Mosaic Peer Review Summary

Introduction

Mosaic is Oregon's least cost planning methodology, developed by the Oregon Department of Transportation (ODOT) in response to direction from the state legislature to develop "*a process of comparing direct and indirect costs of demand and supply options to meet transportation goals, policies or both, where the intent of the process is to identify the most cost-effective mix of options.*" ODOT therefore wanted to develop a flexible methodology that will enable fair and transparent analysis of different kinds of transportation actions and investments, be useful within Oregon's transportation planning process, and assist in decision-making. Mosaic is now both an Excel-based evaluation tool that was the focus of the peer review, and a recommended process for using Mosaic analysis in transportation planning.

The purpose of the 2014 Mosaic peer review was to ensure that important innovative methodological approaches and elements of the analysis tool were objectively evaluated by experts. ODOT wants to ensure that these have been evaluated for appropriateness and applicability for Mosaic uses, before completion of the Mosaic development project. This allows a higher level of confidence in Mosaic for its users.

Topics reviewed were limited and focused so that essential peer review could take place within about six months during the last phase of Mosaic development. The peer review was conducted by experts from the U.S. and Canada who were not involved in Mosaic development. Reviewers were asked to provide objective and impartial feedback on the Mosaic tool, clarify potential applications and current tool limitations, and identify potential improvements. This document summarizes themes from the peer reviewers' discussions and the primary ideas and recommendations mentioned for each review topic. The items noted here represent ideas from the peer reviewers and may or may not reflect the perspective of ODOT; additionally, the reviewers' ideas and recommendations listed here are ones that ODOT will consider but may or may not choose to pursue.

Mosaic Peer Review Topics and Panelists

The peer review for Mosaic focused on four main topics:

- Mosaic Indicators and their use in Benefit-Cost Analysis (BCA)
- Multi-Objective Decision Analysis (MODA) or weighted values comparison
- Transportation data use
- The Mosaic analysis tool in general

The peer review panelists were (please see Appendix A for panelist biographies):

Mark W. Burris
Herbert D. Kelleher Professor, Associate Department Head for Operations and Research, Zachry Department of Civil Engineering, Texas A&M University
College Station, Texas

Shinwon Kim
Principal Travel Demand Modeler
Southwest Washington Regional Transportation Council
Vancouver, Washington

Lee Merkhofer
President
Lee Merkhofer Consulting
Cupertino, California

Lyle Walker
Senior Planner
TransLink (South Coast British Columbia Transportation Authority)
Vancouver, British Columbia

Glen Weisbrod
President
Economic Development Research Group
Boston, Massachusetts

Dennis Yee
Chief Economist
Metro
Portland, Oregon

Panelists were invited to participate in the peer review based on their area of expertise. ODOT sought panelists with expertise in decision analysis, benefit-cost analysis, and travel demand modeling. Panelists and their staffs or students donated considerable time and effort to advance this state-of-the-art tool for transportation planning and their contributions were greatly appreciated.

ODOT staff members Lucia Ramirez, Principal Planner and Robert Maestre, Transportation Programs Unit Manager, coordinated the peer review process with assistance from Denise Whitney Dahlke, transportation economist and Rich Arnold, travel demand modeler.

ODOT's consulting team consisted of Sam Seskin, CH2M Hill Transportation Planning Director, Catherine Ciarlo, CH2M Hill Senior Project Manager, Ryan Farncomb CH2M Hill Transportation Planner, and Stéphane Gros, Principal Economist, HDR Decision Economics.

Mosaic Peer Review Process

Two in-person peer review meetings, opening and closing the process, and three telephone conference call meetings were held. Agency and consultant staff prepared materials for all meetings and brief answers to some of the panelists' questions. Following is a brief description of the five meetings.

Meeting #1 – In-person opening meeting, February 14, 2014, Portland, Oregon

The purpose of this meeting was to become familiar with the essentials of Mosaic, why it was developed, and its key components. The group discussed Mosaic's model structure, categories and indicators, and outputs. Further topics included considering using BCA and MODA together side-by-side, using MODA without the BCA component, travel model contributions, and Mosaic's BCA innovations.

