subsections. The first subsection highlights a significant takeaway from the outreach to peer MPOs. The second subsection highlights findings from the tools that were explored in depth, and the third subsection highlights findings from the snapshots of nine additional tools.

Peer MPO Experiences

Most of the peer MPOs used a hybrid of in-house tools that were built upon traditional trip-based modeling (TBM) platforms. Most of the MPOs surveyed developed exploratory scenario planning process to examine potential trends and disruptors that could affect (negatively or positively) the region's ability to meet its goals. Topics typically included evolving transportation technologies, socio-economic trends, and, in at least one case, potential long-term impacts of the COVID-19 pandemic on travel demand.

The most frequently used tool was UrbanSim/Canvas followed by Remix and Urban Footprint/ RapidFire. Participants were also asked why they may have considered a scenario planning tool but ultimately did not end up further pursuing it. The most common reasons were the cost of the tool and/ or the learning curve required to use it. This finding suggests that, while there is a variety of scenario planning tools available for both broad-based and specialty applications, their limited functionalities and/ or costs to assemble might limit their market penetration as standalone, "go-to" models that can be applied broadly.

Key takeaways from the peer MPOs include:

- All but two MPOs used at least one of the 12 selected tools.
- Nine of the 12 tools were "considered, but not used" by one or more MPO.
- Five of the 12 tools were used regularly by one or more MPO.
- Five of the 12 tools were used periodically by one or more MPO.

In-Depth Tool Findings

The three selected tools for in-depth evaluation all help organizations answer some of the biggest uncertainties. They offer the broadest flexibility in analyzing and understanding the impacts of policy decisions. Although consideration for level of effort meant that each of them was only used by a single MPO.

TRAVEL MODEL IMPROVEMENT PROGRAM EXPLORATORY MODELING AND ANALYSIS TOOL (TMIP EMAT)

TMIP EMAT is a methodological approach to exploratory modeling and analysis. It provides a window to rigorous analytical methods for handling uncertainty and making well informed decisions using travel forecasting models of all types. It is designed to integrate with an existing transportation model or tool to perform exploratory analysis of a range of possible scenarios. In the documentation of TMIP EMAT, we refer to the existing model or tool as the "core model". The core model should take a collection of inputs and generate one or more outputs, or "performance metrics", of interest. Inputs

can include variable inputs (e.g., fuel cost) as well as model parameter inputs (e.g., the elasticity of vehicle travel with respect to fuel cost). It is useful for examining model forecasts as a range of model outcomes rather than a single outcome, and it provides a mechanism for defining uncertainties and visualizing outputs.

TRIP REDUCTION IMPACTS OF MOBILITY MANAGEMENT STRATEGIES (TRIMMS)

Developed in partnership with national and university research institutes, TRIMMS is a scenario planning and analysis tool that augments predictive travel models by considering Travel Demand Management (TDM) policies and investments. TRIMMS is used to understand how transportation and TDM strategies impact air quality and emissions, and is a stand-alone tool separate from a travel demand model. The tool analyzes TDM strategies that 1) directly impact the cost of travel 2) impact access, travel time, and employer-based programs, or 3) impact transit ridership through land use controls (e.g. – zoning). Tool outputs include change in mode share, social externalities, vehicle miles traveled (VMT), and emission pollutants, annual benefits and costs of strategies, and benefit/cost ratios. The outputs are viewed in a spreadsheet. TRIMMS is appropriate for regional and employer-based (worksite level) analysis. It is worth noting that TRIMMS was used as part of COG/TPB/MWAQC's Multi-Sector Working Group Study, the *National Capital Region Climate Change Report*.

VISIONEVAL

VisionEval is a scenario planning suite to evaluate potential transportation-related environmental impacts of policy decisions and is used by MPOs to answer questions that the regional travel demand model cannot answer. VisionEval is appropriate for policies at the aggregated region or regional levels, and is best used prior to or in parallel with a travel demand model. Hosted by FHWA, VisionEval is operated by the Collaborative Development of New Strategic Planning Models Pooled Fund. The VisionEval framework enables new model features to be added in a 'plug-and-play' fashion so they can be easily shared among models, and it is appropriate to analyze policies, but not projects, as there is no road network. The framework is built on the following "GreenSTEP family" of models:

- GreenSTEP - the first model in the strategic planning family, developed by the Oregon Department of Transportation (ODOT). The model was created to assist in the development of plans to reduce greenhouse gas (GHG) emissions from light-duty vehicles and to meet Oregon State statutory goals. GreenSTEP models the effects of many different factors (e.g. transportation supply, prices, land use, etc.) on household vehicle ownership and use, and the effects on emissions, traffic congestion, and other responses.
- Regional Strategic Planning Model (RSPM) – developed by Oregon DOT, RSPM is an offshoot of the original GreenSTEP tool. RSPM goes beyond GHG emissions by including non-motorized travel outcomes and subdivides metropolitan areas into districts.
- Rapid Policy Analysis Tool (RPAT) – developed under the federal Strategic Highway Research Program (SHRP2) also uses part of the GreenSTEP code. RPAT assists in the evaluation of potential effects of growth polices on regional travel.

Overall, TMIP EMAT and VisionEval require significantly more time to prepare and use than TRIMMS. TMIP EMAT and VisionEval are relatively newer tools while TRIMMS has been on the market longer.

Despite being available longer, TRIMMS has less market penetration or industry buzz than TMIP EMAT and VisionEval. TMIP EMAT and VisionEval are both supported by robust github websites while TRIMMS has a more traditional PDF manual and Microsoft Excel platform. All three tools complement and interact differently with a travel demand model. VisionEval is more appropriate prior to or in parallel with a travel demand model, while TMIP EMAT is used after a travel demand model has been run. TRIMMS is a standalone tool, that can be used with or without a travel demand model.

Snapshot Tool Findings

Nine tools were selected for review as snapshots. Notable findings from these tools indicate UrbanSim is the most widely used tool by peer MPOs. A few MPOs had explored Remix for transit service planning.

The issue of incompatible geographic units across data sets was identified for a few tools. Geographic units for UrbanSim, Urban Footprint, Envision Tomorrow, and Remix data outputs are larger than parcel level, making these tools difficult to use for agencies whose GIS datasets and/ or travel demand models are based on parcel-level data. Another theme among the tools was limited functionality, which reduced the cost-effectiveness of investing in software and data development. Two MPOs cited this as the reason for not fully using Remix, while another noted cost issues as the rationale for not using Remix.

Summary of Tool Attributes & Profiles

The following section summarizes all twelve tools with a comparison table of all tools and a profile for each tool. Table 2 and Table 3 highlight the initial attributes researched during the preliminary review to inform selection for the final list of tools. The two tables summarize the in-depth and snapshot tools by the following attributes: description, subject matter addressed, open access, cost, and a list of MPOs that have used the tool. A tool glossary then outlines the attributes identified for the in-depth and snapshot tools per tool profile. Finally, each tool is summarized with its own tool profile.

