Apr 5th, 2:00 PM - 2:15 PM

A decision support framework to assess and prioritize recovery actions for salmon in the Puget Sound

Philip Murphy
InfoHarvest Inc., United States, philip.murphy@infoharvest.com

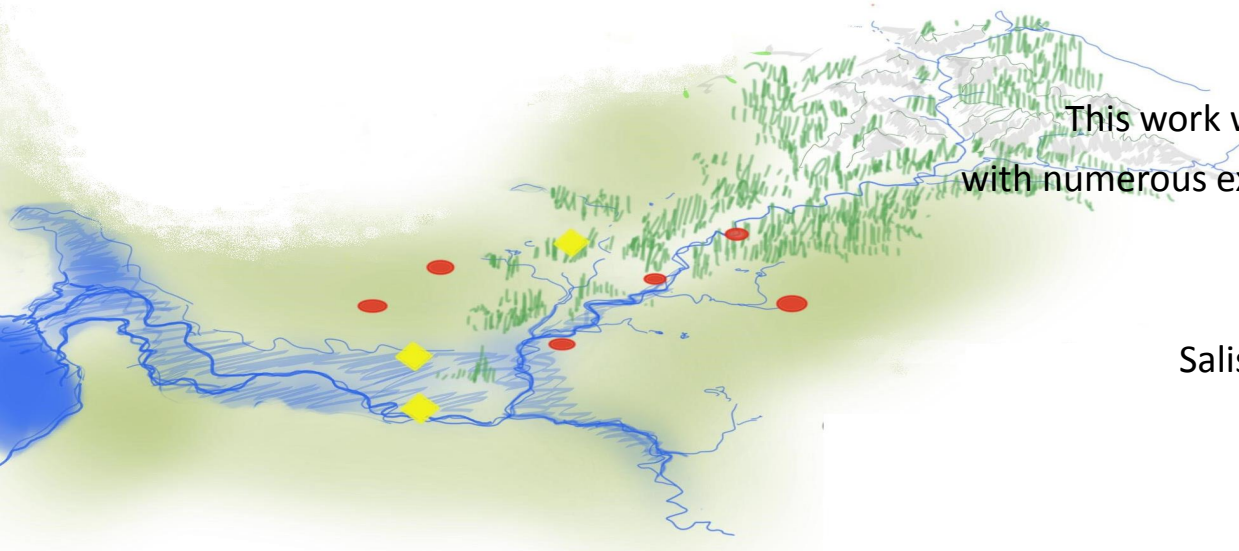
Gregory R. Blair
ICF Jones & Stokes, United States, greg.blair@icf.com

Sono Hashisaki
Springwood Associates, United States, sono@springwood-usa.com

A spatial decision support framework for the Tulalip Tribes' Harmonization Initiative

Philip Murphy, InfoHarvest Inc.
Greg Blair, ICF
Sono Hashisaki, Springwood Associates
And a cast of many
philip.murphy@infoharvest.com