Meeting #2 – Conference Call, April 4, 2014

The purpose of this call was to review and discuss panelist questions and answers provided by the consultant team, and discuss indicator measurement types and sketch model uses in Mosaic especially as these are used in the benefit-cost portion of Mosaic. Discussion included the intended uses of Mosaic, Mosaic indicators and their recommended measurement method: monetary, quantitative, or qualitative, sketch model uses, and addressing uncertainty.

Meeting #3 – Conference Call, April 11, 2014

The purpose of this meeting was to review Mosaic's MODA (weighted values) component and its comparison process for using MODA and BCA together. Questions considered included: how can use of both BCA and MODA be encouraged? What needs to be considered if a bundle of projects does not perform as well as the base case? Does using MODA alone provide a useful comparison between bundles regarding costs and values? Do all indicators represent a separate aspect of value and can they be weighted effectively?

Meeting #4 – Conference Call, May 6, 2014

The purpose of this meeting was to discuss and understand uses of travel demand model output in Mosaic. Discussion topics included recommended metrics and methods for assessing travel time reliability at Mosaic's system level scale, approaches for interpolating benefits and costs between modeled years, and expressing uncertainty associated with long-term travel demand forecasts.

Meeting #5 – In-person closing meeting, June 4, 2014, Portland, Oregon

The purpose of this meeting was to inform reviewers of the outcomes of other elements of the Mosaic testing process, discuss reviewers' further Mosaic questions and ideas, and determine priorities for Mosaic development in the future.

Mosaic Peer Review Topics

This section summarizes important themes and ideas from the Peer Review process related to the four topic areas panelists were asked to consider. In general, panelists were in agreement that Mosaic makes important advances in the use of data and BCA that contributes to decision-making. Panelists were asked for their critical review, ideas, and recommendations for improvements to Mosaic.

Mosaic indicators and their use in benefit-cost analysis

Reviewers discussed accuracy of the BCA in Mosaic and shared a few observations. First was that shifts in the use of various modes of travel may not be well captured and reflected in Mosaic results. Most jurisdictions in Oregon have a simple travel model, and most of our metropolitan models have less well developed mode components than Portland Metro, where our test information was developed. It was acknowledged that this is a limitation, and that the situation should improve as travel models in Oregon improve. Steps are being taken to continuously improve travel models, particularly in metropolitan areas. In the meantime, sketch models are included in Mosaic to try to assist prediction of mode shifts.

Another comment was that freight may not be well enough represented in the monetized portion of Mosaic analysis, and more effort might be made to include it. Similarly, highway mode and capacity expansion benefits may not be adequately captured, as emphasis throughout Mosaic's development was on trying to include alternate modes and program investments such that they would be equal considerations with roadway. It may now be perceived that roadway and capacity investments are not as well represented as the others.

Several partial solutions were suggested. One was making it clearer in the User Guide that capacity improvements are a part of what Mosaic can help analyze. It was recommended that the monetized portion of Mosaic also provide information on net benefits to reflect total benefit as compared to the cost constraint rather than focus only on the benefit-cost ratio, particularly as Mosaic analyzes transportation bundles in relation to one another. Further, it was recommended that inventory cost be added to freight value of travel time. In the future, it was recommended that Mosaic indicators should each have a way of being estimated for every mode considered.

Mosaic MODA, or weighted values comparison

The peer reviewers were very interested in Mosaic's MODA process and discussed it thoroughly. The first item noted was that there are many ways of doing a weighted values comparison; they are related and have various names. MODA may or may not be the best term for Mosaic's process, but most Oregon Mosaic stakeholders now recognize it.

There are also a variety of ways of completing the weighting exercise for MODA. For example, it may be done early in the process or later, after high and low scores for indicators are known. There are advantages and disadvantages of each approach. From initial testing, ODOT has determined that Mosaic's recommended weighting process will include a round of weighting once high and low scores are known, distributing only one set of points to represent weights, and weighting indicators individually rather than categories.

One peer review panel recommendation for the future was to consider reducing the number of indicators, especially any found to not represent separate aspects of value and be suitable for effective weighting. Further panelist recommendations included: make sure the scale used to represent MODA scores is intuitive, consider ways we might merge the BCA and MODA scores in Mosaic, look for ways to quantify indicators currently qualitative and clarify what we mean by qualitative scores in Mosaic, consider any factors that might be missing from Mosaic analysis such as intermodal connectivity, and provide clear guidance regarding how to work with Mosaic outputs.