Table 2: Tools Selected for In-Depth Profiles

Tool	Description	Subject Matter Addressed	Open Access/ Cost	Organizations That Have Used Tool
TMIP EMAT	Aims to address deep uncertainty as a complement to traditional models. Examines forecasts as a range of outcomes to help agencies explore/ experiment with the impact of rapid technological changes such as Connected and Automated Vehicles (CAVs) on real-world planning needs.	Infrastructure Emerging Technology (automated/ connected/ electric / shared) Land use Resilience Demographics	Open: Yes (pilot phase) Cost: Free	Chicago Metropolitan Agency for Planning (CMAP), IL Metropolitan (Met) Council, Minneapolis, MN Oregon DOT Sacramento Area Council of Governments (SACOG), CA Southern California Association of Governments (SCAG), Los Angeles, CA Greater Buffalo-Niagara Regional Transportation Council, NY
TRIMMS	Estimates the impacts of Transportation Demand Management (TDM) initiatives and strategies affecting travel costs, access, time, and employer-based strategies.	Economy Environment	Open: Yes Cost: Free	French Broad River MPO, Asheville, NC San Diego Association of Governments (SANDAG), CA San Joaquin Council of Governments, Stockton, CA
VisionEval	Suite of tools to evaluate transportation-related environmental impacts of policy decisions. Brings together GreenSTEP, RSPM, and RPAT into a single framework.	Transportation, Environment Land use Public health Emerging Technology (in development)	Open: Yes Cost: Free	Atlanta Regional Commission (ARC), GA; Corvallis Area MPO, OR; Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Durham-Chapel Hill-Carrboro MPO, NC; Metropolitan (Met) Council, Minneapolis, MN; Sacramento Area Council of Governments (SACOG), CA

Table 3: Tools Selected for Snapshots

Tool	Description	Subject Matter Addressed	Open Access / Cost	Organizations That Have Used Tool
CityEngine	ArcGIS 3D city design software to build city and street models / simulations, and to visualize / measure scenarios.	Land Use Transportation and Land Use integration	Open: No Cost: $2,000 - $4,000 (annual)	Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA Merced Partnership in Planning (PIP), Merced, CA City of Redlands, CA
CommunityViz	ArcGIS extension capable of scenario planning, suitability analysis, build out potential, impact analysis, site planning, and comprehensive planning.	Land Use Transportation Economy Environment	Open: No Cost: Commercial ($1500 first year, $1000 annual renewal); Government / Non-profit ($875 first year, $675 annual renewal); Academic ($1000 first year, $500 annual renewal)	Bannock Transportation Planning Organization, ID Berkeley-Charleston-Dorchester Council of Governments, Charleston, SC Capital Area MPO (CAMPO), Jefferson City, MO Capital Area MPO (CAMPO), Raleigh, NC Cape Cod Commission, MA Centralina Council of Governments, Charlotte, NC Community Planning Association of Southwest Idaho, (COMPASS), Boise, ID Corvallis Area MPO, OR Lake Charles MPO, Calcasieu Parish, LA Macatawa Area Coordinating Council, Holland, MI Metropolitan Area Planning Council (MAPC), Boston, MA Pikes Peak Area COG, CO San Luis Obispo COG, CA
CubeLand	Forecasting model for real estate supply and demand scenarios. Forecasts land use and land price by simulating the real estate market under different conditions. Builds alternative housing and employment data sets for other modeling and analysis tools.	Land Use Transportation accessibility Econometrics Real Estate Employment Cost Residential Cost	Open: No Cost: Contact CitiLabs for demo/ quote	Fredericksburg Area MPO/ George Washington Regional Commission, VA Indianapolis MPO, IN Kern COG, Bakersfield, CA Metropolitan Area Planning Council (MAPC), Boston, MA Metropolitan (Met) Council, Minneapolis, MN Montgomery Area MPO, AL Southern California Association of Governments (SCAG), Los Angeles, CA

Tool	Description	Subject Matter Addressed	Open Access / Cost	Organizations That Have Used Tool
Envision Tomorrow	Allows users to analyze how their community's current growth pattern and future decisions will impact measures such as public health, fiscal resiliency, and environmental sustainability.	Location Efficiency Transportation Fiscal Impact Public Health Redevelopmen Housing Equity	Open: Yes Cost: Free	Cape Cod Commission, MA Chicago Metropolitan Agency for Planning (CMAP), IL Fresno Council of Governments, CA Omaha-Council Bluffs Metropolitan Area Planning Association, NE Mid-America Regional Council (MARC), Kansas City, KS/MO Sacramento Area COG (SACOG), CA Southern California Association of Governments (SCAG), Los Angeles, CA Wasatch Front Regional Council (WFRC), Salt Lake City, UT
Remix	Multiple tools including Transit, Shared Mobility, Multimodal Street Planning, and Exploring. Each tool can be used individually or paired together. Strives for user-friendly and fast acting interfaces that provide real time insight to the public and decision makers.	Transportation Emerging Technology	Open: No Cost: Contact Remix for demo/ quote	Atlanta Regional Commission (ARC), GA Evansville MPO, IN Metropolitan (Met) Council, Minneapolis, MN Miami-Dade County Transportation Planning Organization, FL Montgomery County, MD Piedmont Authority for Regional Transportation, Greensboro, NC Puget Sound Regional Council (PSRC), Seatle, WA City of Providence, RI Sacramento Area Council of Governments (SACOG), CA
TDM+ (Fehr & Peers)	Allows employers and developers to estimate how a Transportation Demand Management (TDM) plan affects vehicle trip generation and corresponding vehicle miles traveled (VMT).	Transportation Environment	Open: No Cost: Can be customized for clients on an engagement basis	California Air Resources Board City of Los Angeles City of San Francisco
Uplan	Simple rule based urban growth model intended for regional or county level modeling on an ArcGIS platform.	Land Use	Open: Yes Cost: Free	Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA Kern COG, Bakersfield, CA

Tool	Description	Subject Matter Addressed	Open Access / Cost	Organizations That Have Used Tool
Urban Footprint / RapidFire	UrbanFootprint: geospatial bottom-up tool to evaluate existing conditions, explore urban markets, analyze impacts of future scenarios, and support transparent communication with easy-to-understand maps and reports. RapidFire: spreadsheet-based top-down tool to test data input impacts on land use patterns and policies across metrics.	Public Health Land Use Environment	Open: No Cost: Contact Urban Footprint for quote	Capitol Region COG, Hartford, CT Greater Nashville Regional Council, TN Metropolitan (Met) Council, Minneapolis, MN Sacramento Area COG (SACOG), CA San Diego Association of Governments (SANDAG), CA Southern California Association of Governments (SCAG), Los Angeles, CA
UrbanSim/ UrbanCanvas	UrbanSim: Leverages urban simulation, 3D visualization, and shared open data to explore, gain insights into, and develop and evaluate alternative community development plans. UrbanCanvas: scenario modeling tool within UrbanSim comparable to CityEngine within ArcGIS.	Land Use Economy Environment	Open: Urban Sim yes, Urban Canvas no Cost: Some features free, others at cost.	Capital Area MPO (CAMPO), Austin, TX Central Lane MPO, Eugene, OR Champaign County Regional Planning Commission, Urbana, IL Chicago Metropolitan Agency for Planning (CMAP), IL Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA Denver Regional COG (DRCOG), CO Greater Nashville Regional Council, TN Maricopa Association of Governments (MAG), Phoenix, AZ Metropolitan Area Planning Council (MAPC), Boston, MA Metropolitan (Met) Council, Minneapolis, MN Mid-America Regional Council (MARC), Kansas City, KS. MO Mid-Region COG, Albuquerque, NM North Front Range COG, Fort Collins, CO Oahu MPO and City of Honolulu, HI Pikes Peak Area COG, CO Pima Association of Governments, Tucson, AZ Puget Sound Regional Council (PSRC), Seattle, WA Sacramento Area COG (SACOG), CA San Diego Association of Governments (SANDAG), CA

Tool Profiles

Glossary

The twelve tools explored in this white paper are summarized in individual profiles, beginning with detailed descriptions of the three in-depth profile tools and shorter summaries of the other nine snapshot tools.

