# MODEL/PRODUCT/TOOL/FRAMEWORK EVALUATION CRITERIA

Tool Reviewed: Ecosystem Management Decision Support--EMDS
(Keith Reynolds and Paul Hessburg)

Small Group Members: Please listen carefully to the presentation for the tool you have been assigned to review. Record comments below related to your understanding based on what you hear. There will be a chance to get clarification with the presenter later in the day.

| Criteria | Review Comments |
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| Model Objectives | EMDS provides spatial decision support for environmental assessment and planning. Logic processing is used to assess (interpret) landscape condition information. There is no limit to the amount or kind of information it can consider. Multi-criteria decision analysis (MCDA) is used for strategic prioritization of treatment areas (where are the high priority land units in light of the logic for what needs treatment) and tactical priorities (what are the high priority management actions in specific land units?).<br>The Okanogan-Wenatchee NF (OWNF) case demonstrates integrated resource restoration, based on an assessment of landscape departure. The overall departure analysis is basically assessing landscape integrity across a large number of dimensions, and strategic decision models identify priorities for restoration patches within 12-digit HUCs (individual subwatersheds or groups of them). |
| Processes Modeled | The OWNF case evaluates departures in vegetation successional patterns, surface and canopy fuels, any number of wildlife habitats, wildfire behavior, and insect and disease vulnerabilities in terms of patch and landscape metrics that are compared to two reference conditions—HRV and FRV, a climate change analogue condition. Several reference conditions can be represented as needed. |
| Vegetation classification used | The OWNF case illustrates use of photo interpreted data to classify a large set of attributes of all vegetation patches in a landscape. These attributes are used to derive dozens of habitat, successional, and lifeform conditions. |
| Treatment of uncertainty | Fuzzy logic (used to address logical uncertainty) is used for conducting the assessments. Fuzzy logic metrics express strength of evidence presented for a formal logical proposition such as “White-headed woodpecker habitat is within its HRV or the FRV.” Sensitivity analysis is used in strategic and tactical decision models to assess robustness of decision model weights. A new feature coming to the (CDP) decision models in summer 2016 allows estimating confidence limits on decision scores, based on uncertainty in data inputs (measurement uncertainty).<br>Also coming in summer or fall 2016, EMDS will directly support Bayesian models (from BayesFusion GeNIe) that explicitly model probabilistic uncertainty for applications such as habitat suitability and population viability. Current EMDS models can use BBNs or influence diagrams from other platforms as model input. |
| Spatial options/landscape size limits | EMDS can evaluate data associated with points, lines, polygons, and rasters as appropriate, and including methods for mixed raster/vector datasets. |

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| | There is no limit on landscape size, there is no limit on number of scales of data evaluated at one time. There is no limit on the number of different kinds of data that may be co-considered (e.g., FIA plot data, FVS simulated outputs, STM model outputs, LiDAR classified data, photo-interpreted data, BBN model output, econometric model outputs). Spatial resolution is user defined. In the OWNF case, landscape units are 12-digit HUCs and the polygons within them. |
| **Criteria** | **Review Comments** |
| Required inputs and possible outputs | Inputs and outputs are user defined. Generically, assessments evaluate landscape condition, strategic decision models identify priority actions, and tactical decision models prioritize management actions into their component parts.<br>In the OWNF case, EMDS evaluates departures in vegetation pattern, fuels, wildlife habitat, wildfire and insect and disease in terms of patch and landscape metrics that are compared to reference conditions. |
| Scenario comparison capability/ease | New in summer 2016, we are adding designed management actions that implement Carl Steinitz's geodesign concept. This will allow users to paint the landscape according to a set of rules to represent multiple alternative scenarios for landscape treatment, and compare the outcomes of each scenario. The goal is to produce synthesized interpretations of model outcomes to enable easy comparisons of map outputs across scenarios. |
| Compatibility with other modeling systems | Runs under ArcGIS and open source MapWindow GIS systems.<br>Uses NetWeaver for logic modeling (what is the state of the system?).<br>Uses Criterium DecisionPlus for decision modeling (considers costs, benefits, feasibility and efficacy criteria, what can be done about the state of the system?). Uses BayesFusion for Bayes reasoning (summer 2016).<br>Uses LPA prolog for more complex AI (artificial intelligence) applications. |
| Documentation/training/ease of use/user interface | EMDS has an online help system, and comes with tutorials. Training is available on request. A comprehensive course, including how to design logic/decision models, and run them requires about three days. |
| Planning horizon capability – how many years out can it "look"? 10, 50, 100? | Other simulation architectures are used to model changes over time. These results can be used by logic models in EMDS to provide any number of point-in-time assessments of landscape condition along multiple dimensions, as described above. An individual assessment may represent either the present time, or any point in the past or future. The past may be represented by empirical or modeled data. The future may be represented by projections obtained from simulation models. |
| Need for researchers to run the model | Typically, logic models are developed by researchers, but anyone with modest training can run them. Decision models are typically developed by managers with assistance from a decision scientist, and again, anyone can run them with modest training (3-4 days). |
| Data requirements: existing? readily available? | In general, data requirements are user defined. In the OWNF example, data on vegetation characteristics are derived from photo interpretation because the greatest number of raw attributes can be realistically extracted and validated from that remotely sensed image. |
| Feasible with existing computing capability? | EMDS runs on Win 7, and requires either ArcGIS or the open source MapWindow GIS as its GIS interface. It can simultaneously used statistically |

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| | modeled, simulated, and empirically derived data that can be spatially represented. |
| **Criteria** | **Review Comments** |
| How simple is it to understand outcomes? | The native outputs from a logic-based assessment are maps that express strength of evidence for the complete set of propositions evaluated, such as "lodgepole pine vulnerability to mountain pine beetle attack is not outside of the climate change analogue range of reference conditions." Maps can easily be re-symbolized to scales and legends that are useful to planning and discussion. Maps of strategic or tactical decision scores express the respective management priorities and the results from evaluations that support them. Strategic outcomes describe the priority of landscape unit for treatment. Tactical priorities rate the effectiveness of specific alternative treatments (e.g., "treatment X is the most effective in this landscape unit"). |
| Are the drivers obvious and sensitivity known? | Drivers and the degree of sensitivity that determine the logic-based and decision model outcomes **are user defined** in logic & decision models. |
| Is it transparent? Any black boxes? | There are no black boxes. This has always been a key design criterion. Each of the analytical components in EMDS (NetWeaver, CDP, GeNIe, and LPA) have graphical interfaces that explain the derivation of their conclusions in a very intuitive way. EMDS is definitely not a black box. |
| Can the model predict trends, or would other tools need to generate products to feed in for evaluation? | EMDS is not a simulation tool, but it is frequently used to interpret future conditions generated by simulators such as FSVeg, SIMPPLE, VDDT, FLAMMAP, etc. |