Use of transportation data in Mosaic

Much of the discussion of transportation data used in Mosaic centered on the form of the data used and how it is or is not aggregated. Mosaic is intended to use travel model data that is disaggregated to reflect different modes, peak and off peak travel, and also origins and destinations. While Mosaic can accept aggregated data, the Mosaic team's research determined using disaggregated data is a better way to estimate changes in consumer surplus, and felt that it is necessary to effectively evaluate the equity indicators in which the distribution of the impacts are considered. The group agreed that sensitivity testing (enabled within the Mosaic tool) will be important to see how Mosaic reacts to changes in these data.

A second topic of discussion was the many possible variations in the value of travel time that may be considered for use in Mosaic. Mosaic does not vary the value of time by income, as this is not a practice used by Oregon modelers nor is it a recommended way to do BCA. Another way to vary it would be to consider how to value small decreases in travel time: the first minute saved may not be as valuable as the tenth. Also, some extra trip time may not always represent a cost to all users, such as cyclists using the time for their daily exercise or a transit rider able to work during the trip. Reviewers recommended that ODOT continue to consider this issue and best ways to represent values of time in Mosaic.

Mosaic overall comments

Peer reviewers provided comments and thoughts about Mosaic overall, and several of them had to do with communication about Mosaic. First was that it is very important to make sure that the intended uses of Mosaic are clear to users, decision makers, and any others asked to review the Mosaic tool or process. This way everyone will have a shared understanding of what

Mosaic is intended to do and when to consider employing Mosaic. Similarly, better establishing how Mosaic fits in the transportation planning process will make it more tangible and aid understanding. Another recommendation was to provide an updated glossary and noting that Mosaic's terms are largely defined by how the Oregon Transportation Plan uses the same concepts.

One reviewer noted that there are six criteria relevant to judging a tool like Mosaic: logical, accurate recommendations produced, comprehensive, practical, acceptable, and useful. Because of where Mosaic is in development and use, information is only available for the first three. Therefore, future evaluators should emphasize the remaining criteria to help develop a thorough understanding and evaluation of the Mosaic tool.

A recommendation discussed for the future was to improve Mosaic's user interface. It was built within Excel 2010 for convenience in development and for proof of concept. In the future, a more user friendly interface will make it more likely to be used and better align with how people now expect to interact with a computerized tool. In addition, a different user interface may better enable users to click on through the tool for more information about data, scores, and results for each indicator.

Conclusion

The Mosaic peer review panelists volunteered their (and sometimes their staff's or students') time to assist ODOT with an early evaluation of a new tool intended to assist and improve Oregon transportation planning and decision-making. Due to time limitations, no attempt was made to review everything about the Mosaic analysis tool. Instead, four topics that relate to innovative Mosaic tool components were selected for review: indicators used and benefit-cost analysis, MODA or weighted comparison, use of travel data, and the Mosaic tool in general.

Peer review panelists thoroughly discussed these topics throughout a total of five meetings and in doing so provided information, ideas, and recommendations for ODOT to consider as Mosaic begins to be used in Oregon and for its future development. Some recommendations were acted on during the last parts of Mosaic initial development; Mosaic tool updates completed are listed in Appendix B to this report. Other recommendations are saved for the future. ODOT will continue to consider these for any future revisions and updates to the Mosaic tool and its recommended process for use as described in the Mosaic User's Guide. Whether implemented now or saved for future consideration, the peer reviewers' contributions have made significant improvements to Mosaic and will assist with future improvements. Thanks to reviewers' time and considerations, Mosaic is a more robust analysis tool and transportation planning methodology for Oregon to continue to test, develop, and improve.

Appendix A: Peer Review Panelist Biographies

Mark W. Burris: Herbert D. Kelleher Professor, Associate Department Head for Operations and Research, Zachry Department of Civil Engineering, Texas A & M University. Member: expert panel for FHWA's "Benefit/Cost Methods for Operations Planning." Research focused on travel behavior in response to pricing, particularly congestion pricing. Mark's main area of interest is traveler behavior in response to pricing, particularly congestion (or value) pricing. He has been, and continues to be, involved in many projects in this area and has published extensively in this area of research. He has served in an evaluation and monitoring role for projects around the country, including the Houston Value Pricing Project and the Lee County Variable Pricing Pilot Project. He has also led many studies and surveys on how travelers will react to innovative tolling projects and the costs and benefits associated with those projects.