This glossary provides a general definition for each attribute. An asterisk (*) indicates the attribute is included only in the in-depth tool profiles.

SUBJECT MATTER
Topics that can be addressed by the tool such as economy, environment, and technology.

TOOL TYPE
Quick characterization of the tool's application to sketch planning, analysis, and evaluation.

APPLICATION
Exploratory, predictive, or normative.

INPUT VALUES
Specific variables or general categories

INPUT TYPES
Input formats, e.g., visualizations (charts, tables), spreadsheets, maps, dashboards, or web-based formats.

OUTPUT VALUES
Specific variables or general categories.

OUTPUT TYPES
Output formats, e.g., visualizations (charts, tables), spreadsheets, maps, dashboards, or web-based formats.

GEOGRAPHY AND SCALE*
Level of analysis granularity, e.g., site specific, road segment, neighborhood, or region.

CUSTOMIZABILITY*
Ability to customize features, inputs, outputs.

RESOURCES REQUIRED*
Equipment and Software : Primary equipment or software need for tool use.

Data Collection: Data needed for tool inputs.

Calibration and validation needs: Steps/ inputs to calibrate and validate the tool.

Maintenance needs: Ongoing or periodic process or input maintenance.

Baseline and alternative scenario input preparation needs: Steps to prepare and enter data.

Average time to run a scenario: Typical time for one model run.

Average time for study: Average time to conduct a full initial study, which can vary greatly depending on the user's project.

RAPID VISUALIZATION CAPABILITIES*
Tool's capability to produce and update a ready-made visualization for public engagement use, often in real-time.

COMPARISON TO TRAVEL DEMAND MODEL*
How tool relates to a traditional travel model.

ORGANIZATIONS THAT USE IT
MPOs and others that have used the tool.

OPEN ACCESS
Open-source verses licensed tool.

COST
General range to purchase software and/ or license.

WEBSITE
Tool URL

In-Depth Tool Profiles

In-depth profiles were developed for three tools: Travel Model Improvement Program's Exploratory Modeling and Analysis Tool (TMIP EMAT), the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS), and VisionEval. Each tool's profile includes a narrative description, analysis capabilities, and the tool workflow. Following the paragraph format is a two-column list of attributes defined in the previous Tool Details Glossary.

TRAVEL MODEL IMPROVEMENT PROGRAM EXPLORATORY MODELING AND ANALYSIS TOOL (TMIP EMAT)

The Exploratory Model and Analysis Tool (EMAT) from FHWA's Transportation Model Improvement Program (TMIP), or TMIP EMAT, was created as a complementary tool to address uncertainty in traditional travel demand models. TMIP EMAT explores uncertainties in input variables and model parameters that are outside the policy-maker's control, and the impact that those uncertainties have on performance metrics. It is useful for examining model forecasts as a range of model outcomes rather than a single outcome and provides a mechanism for defining uncertainties and visualizing outputs. It can also be used to understand how uncertainties interact with policy decisions or "levers" (e.g., extending a transit line), which are expressed as model inputs that are within the policy-maker's control.

TMIP EMAT is an add-on tool and does not replace traditional models. The tool takes core model outputs to create a meta-model using RAND's quantitative Robust Decision-Making approach. Performance measures are then reviewed through risk analysis and exploratory analysis.

Analysis Capabilities

TMIP EMAT is used to analyze risk factors across various strategies and performance measures. During scoping, a user defines strategies to test, performance measures to evaluate per strategy, and identifies risk variables per strategy. The outputs of the tool are then reviewed through risk analysis and exploratory analysis visualizers. Because TMIP EMAT is an add-on to a core model, performance measures are limited to those that can be derived from core model outputs.

An example of a strategy that might be analyzed is the extension of a light rail system or the decommissioning of a highway to an arterial roadway as was presented in *Introducing the TMIP Exploratory Modeling Analysis Tool (TMIP-EMAT)*[2]. Performance measures around VMT, trip length, accessibility, changes in trips, and travel time can be used to measure outcomes. Risk analysis factors that could impact these two strategies are used, such as household and employment changes, roadway capacity, vehicle availability, and the perceived cost of auto in-vehicle travel time. Three levels per risk variable are then selected to highlight the minimum outcome, most likely, and maximum threshold. TMIP EMAT builds the meta models based on the core model runs per risk variable and strategy.

TMIP EMAT Workflow[3]

1. Scoping: Define the uncertainties, the decision space, and performance measures.

[2] Cook, S., Copperman, R., Milkovits, M., & Sun, S. (2018, December 18). Webinar - Introducing the Exploratory Modeling and Analysis Tool (TMIP-EMAT) | FHWA TMIP FMIP

3 SACOG Peer Review of TMIP EMAT – August 2019

2. Model development. In TMIP EMAT, the underlying travel demand model is called the "core model." If the core model runs quickly, it can simply be run many times to explore the uncertainties and decision space. If the core model has a longer run time (e.g., several hours to days for an MPO travel demand model), then meta-models are developed. Meta-models are regression models of the core model outputs that run very quickly. The steps to develop a meta-model include:
    a. Design a set of experiments to be run in the core model
    b. Run the experiments in the core model
    c. Derive the meta-model
3. Simulation and analysis. Thousands of experiments are run using the meta-model, to build a multi-dimensional surface of outcomes. These outcomes are then examined to see how well they match the goals.

TMIP EMAT Tool Details

SUBJECT MATTER
Infrastructure, Technology (Automated/ Connected/Electric/Shared); Land Use; Resilience; Demographics.

TOOL TYPE
Scenario planning and analysis.

APPLICATION
Exploratory scenario planning for high-uncertainty subjects.

INPUT VALUES
Performance measures generated by the core regional travel demand model (e.g., regional vehicle miles traveled, total transit boardings, regional mode share); "Risk variables" from core regional travel demand model inputs (e.g., land use, transportation network) and/or core model parameters (e.g., value of time, auto operating costs, freeway capacities).

Risk variables are used as independent variables and performance measures as dependent variables to design an experiment that coveres the uncertainty space and estimates a regression-based metamodel. All needed input values are available from the core model.

INPUT TYPES
Application Programming Interface (API) connection established directly to core model.

OUTPUT VALUES
Meta-model exports fall into risk analysis and exploratory analysis categories unique to the user's performance measures. Risk analysis displays a probability distribution of inputs. Exploratory analysis ranges are focused on existence, not probability.

OUTPUT TYPES
Visualizations and spreadsheets.

GEOGRAPHY AND SCALE
Corridor, neighborhood, and region.

CUSTOMIZABILITY
Highly customizable; based on risk variables and policies examined by core model.

RESOURCES REQUIRED
Equipment and Software: API Connection.

Data Collection: Outputs from scenario run conducted by the core regional travel demand model.

Calibration and validation needs: Unknown.

Maintenance needs: Unknown.

Baseline and alternative scenario input preparation: Unknown.

Average time to run a scenario: Unknown (substantially less than full travel demand model run).

Average time for study: Months to a year.

RAPID VISUALIZATION CAPABILITIES
No.