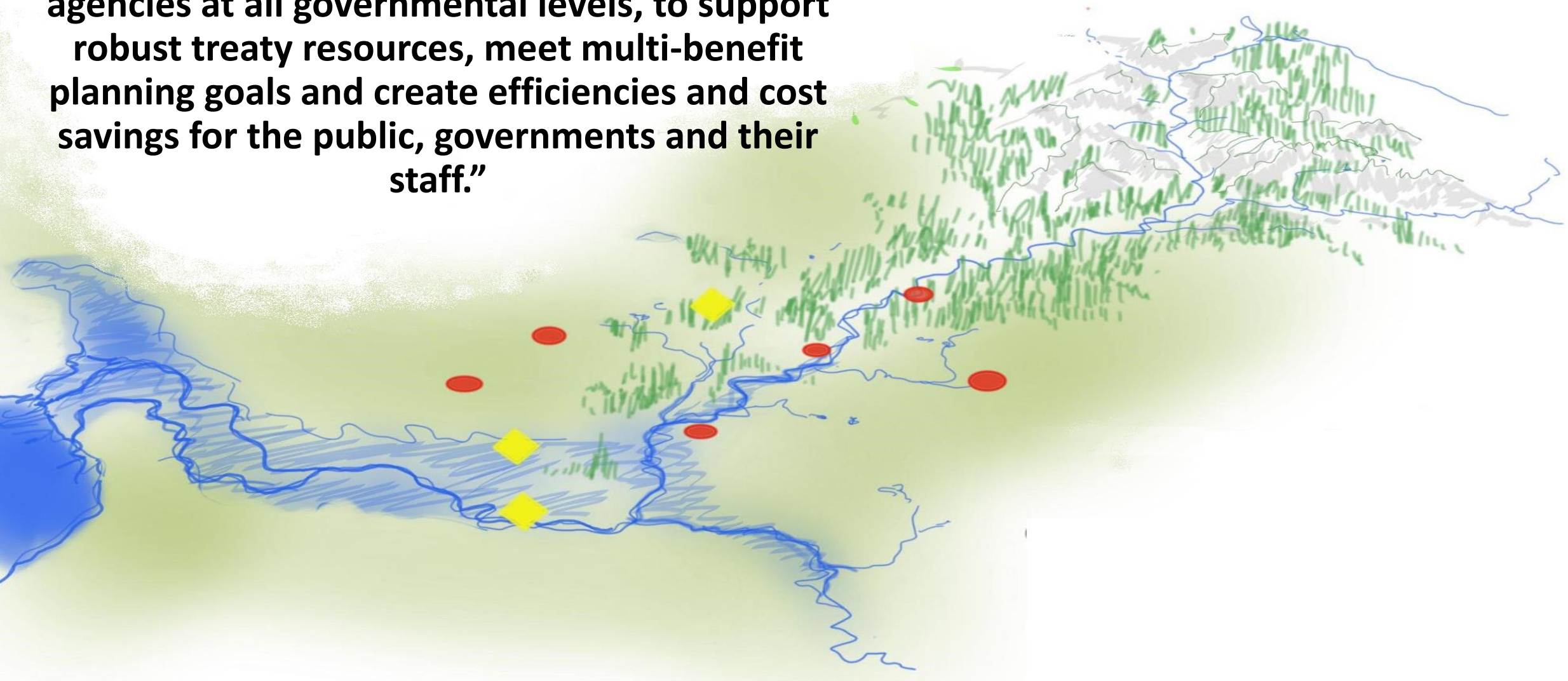
This work was supported by the Tulalip Tribes and in collaboration with numerous experts from King County, Snohomish County, EPA, WA DNR, ….



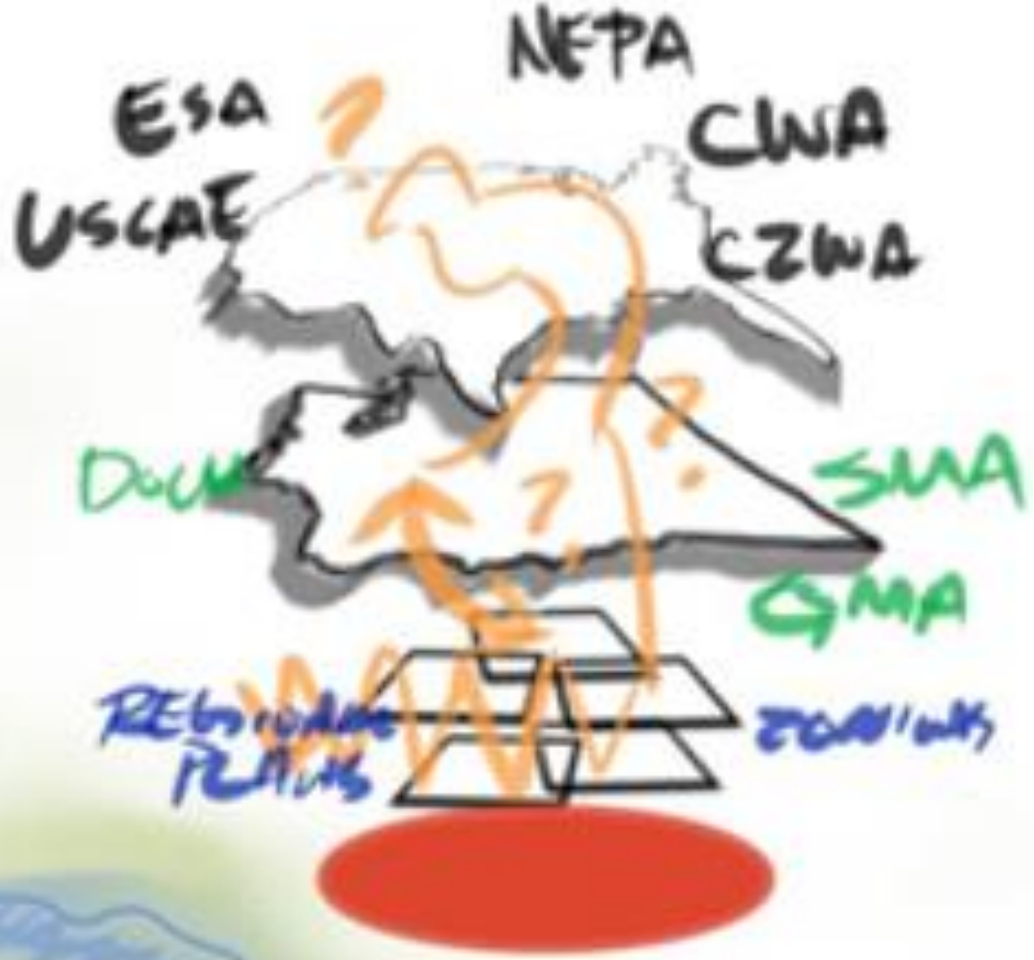
Salish Sea Conference Paper SSE15-546, Apr 5, 2018