Shinwon Kim: Principal Travel Demand Modeler at Southwest Washington Regional Transportation Council for Clark County Washington. Shinwon has also been a transportation planner at Metro in Portland, Oregon and a Research Assistant in the Urban Studies-Regional Science department at Portland State University. He received his education from Seoul National University, University of Colorado and Portland State University.

Lee Merkhofer: President, Lee Merkhofer Consulting. Lee is a well-known author, researcher, and practitioner in the field of decision analysis. For 25 years he has helped clients evaluate alternatives and make better decisions, working in industries such as electric power, healthcare, high tech, manufacturing, oil & gas, pharmaceuticals, and for federal, state, and local governments. Lee served as Manager of Research Programs for the Decision Analysis Group, SRI International, Vice President of Applied Decision Analysis, Inc., and Partner of PricewaterhouseCoopers, LLC. He was a founding partner of the software company Folio Technologies LLC. Lee has published over a three-dozen professional papers and is the author of two books on the decision and risk analysis.

Lyle Walker: Senior Planner at TransLink, the regional transportation authority for Metro Vancouver BC. Lyle is engaged in better coordinating land use and transportation, policy development, and fostering transit-oriented communities with its partner agencies. Lyle has also conducted innovative land use and transport research and policy development focused on the regions Frequent Transit Network. Prior to joining TransLink, Lyle worked as a planning consultant with a small firm on a variety of sustainability, energy, greenhouse gas, and community planning processes primarily for local government in Western Canada. Mr. Walker holds a M.Sc. (Planning) from the University of British Columbia.

Glen Weisbrod: President of Economic Development Research Group in Boston. Glen has worked over the past 35 years on economic impact and benefit evaluation for a wide variety of transportation, energy and economic development programs and projects. His work on this topic has spanned Japan, South Africa, India, Australia, Netherlands, Scotland, England, Canada and the US. He has also authored a variety of reports and guides on benefit-cost analysis, project impact analysis and metrics for measuring wider economic effects of projects and policies. He has also worked with a variety of DOTs on project prioritization methods. Glen was formerly Chair of the TRB Committee on Transportation and Economic Development, and a member of the Social and Economic Factors, Economics, and Land Development Committees of TRB. He also previously served on the Board of Directors of the Council for Urban Economic Development. He holds an MCP in Planning from M.I.T., and BA in Economics from Brandeis University.

Dennis Yee: Chief economist for Metro for over 20 years. Dennis oversees Metro's economic forecasting and land use research department. Dennis has been in the business of forecasting regional economic, business and demographic trends for over 30 years. The forecasting and research department is responsible for various economic studies, which are used to inform Metro's UGB decisions; land use planning and transportation studies. Before joining Metro, Dennis was a staff economist for the Bonneville Power Administration and worked in BPA's economic research section. Dennis received his graduate degree in economics from the University of Oregon and also holds a bachelor's degree in business administration.

Appendix B: Completed Mosaic Tool Improvements

The following improvements were completed following the test and are now included in the Mosaic tool, version 2.

Category or Topic	Worksheet(s) affected	Improvement Completed
QUALITY OF LIFE	QUALITY OF LIFE	Allow estimation of mortality risk reduction from walking (QL.1).
QUALITY OF LIFE	MULTIPLE	Combine QL.1 and QL.2 into a single specific indicator (renamed, *Health Benefits from Active Transportation*).
ECONOMIC VITALITY	SKETCH MODELS	Direct users to external tools for the estimation of EV.4 (agglomeration economies).
SAFETY & SECURITY	MULTIPLE	Build ability to estimate Property Damage Only (PDO) accidents.
GRAPHICS	MULTIPLE	Enhance graphic options to display Mosaic results in new and different ways in the CONTROL PANEL and OUTPUT CHARTS sheets.
NPV CALC	NPV CALC	Add ability to estimate a second B/C ratio where cost is defined as *Net Agency Expenditures.* This metric shows the B/C ratio for only those costs incurred by the agency and not other entities (e.g., state or federal government).
ENVIRONMENTAL STEWARDSHIP	MULTIPLE	Combine ES.2 and ES.3 into a single specific indicator (Air Toxics).
RESULTS	OUTPUT TABLES	Add a “Consequences Table” which allows for easy and quick visual comparison of Mosaic results by bundle.