COMPARISON TO TRAVEL DEMAND MODEL
TMIP EMAT is an add-on tool for a regional travel demand model and does not replace traditional models.

ORGANIZATIONS THAT USE IT
Chicago Metropolitan Agency for Planning (CMAP), IL; Metropolitan (Met) Council, Minneapolis, MN; Oregon DOT; Sacramento Area Council of Governments (SACOG), CA; Southern California Association of Governments (SCAG), Los Angeles, CA; Greater Buffalo-Niagara Regional Transportation Council, NY

OPEN ACCESS
Yes.

COST
Free.

WEBSITE
tmip-emat.github.io

TRIP REDUCTION IMPACTS OF MOBILITY MANAGEMENT STRATEGIES (TRIMMS)

The Trip Reduction Impacts of Mobility Management Strategies (TRIMMS) tool is a visual basic spreadsheet model that estimates the impacts of a broad range of transportation demand management (TDM) initiatives and provides cost effectiveness assessment, such as net program benefit and benefit-to-cost ratio analysis. Strategies affecting the cost of travel, travel access, travel time, land use, and employer-based support programs can be analyzed at regional or worksite levels.

The tool was developed by the National Center for Transit Research and the Center for Urban Transportation Research at the University of South Florida with funding from state and federal sources. The US Environmental Protection Agency has primarily used TRIMMS for its Travel Efficiency Assessment Method (TEAM) case studies to understand how transportation and TDM strategies impact air quality and emissions.

Analysis Capabilities

The user can analyze TDM strategies in the following categories:

- Transportation strategies that directly impact the cost of travel (e.g. transit subsidies, vanpool discounts, bicycle incentives, parking pricing)
- Employer-based program strategies that impact accessibility and travel time (e.g. telework, emergency ride home, worksite amenities)
- Land-use controls that impact transit ridership (e.g. transit-oriented development initiatives, population, and retail density level policies)
- Evaluation of TDM strategies that provide an estimate of mode share and VMT changes, and the benefit-to-cost ratio for implementing TDM strategies. The tool uses these estimated mode share and VMT changes to estimate the impact on social externalities such as air pollution, added congestion, excess fuel consumption, global climate change, health and safety, and noise pollution.

TRIMMS Workflow

1) Data inputs: A user selects a Metropolitan Statistical Area (MSA) and inputs the following data in four tables:
    a) Analysis Details: project details at a regional or employment site level (e.g. number of employees, project duration, project cost)
    b) Employer-Based Commuter Programs: program to be analyzed (e.g. TDM subsidies, access to transit or bike facilities near site)
    c) Transportation and Employer-based Strategies: e.g. current cost of parking, new cost of parking, new travel time after a transit station opens
    d) Land Use Controls: only used for area wide analysis (e.g. zoning, parcel size)
2) Run analysis
3) Review results worksheet
4) Edit default parameters and elasticities to refine results

TRIMMS Tool Details

SUBJECT MATTER
Economy, Environment.

TOOL TYPE
Sketch planning and analysis to augment predictive travel models with consideration of TDM policies and investments.

APPLICATION
Predictive and exploratory scenario planning.

INPUT VALUES
Analysis Details: project details at a regional or employment site level (e.g. number of affected employees, occupations, industries); program duration and cost.

Employer-based Programs: worksite characteristics (e.g., bike facilities near site, shopping onsite); selection of programs for analysis (e.g. TDM subsidies, telework).

Transportation and Employer-based Strategies: parking/ trip costs, access, travel times by mode (transit, cycling, and walking)

Land Use Controls: area-wide analysis of policies to influence population density, retail density, transit station accessibility, transit-oriented development

INPUT TYPES
Area-wide or site-specific numeric values (e.g., cost of parking) or binary yes/no selections (e.g., flexible hours, shopping onsite or within ¼ mile). Single input value per parameter and analysis; no geographic granularity.

OUTPUT VALUES
Change in mode share, social externalities, VMT, emission pollutants; annual benefits and costs; benefit/cost ratio.

OUTPUT TYPES
Spreadsheets.

GEOGRAPHY AND SCALE
Regional and employer-based (worksite level).

CUSTOMIZABILITY
Limited

RESOURCES REQUIRED
Equipment and Software: Microsoft Excel.

Data Collection: Employment inputs for a worksite or region, and elements of TDM strategies to measure.

Calibration and validation needs: User can review and edit sensitivity analysis using default or self-defined parameters (global and local), fare elasticities, and mode share.

Maintenance needs: Ensure software is up to date with latest version.

Baseline and alternative scenario input preparation needs: Baseline average defaults provided for U.S. and by metro area. Default parameters (e.g., population, employment, wages, mode share, vehicle occupancy, trip length, fuel prices, etc.) can be overridden.

Scenario preparation requires basic definition of programs to be evaluated (see Input Values).

Average time to run a scenario: Minutes.

Average time for study: Hours or days.

RAPID VISUALIZATION CAPABILITIES

No.

COMPARISON TO TRAVEL DEMAND MODEL

Stand-alone estimation tool for impacts of TDM programs on region or worksite.

ORGANIZATIONS THAT USE IT

French Broad River MPO, Asheville, NC; San Diego Association of Governments (SANDAG), CA; San Joaquin Council of Governments, Stockton, CA

OPEN ACCESS

Yes.

COST

Free.

WEBSITE

trimms.com

VISIONEVAL SUITE: GREENSTEP, REGIONAL STRATEGIC PLANNING MODEL (RSPM) AND RAPID POLICY ANALYSIS TOOL (RPAT)

VisionEval is an ongoing collaborative project facilitated by FHWA, through which participating State DOTs and MPOs create applications to integrate the GreenSTEP family of strategic tools for performance-based transportation planning into a single, open-source programming framework. Strategic tools are designed to evaluate many alternative futures and policies to help state and metropolitan area governments address pressing issues, despite uncertainty. The common framework enables new model features to be added in a 'plug-and-play' fashion so they can be easily shared among model users.

VERPAT and VERSPM are the two primary models within VisionEval. They differ by geographic scale, outputs, and evolved respectively from the Rapid Policy Analysis Tool (RPAT) and the Regional Strategic Planning Model (RSPM), and both have elements of the GreenSTEP tool. VERSPM operates at the zonal level, providing results for geographic units similar to Transportation Analysis Zones. A third model, VEState, provides a statewide analysis capability for the VERSPM model. VERPAT operates at the regional or neighborhood level, providing a single result for each measure and for each geography.

Analysis Capabilities

VisionEval's strength lies in its ability to evaluate large numbers of scenarios and analyze how future scenarios are sensitive to novel behavioral travel changes, such as the potential for travelers to shift toward shared-ride and/ or ridehailing services or to increase use of personally owned vehicles in response to the market penetration of evolving transportation technologies and mobility options.

VisionEval supports high level analyses of the potential impacts of policy decisions on outcomes such as peak travel, active travel, land use (e.g., testing the impact of an Accessory Dwelling Unit ordinance), energy, and the built environment. It is used by MPOs to explore topics that the regional travel demand model is not well suited to address, such as economic factors, fuel prices, changes in urban form, TDM strategies, and ITS improvements. MPOs can use the insights gained from VisionEval scenarios to inform and revise assumptions for travel demand modeling.