We define Harmonization as

“the alignment of laws, regulations, voluntary measures, plans, processes, and actions among agencies at all governmental levels, to support robust treaty resources, meet multi-benefit planning goals and create efficiencies and cost savings for the public, governments and their staff.”

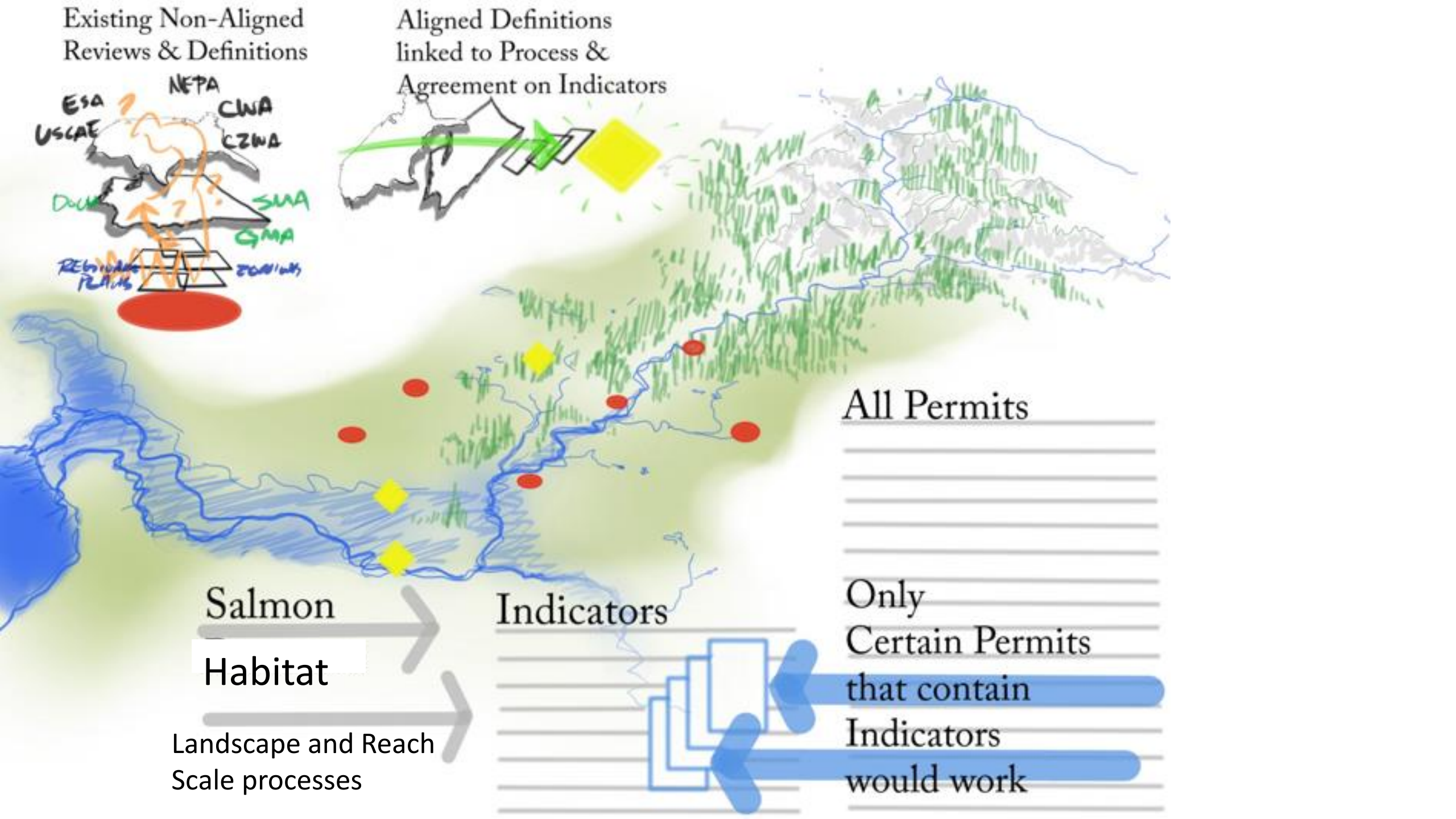


Existing Non-Aligned Reviews & Definitions



Aligned Definitions linked to Process & Agreement on Indicators

Spatial Analysis support:
Will current trends and plans tend towards salmon recovery?