Category or Topic	Worksheet(s) affected	Improvement Completed
ACCESSIBILITY & EQUITY	MULTIPLE	Change indicator for EQ.1 to *User Benefits for Different Groups*; Leave AC.1 *Transportation Cost Index* as is. This change for EQ.1 allows for estimation of user benefits across population groups without access to Transportation Cost Index data.
MOBILITY	INDICATORS	Change Reliability indicators MO.3 and MO.4 to Qualitative or Report Only. The previous quantitative method proved unworkable.
ECONOMIC VITALITY	SKETCH MODELS	Add inventory costs to value of time for freight travel.
SENSITIVITY	MULTIPLE	Restructure SENSITIVITY and MODA SENSITIVITY worksheets to make interpretation of results easier.
GENERAL	HELP	Add ability to send email and tool directly from the tool.
GENERAL	HELP	Add ability to “Save As” from last step of HELP worksheet.
GENERAL	WELCOME	Add ability to Lock / Unlock the tool.
LOAD TRAVEL DATA	LOAD TRAVEL DATA	Relocate input data for loading travel data to OTHER INPUT DATA worksheet and adjust code accordingly.
NPV CALC	NPV CALC	Modify estimation of undiscounted benefits and costs.
MODEL PARAMETERS	MODEL PARAMETERS	Modify structure and formatting to enhance readability.
INDICATORS CALC	MULTIPLE	Revise worksheet structure (estimation of quantitative scores) to simplify layout and improve usability.
XY CHARTS	MULTIPLE	Add automatic update of labels in XY charts (CONTROL PANEL and OUTPUT CHARTS).

Category or Topic	Worksheet(s) affected	Improvement Completed
QUALITY OF LIFE	SKETCH MODELS	Add sketch-tool for estimating number of walking trips based on trip length (Row 55).
MOBILITY	TRAVEL DATA CALC	Revise estimation of changes in business transportation costs used in calculation of EV.5.
GENERAL	CONTROL PANEL	Expand list of parameters under "ARE ALL MODEL PARAMETERS WITHIN RECOMMENDED RANGE?" to reflect recent additions to MODEL PARAMETERS worksheet.
ENVIRONMENTAL STEWARDSHIP	MODEL PARAMETERS	Add placeholders for social costs of ozone and lead emissions to MODEL PARAMETERS worksheet and adjust formulas as needed.
MODEL PARAMETERS	MODEL PARAMETERS	Revise "Restore Default Values" macro to reflect changes to MODEL PARAMETERS worksheet (addition of parameters and re-formatting).

The following possible Mosaic improvements were identified, but deferred for future consideration.

Improvements deferred
Add an indicator related to business attraction.
EV3 (Changes in Employment by Industry and Associated Income Metrics) currently has no secondary effects included as it is based on a basic sketch model. Consider including effects of congestion relief on factors other than economic activity. Possible sources for the future may include a look up table from SWIM output or SHRP2 reports.
Varying value of time by trip length or by large vs. small time savings
Allow users to input both the value and their confidence level in the estimated value of the indicators.
Display the effects of uncertainty (in the value of parameters, and in the output of sketch tools) graphically.
Refine safety tool developed by CH2M HILL.
Add an indicator of option value for transit and other modes if possible.
Enable use of other equity indicators as desired by Mosaic users.
Consider extracting look-up tables/parameter values from SWIM/SWIM runs to help in estimating several economic vitality indicators.
Add a feature to output tables or charts that enables a user to click on the values and “find out why” through hyperlinks to specific part of the tool.
Incorporate a freight intermodal connectivity indicator.
Consider broader effects for programmatic actions. Programmatic actions currently only affect vehicle miles travelled calculations.
Review and enhance indicators as needed to make sure each treats all modes equally.