The framework is appropriate to analyze general, theoretical potential impacts of policies, but not to assess specific projects or programs, as the tool does not involve defining a roadway network or location-specific data. Policies suitable for testing in VisionEval typically feature one or more of the following characteristics:

- Region-wide impacts;
- Early in development and/ or involve a lot of unknown elements;
- Can be compared across broad ranges or types of programs (e.g., TDM, ITS, transit service);
- Appropriate for testing resilience of impacts under an array of uncertain conditions; and /or
- Require analysis at the policy level (e.g., carbon tax).

Within VERSPM, almost 100 performance metrics are produced. Eight key metrics are displayed in the Scenario Viewer : greenhouse gas target reduction, daily vehicle miles per capita, walk trips per capita, air pollution emissions, annual fuel use, truck delay, household vehicle costs as percentage of income, low income household vehicle costs as percentage of income. Within VERPAT, 22

performance metrics are produced. Six key metrics are displayed in the Scenario Viewer: fatalities and injuries per 1,000 persons, vehicle cost per capita, daily vehicle miles traveled per capita, greenhouse gas emissions per capita, fuel consumption and daily vehicle hours traveled per capita.

VisionEval Workflow

1) Select VisionEval Model scale (VERPAT, VERSPM, or VEState).
2) Customize model by removing or adding modules and packages to and from other models. VisionEval modules are the core building blocks within the script and perform single tasks such as “create household.” Packages are combinations of one or more related modules. Each module has specific instructions for recommended data input.
3) Use R or RStudio to input data and run analysis.
4) Use Graphical User Interface and Scenario Viewer to analyze results.

VisionEval Tool Details

SUBJECT MATTER
Uncertainty, Transportation, Environmental, Land Use, Public Health.

TOOL TYPE
A robust scenario planning suite to evaluate potential transportation-related environmental impacts of policy decisions.

APPLICATION
Exploratory scenario planning.

INPUT VALUES
Employment count or characteristics (e.g., industry); land use attributes (e.g., location type, built form density, diversity, design ('D') values); parking policies; transportation demand management (TDM) programs.

INPUT TYPES
Population, employment, land use, and transportation characteristics.

OUTPUT VALUES
Default performance measures that vary by module. Output metric categories include travel, cost, safety, and environment.

OUTPUT TYPES
ScenarioViewers are interactive web maps and interfaces that enable public engagement such as altering pre-defined inputs and voting.

GEOGRAPHY AND SCALE
Aggregated region or regional zones.

CUSTOMIZABILITY
Relatively customizable using an open-source plug-and-play format.

RESOURCES REQUIRED
Equipment/Software: R or RStudio.

Calibration and validation needs: Default parameters can be adjusted. Calibration mostly involves the sensitivity of scenarios, or dynamic validation.

Maintenance needs: varies depending upon complexity of scenarios and number of inputs.

Baseline and alternative scenario input preparation needs: Scenario development is the most time consuming within the initial study, and is impacted by number of inputs and outputs, and engagement of agency staff.

Average time to run a scenario: 15 to 60 minutes.

Average time for study: Months to a year.

RAPID VISUALIZATION CAPABILITIES
ScenarioViewers are online, quick-response tools that allow the public to "play with" scenario options to learn how certain policies would impact the region.

COMPARISON TO TRAVEL DEMAND MODEL
VisionEval is more agile but less detailed than a traditional model. It should run before or in conjunction with developing a travel demand model. Outputs can inform assumptions used for the travel demand model.

ORGANIZATIONS THAT USE IT
Atlanta Regional Commission (ARC), GA; Corvallis Area MPO, Fort Collins, OR; Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Durham-Chapel Hill-Carrboro MPO, NC; Metropolitan (Met) Council, Minneapolis, MN; Sacramento Area Council of Governments (SACOG), CA

OPEN ACCESS
Yes.

COST
Free. Option to participate as collaborative MPO partner: $15,000 annually for three years.

WEBSITE
visioneval.org

Tool Snapshots

The following nine tools are featured in the next section of snapshots:

- CityEngine
- CommunityViz
- Cube Land
- Envision Tomorrow
- Remix
- TDM+ by Fehr & Peers
- Uplan
- Urban Footprint / RapidFire
- UrbanSim / UrbanCanvas.

Each profile includes a narrative description followed by two columns of tool attribute data.

CityEngine

ArcGIS CityEngine is a 3D modeling software which can rapidly generate urban environments. CityEngine can use real-world GIS data, and iterate various design scenarios for urban planning and transportation projects. CityEngine is extensible for entire urban areas or localize areas of specific plans. 3D visualizations allow stakeholders to view project details and contemplate various scenarios. CityEngine is applicable software for jurisdictions to create a Digital Twin of their built environment.

SUBJECT MATTER
3D Urban modeling, Land Use, Transportation and Land Use integration.

TOOL TYPE
GIS model for allocating land development according to user-defined parameters.

APPLICATION
Normative and exploratory scenario planning.

INPUT VALUES
GIS data, building footprints, streets, public infrastructure assets, demographics, any GIS data.

INPUT TYPES
GIS data, CADD data,

OUTPUT VALUES
Cities, buildings and streets.

OUTPUT TYPES
Web maps and interfaces, 3D simulation, 3D models,

NOTABLE PEER FEEDBACK
Considered using, but learning curve was not worth the outputs for earlier iteration. Newer versions are a little simpler. – DRCOG

ORGANIZATIONS THAT USE IT
Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Merced Partnership in Planning (PIP), Merced, CA; City of Redlands, California

Most organizations may have CityEngine developed by consultants as the technology is very detail oriented and often beyond a local jurisdiction's internal capabilities.

OPEN ACCESS
3D outputs are easily shared via video or online.

COST
Purchase from vendor –

For use with ArcGIS online - $2,000 / year

For use as a desktop license - $2,000 / year

For use as a desktop license perpetually - $4,000

https://www.esri.com/en-us/arcgis/products/arcgis-cityengine/buy

WEBSITE
esri.com/en-us/arcgis/products/arcgis-cityengine/overview

CommunityViz

CommunityViz is an ArcGIS extension capable of scenario planning, suitability analysis, build out potential, impact analysis, site planning, and comprehensive planning. The tool illustrates alternative land development patterns and associated impacts on criteria that the user can select from a pre-defined list. CommunityViz offers Scenario 360, an ArcGIS extension that adds interactive analysis tools and a decision-making framework.

SUBJECT MATTER
Land Use, Transportation, Economy, Environment.

TOOL TYPE
Planning for land development scenarios.

APPLICATION
Normative, predictive, and exploratory scenario planning.

INPUT VALUES
Existing development, local land use plans, environmental features, etc.

INPUT TYPES
GIS shapefiles and travel demand software.

OUTPUT VALUES
Demographic indicators, such as: population, employment, school-aged children

Transportation indicators, such as VMT,walkability, households served by transit

Land Use and Housing Indicators, such as: residential density, retail square feet, average lot size

Environmental and Climate Change indicators, such as: residential building energy use, water use, wastewater generation

Economy indicators, such as: Jobs-housing balance indicators, such as: retail/service floor space, cost of new residential infrastructure

OUTPUT TYPES
3D Scenarios, Web-ready illustrations, dynamic charts and displays, Google Earth Exports.

NOTABLE PEER FEEDBACK
None.

ORGANIZATIONS THAT USE IT
Bannock TPO, ID; Berkeley-Charleston-Dorchester Council of Governments, Charleston, SC; Capital Area MPO (CAMPO), Jefferson City, MO; Capital Area MPO (CAMPO), Raleigh, NC; Cape Cod Commission, MA; Centralina COG, Charlotte, NC; Community Planning Association of Southwest Idaho (COMPASS), Boise, ID; Corvallis Area MPO, OR; Lake Charles MPO, LA; Macatawa Area Coordinating Council, Holland, MI; Metropolitan Area Planning Council (MAPC), Boston, MA; Pikes Peak Area COG, CO; San Luis Obispo COG, CA

OPEN ACCESS
No.

COST
Purchase from vendor.

WEBSITE
communityviz.city-explained.com/index.htm

Cube Land

Cube Land is an econometric land-use allocation model that brings realistic land-transport interactions into the modeling process. Cube Land identifies the impacts of economic growth, changes in population, employment and wealth, urban growth management policies, real estate development projects, and transportation projects and policies.

SUBJECT MATTER
Land Use, Accessibility, Econometrics, Real Estate, Employment Costs, Residential Cost.

TOOL TYPE
Forecasting model for real estate supply/ demand scenarios and econometric land use forecasting model.

APPLICATION
Predictive scenario planning.

INPUT VALUES
Parcel zoning, parcel value (residential) or rent (residential and commercial), attractiveness (proximity to parks, schools, transportation options, job and shopping opportunities), existing development, control total development.

INPUT TYPES
Parcel data for zoning, price, and accessibility. Regional or sub-regional control totals by land use type.

OUTPUT VALUES
Total and incremental changes in land supply, location, and rents by zone. Estimates location of households and non-residential activities for different groups. Incentive and disincentive scores. Income distribution by geography.

OUTPUT TYPES
Maps, charts, databases, and spreadsheets.

NOTABLE PEER FEEDBACK
None.

ORGANIZATIONS THAT USE IT
Fredericksburg Area MPO/George Washington Regional Commission, VA; Indianapolis MPO, IN; Kern COG, Bakersfield, CA; Metropolitan Area Planning Council (MAPC), Boston, MA; Metropolitan (Met) Council, Minneapolis, MN; Montgomery Area MPO, AL; Southern California Association of Governments (SCAG), CA

OPEN ACCESS
No.

COST
Purchase from vendor.

WEBSITE
citilabs.com/software/cube/cube-land

Envision Tomorrow

Envision Tomorrow is an open-access scenario planning package that allows users to analyze how their community's current growth pattern and future decisions impacting growth will impact a range of measures from public health, fiscal resiliency, and environmental sustainability. A design-based model capable of comparing five scenarios against existing conditions.

SUBJECT MATTER
Location Efficiency, Fiscal Impact, Public Health, Redevelopment, Housing,Equity.

TOOL TYPE
Planning for land development scenarios.

APPLICATION
Design-based model and normative scenario planning.

INPUT VALUES
Unknown

INPUT TYPES
Commonly accessible GIS data, such as tax ssessor parcel data and Census data

OUTPUT VALUES
Housing density, job density, housing type, job type, energy emissions and carbon emissions associated with buildings, vehicles, travel behavior, and fiscal impacts and more.

OUTPUT TYPES
Spreadsheets and maps.

NOTABLE PEER FEEDBACK
Utilized pro-forma version to determine types of feasible development in different locations. The manual input process has made it difficult to keep current. -MARC

Spatial scope is larger than necessary for travel and land use model, making it difficult to use. Can paint land uses, but the data often need fixing in GIS. -SACOG

ORGANIZATIONS THAT USE IT
Cape Cod Commission, MA; Chicago Metropolitan Agency for Planning (CMAP), IL; Fresno Council of Governments, CA; Mid-America Regional Council (MARC), MO; Omaha-Council Bluffs Metropolitan Area Planning Association, NE; Sacramento Area Council of Governments (SACOG), CA; Southern California Association of Governments (SCAG), Los Angeles, CA; Wasatch Front Regional Council (WFRC), Salt Lake City, UT

OPEN ACCESS
Yes.

COST
Free.

WEBSITE
envisiontomorrow.org

Remix

Remix is an online browser-based tool primarily used for public transit planning. It provides rapid route design and allows users to create complex scenarios and communicate ideas visually, quickly, and easily. Remix has multiple tools including Transit, Shared Mobility, Multimodal Street Planning, and Exploring. Each tool can be used individually or with others. Remix strives for user-friendly and fast acting interfaces that provide real time insight to the public and decision makers.

SUBJECT MATTER
Accessibility, Emerging Technology.

TOOL TYPE
Planning, primarily for transit, and analysis of alternative route configurations.

APPLICATION
Normative, predictive, and exploratory scenario planning.

INPUT VALUES
Unknown.

INPUT TYPES
Unknown.

OUTPUT VALUES
Jobs, employees, and population demographics within range of transit/bike facilities, daily micromobility trip number and locations, public outreach language needs.

OUTPUT TYPES
Interactive maps/ web interface, and street design mock-ups, charts.

NOTABLE PEER FEEDBACK
Does not provide enough functionality and is only usable for project level evaluation. -ARC

Considered Remix but the cost for licensing was prohibitive. -Miami-Dade TPO

Not used for MPO Transportation plan, only transit planning with providers. -SACOG

Easy to use functionality and visualization, but limitations with base maps, merging multiple networks, and underestimation of travel times. – PSRC

ORGANIZATIONS THAT USE IT
Atlanta Regional Commission (ARC), GA; Evansville MPO, IN; Metropolitan (Met) Council, Minneapolis, MN; Miami-Dade County Transportation Planning Organization, FL; Montgomery County, MD; Piedmont Authority for Regional Transportation, Charlotte, NC; Puget Sound Regional Council (PSRC), Seattle, WA; City of Providence, RI; Sacramento Area Council of Governments (SACOG), CA

OPEN ACCESS
No.

COST
Purchase from vendor.

WEBSITE
remix.com

TDM+ (Fehr & Peers)

TDM+ is a tool developed by Fehr & Peers that enables agencies, employers, and developers to estimate how a Transportation Demand Management plan affects vehicle trip generation and corresponding vehicle miles traveled (VMT).

SUBJECT MATTER
Transportation, Environment.

TOOL TYPE
Sketch planning and analysis tool for TDM impacts.

APPLICATION
Predictive scenario planning.

INPUT VALUES
Project Location Type (based on Deborah Salon's 2014 study *Quantifying the Effect of Local Government Actions on VMT*), Project land use (Office, Residential, Retail, and "Other), TDM strategies (participation rate, subsidy value.

INPUT TYPES
Land Use context, project land use, project TDM strategies.

OUTPUT VALUES
Change in trip generation, mode share, trip types (employee v. visitor) and VMT.

OUTPUT TYPES
Charts and visualizations.

NOTABLE PEER FEEDBACK
None.

ORGANIZATIONS THAT USE IT
California Air Resources Board; City of Los Angeles; City of San Francisco

OPEN ACCESS
No.

COST
Purchase from vendor.

WEBSITE
fehrandpeers.com/tdm

UPlan

UPlan is a simple, rule-based urban growth model intended for regional or county level modeling on an ArcGIS platform.

SUBJECT MATTER
Land Use.

TOOL TYPE
GIS model for allocating land development according to user-defined parameters.

APPLICATION
Normative and exploratory scenario planning.

INPUT VALUES
Unknown.

INPUT TYPES
Commonly accessible GIS data, such as tax assessor parcel data and Census data.

OUTPUT VALUES
Identification of land sites and unsuitable development sites.

OUTPUT TYPES
3D Scenarios, Web-ready illustrations, dynamic charts and displays, Google Earth Exports.

NOTABLE PEER FEEDBACK
None.

ORGANIZATIONS THAT USE IT
Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Merced Partnership in Planning (PIP), Merced, CA; Kern COG, Bakersfield, CA

OPEN ACCESS
Yes.

COST
Free.

WEBSITE
ice.ucdavis.edu/project/uplan

UrbanFootprint / RapidFire

UrbanFootprint is a geospatial bottom-up tool that evaluates existing conditions, explores urban markets, analyzes the impacts of future scenarios, and supports transparent communication with easy-to-understand maps reporting. The companion tool RapidFire is a spreadsheet-based top-down tool that tests data input impacts on land use patterns and policies across metrics.

SUBJECT MATTER
Health, Land Use, Environment.

TOOL TYPE
Planning for land development scenarios.

APPLICATION
Normative and exploratory scenario planning.

INPUT VALUES
Existing buildings, land uses, and other details of the built environment.

INPUT TYPES
Data and research-based assumptions about the future.

OUTPUT VALUES
Pollutant emissions, land consumption, water use, VMT, fuel use, household energy, and water and transportation expenses. Transit accessibility to employment, parks, schools, hospitals. Walk accessibility to transit, parks, schools, services. Measure projected sea level rise and flood and fire hazards.

OUTPUT TYPES
Charts, maps, and interactive web / interfaces.

NOTABLE PEER FEEDBACK
Spatial scope is larger than parcel level data, which is what we need for travel and land use models. Had to switch to GIS. -SACOG

ORGANIZATIONS THAT USE IT
Capitol Region COG, Hartford, CT; Greater Nashville Regional Council, TN; Metropolitan (Met) Council, Minneapolis, MN; Sacramento Area Council of Governments (SACOG), CA; San Diego Association of Governments (SANDAG), CA; Southern California Association of Governments (SCAG), Los Angeles, CA

OPEN ACCESS
No.

COST
Purchase from vendor.

WEBSITE
urbanfootprint.com/features/analysis-modules

UrbanSim / UrbanCanvas

UrbanSim is a complex and powerful modeling platform available to simulate metro real estate markets and impacts of land use and transportation plans. It is used to predict behaviors or interaction within a network or system to illustrate the cause and effect of different scenario variables relative to environmental, transportation, economic, and development goals. It can be used in conjunction with activity-based travel models to analyze alternatives and explore strategies to achieve target outcomes. Urban Canvas provides access to block, zone, and parcel-level UrbanSim models. UrbanCanvas is similar to CityEngine, but is integrated with UrbanSim. It provides 3D visualization and scenario comparisons but with lower analytical capability than CityEngine.

SUBJECT MATTER
Land Use, Economy, Environment.

TOOL TYPE
Predictive modeling and visualization suite of tools for augmenting travel models with alternative land use inputs.

APPLICATION
Normative and exploratory scenario planning.

INPUT VALUES
Transit investments, roadway improvements by type, pricing strategies, TDM/bike-sharing; comp. plans, zoning codes, parking availability and pricing, TOD, urban villages and centers, subsidies, impact fees, Financing, UGBs, protection of environmentally sensitive areas.

INPUT TYPES
The tool leverages simulation, 3D visualization, and shared open data to develop and evaluate alternative land use and transportation scenarios.

OUTPUT VALUES
Households by income, age, size, and prescence of children; employment by industry and land use type; acreage by land use; dwelling units by type; square feet of nonresidential space by type; real estate prcies and rents.

OUTPUT TYPES
3D simulation and modeling.

NOTABLE PEER FEEDBACK
UrbanCanvas has essentially morphed into UrbanSim. UrbanSim helps set up initial implementation. -DRCOG

Considering parcel model as it auto-generates pro forma. Currently use block model but only partially run. Data requirements and cost have been main deterrent from changing to parcel version. -MARC

ORGANIZATIONS THAT USE IT
Capital Area MPO (CAMPO), Austin, TX; Central Lane MPO, OR; Champaign County Regional Planning Commission, Urbana, IL; Chicago Metropolitan Agency for Planning (CMAP), IL; Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Denver Regional COG (DRCOG), CO; Greater Nashville Regional Council, TN; Maricopa Association of Governments (MAG), Phoenix, AZ; Metropolitan Area Planning Council (MAPC), Boston, MA; Metropolitan (Met) Council, Minneapolis, MN; Mid-America Regional Council (MARC), Kansas City, KS/MO; Mid-Region COG, Albuquerque, NM; North Front Range COG, Fort Collins, CO; Oahu MPO and City of Honolulu, HI; Pikes Peak Area COG, CO; Pima Association of Governments, Tuscon, AZ; Puget Sound Regional Council (PSRC), Seattle, WA; Sacramento Area Council of Governments (SACOG), CA; San Diego Association of Governments (SANDAG), CA; Southeast Michigan Council of Governments (SEMCOG), Detroit, MI; Wasatch Front Regional Council (WFRC), Salt Lake City, UT

Open Access
UrbanSim yes, Urban Canvas no.

COST
Purchase from vendor.

WEBSITE
urbansim.com

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Tool Comparisons

Table 4: Comparison of TMIP EMAT, TRIMMS, and VisionEval

	TMIP EMAT	TRIMMS	VisionEval
Subject Matter	Infrastructure projects, technology (automated/ connected/ electric / shared); land use; resiliency; demographics.	Economic, environmental.	Uncertainty, transportation, environmental, land use, public health.
Tool Type	Scenario planning and analysis.	Scenario planning and analysis to augment predictive travel models with consideration of TDM policies and investments.	A robust scenario planning suite to evaluate potential transportation-related environmental impacts of policy decisions.
Application	Exploratory scenario planning, particularly uncertainties.	Predictive and exploratory scenario planning.	Exploratory scenario planning.
Input Values	Performance measures generated by the core regional travel demand model (e.g., regional vehicle miles traveled, total transit boardings, regional mode share); "Risk variables" from core regional travel demand model inputs (e.g., land use, transportation network) and/or core model parameters (e.g., value of time, auto operating costs, freeway capacities). Risk variables are used as independent variables and performance measures as dependent variables to design an experiment that coveres the uncertainty space and estimates a regression-based metamodel. All needed input values are available from the core model.	Analysis Details: project details at a regional or employment site level (e.g. number of affected employees, occupations, industries; program duration and cost. Employer-based Programs: worksite characteristics (e.g., bike facilities near site, shopping onsite); selection of programs for analysis (e.g. TDM subsidies, telework). Transportation and Employer-based Strategies: parking/ trip costs, access, travel times by mode (transit, cycling, and walking) Land Use Controls: area-wide analysis of policies to influence population density, retail density, transit station accessibility, transit-oriented development	Employment count and characteristics (e.g., industry); employment and land use attributes (e.g., location type, built form density, diversity, design ('D') values); parking policies; transportation demand management (TDM) programs.
Input Types	Application Programming Interface (API) connection established directly to core model.	Area-wide or site-specific numeric values (e.g., cost of parking) or binary yes/no selections (e.g., flexible working hours offered, shopping onsite or within ¼ mile). Single input value per parameter and analysis; no geographic granularity.	Population, employment, land use, and transportation characteristics.
Output Values	Meta-model exports fall into risk analysis and exploratory analysis categories and are unique to the performance measures input by the user. Risk analysis displays a probability distribution of inputs. Exploratory analysis also uses a range but is focused more on existence and not probability.	Change in mode share, social externalities, VMT, and emission pollutants; annual benefits and costs; and benefit/cost ratio.	Default performance measures and dependent upon the module being used. Output metric categories include travel, cost, safety, and environmental metrics.
Output Types	Visualizations and spreadsheets.	Spreadsheets.	ScenarioViewers: interactive web maps/ interfaces with outreach tools such as voting.
Geography and Scale	Corridor, neighborhood, and region.	Regional and employer-based (worksite level).	Aggregated region or regional zones.
Customizability	Highly customizable; based on risk variables and policies examined by core model.	Limited.	Relatively customizable using an open-source plug-n-play format.
Resources Required	API Connection.	Microsoft Excel.	R or RStudio.
Public Engagement Visualization Capabilities	No	No.	ScenarioViewers: online quick responsive tools that allow the public to "play with" scenario options to learn how certain policies would impact the region.
Comparison to Travel Demand Model	TMIP EMAT is an add-on tool for a regional travel demand model and does not replace traditional models.	TRIMMS is a stand-alone estimation tool that looks at specific impacts of TDM programs for a region or worksite.	VisionEval should be run before or in conjunction with developing a travel demand model. VisionEval is more agile but less detailed than a traditional model.
Organizations that Have Used Tool	Chicago Metropolitan Agency for Planning (CMAP),IL; Metropolitan (Met) Council, Minneapolis, MN; Oregon DOT; Sacramento Area COG (SACOG), CA; Southern California Association of Governments (SCAG), Los Angeles, CA; Greater Buffalo-Niagara Regional Transportation Council, NY	French Broad River MPO, Asheville, NC; San Diego Association of Governments (SANDAG), CA; San Joaquin Council of Governments, Stockton, CA	Atlanta Regional Commission (ARC), GA; Corvallis Area MPO, OR; Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, PA; Durham-Chapel Hill-Carrboro MPO, NC; Metropolitan (Met) Council, Minneapolis, MN; Sacramento Area COG (SACOG), CA
Open Access	Yes.	Yes.	Yes.
Cost	Free.	Free.	Free. Optional to be a collaborative MPO partner for $15,000 annually for three years.
Website	tmip-emat.github.io	trimms.com	visioneval.org

Table 5: Comparison of Tools Featured in Snapshots

	Subjects	Tool Type	Application	Input Values	Input Types	Output Values	Output Types	Open Access	Cost
CityEngine	3D Urban modeling, Land Use, Transportation and Land Use integration.	GIS model for allocating land development according to user-defined parameters.	Normative, exploratory.	GIS data, building footprints, streets, public infrastructure assets, demographics, any GIS data.	GIS data, CADD data.	Cities, buildings, streets.	Web maps and interfaces, 3D simulation, 3D models, report, dashboards.	3D outputs are easily shared via video or online.	For use with ArcGIS online - $2,000 / year For use as a desktop license - $2,000 / year For use as a desktop license perpetually - $4,000
CommunityViz	Land use, transportation economy, environment.	Planning for land development scenarios.	Normative, predictive, exploratory.	Existing development, local land use plans, environmental features, etc.	GIS shapefiles and travel demand software.	Demographic (population, employment, school-aged children); Economic (retail/ service floor space, cost of new residential infrastructure); Land Use/ Housing (jobs-housing balance, residential density, retail square feet, average lot size); Environmental/ Climate Change (residential building energy use, water use, wastewater generation); Transportation (VMT,walkability, households served by transit)	3D Scenarios, Web-ready illustrations, dynamic charts and displays, Google Earth Exports.	No.	Contact vendor for quote.
Cube Land	Land use, accessibility, econometrics, real estate, employment costs, residential cost.	Forecasting model for real estate supply/ demand scenarios and econometric land use forecasting model.	Predictive.	Parcel zoning, parcel value (residential) or rent (residential and commercial), attractiveness (proximity to parks, schools, transportation options, job and shopping opportunities), existing development, control total development.	Parcel data for zoning, price, and accessibility. Regional or sub-regional control totals by land use type.	Total and incremental changes in land supply, location, and rents by zone. Estimates location of households and non-residential activities for different groups. Incentive and disincentive scores. Income distribution by geography.	Maps, charts, and spreadsheets.	No.	Contact vendor for quote.
Envision Tomorrow	Location efficiency, fiscal impact, health, redevelopment, housing, equity.	Planning for land development scenarios.	Design-based modeling, normative.	Unknown.	Commonly accessible GIS data, such as tax ssessor parcel data and Census data.	Housing density, job density, housing type, job type, energy emissions and carbon emissions associated with buildings, vehicles, travel behavior, and fiscal impacts and more.	Spreadsheets and maps.	Yes.	Free
Remix	Accessibility, emerging technology.	Planning primarily for transit, and analysis of alternative route configurations.	Normative, exploratory.	Unknown.	Unknown.	Jobs, employees, and population demographics within range of transit/bike facilities, daily micromoblity trip number and locations, public outreach language needs.	Interactive maps/ web interface, and street design mock-ups, charts.	No.	Contact vendor for quote.
TDM+ (Fehr & Peers)	Environment.	Sketch planning and analysis tool for TDM impacts.	Predictive.	Project Location Type (based on Deborah Salon's 2014 study Quantifying the Effect of Local Government Actions on VMT), Project land use (Office, Residential, Retail, and "Other), TDM strategies (participation rate, subsidy value.	Land Use context, project land use, project TDM strategies.	Change in trip generation, mode share, trip types (employee v. visitor) and VMT.	Charts and visualizations.	No.	Contact vendor for quote.

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Uplan	Land use.	GIS model for allocating land development according to user-defined parameters.	Normative, exploratory.	Unknown.	Commonly accessible GIS data, such as tax ssessor parcel data and Census data.	Suitable/ unsuitable development sites.	3D Scenarios, Web-ready illustrations, dynamic charts and displays, Google Earth Exports.	Yes.	Free
Urban Footprint/ RapidFire	Health, land use, environment.	Planning for land development scenarios.	Normative, exploratory.	Existing buildings, land uses, and other details of the built environment.	Data and research-based assumptions about the future.	Pollutant emissions, land consumption, water use, VMT, fuel use, household energy, water, and transportation expenses. Transit accessibility to employment, parks, schools, hospitals. Walk accessibility to transit, parks, schools, services. Measure projected sea level rise, flood, and fire hazards.	Charts, maps, and interactive web / interfaces.	No.	Contact vendor for quote.
UrbanSim / Urban Canvas	Land use, economy, environment.	Predictive modeling and visualization suite of tools for augmenting travel models with alternative land use inputs.	Normative, exploratory.	Transit investments, roadway improvements by type, pricing strategies, TDM/bike-sharing; comp. plans, zoning codes, parking availability and pricing, TOD, urban villages and centers, subsidies, impact fees, Financing, UGBs, protection of environmentally sensitive areas.	The tool leverages simulation, 3D visualization, and shared open data to develop and evaluate alternative land use and transportation scenarios.	Households by income, age, size, and prescence of children; employment by industry and land use type; acreage by land use; dwelling units by type; square feet of nonresidential space by type; real estate prcies and rents.	3D simulation, modeling, and simulation.	UrbanSim yes, Urban Canvas no.	Contact vendor for quote.

National Capital Region
Transportation Planning Board

Metropolitan Washington Council of Governments
777 North Capitol Street NE, Suite 300
Washington, DC 20002

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