Existing Non-Aligned
Reviews & Definitions
NEPA
ESA
CWA
USCAE
CZMA
SMA
GMA
Aligned Definitions
linked to Process &
Agreement on Indicators
All Permits
Salmon
Habitat
Indicators
Only
Certain Permits
that contain
Indicators
would work
Landscape and Reach
Scale processes

Developing a framework one use case at a time…

#	Use Case	Questions addressed
1	Trends simulation	What will the study area look like in the future?
2	Action (project) Assessment Tool	How might an action change that future?
3	Area Prioritization Analysis	How to prioritize sensitive areas for salmon recovery?
4	Permit Analysis Support	What additional information can we provide to support permit reviewers?
5	Regulatory Harmonization Action Simulation	How might a regulatory action (streamlining, bundling, enforcement, …) change that future?
6	Management Action Comparison Support	Is one management prescription more beneficial than an other over time?
7	Harmonization Plan Assessment tool	What is the aggregate effect of an entire plan over time?

What is the EMDS Open Framework?

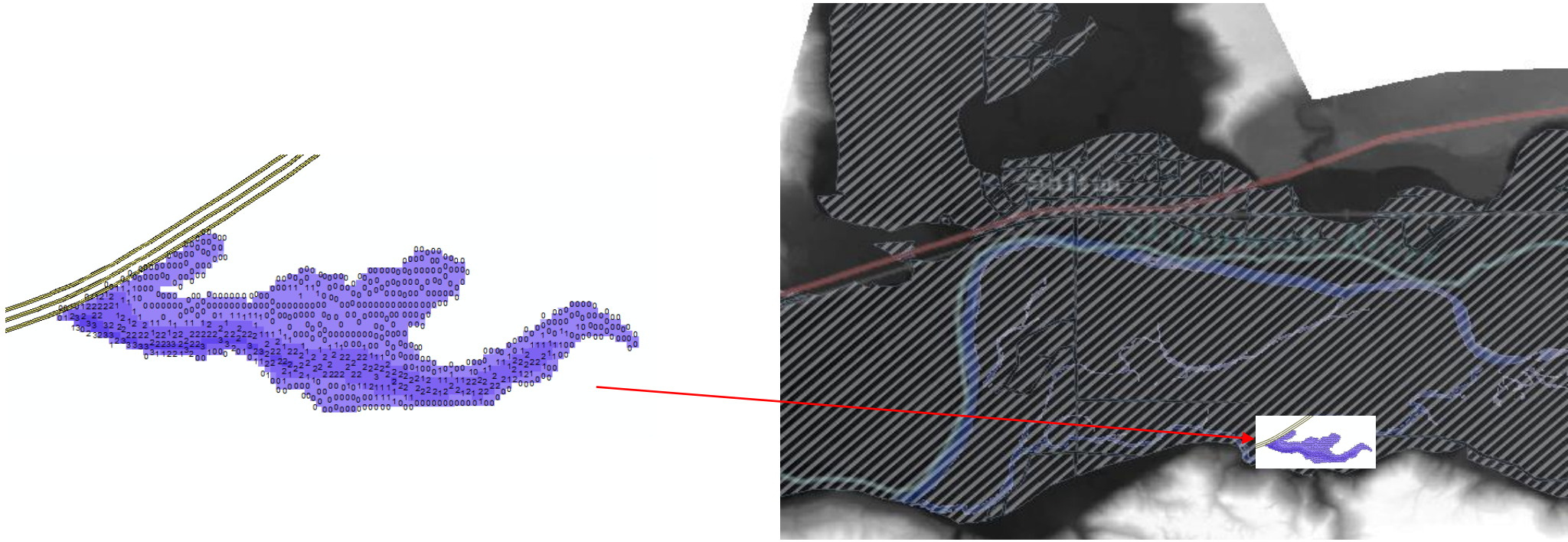
- The EMDS is a spatial tool that uses **Attribute models** to estimate the values of attributes in a study area based on measured data
- It uses **Indicator models** to estimate the values of indicators at multiple scales in the study area based on attribute values
- It uses **Change models** to simulate how proposed actions in the study area drive changes in attributes which in turn drive changes in indicators
- Based on estimated changes in values of indicators, it provides methods to **compare** the effects of actions and groups of actions on common metrics

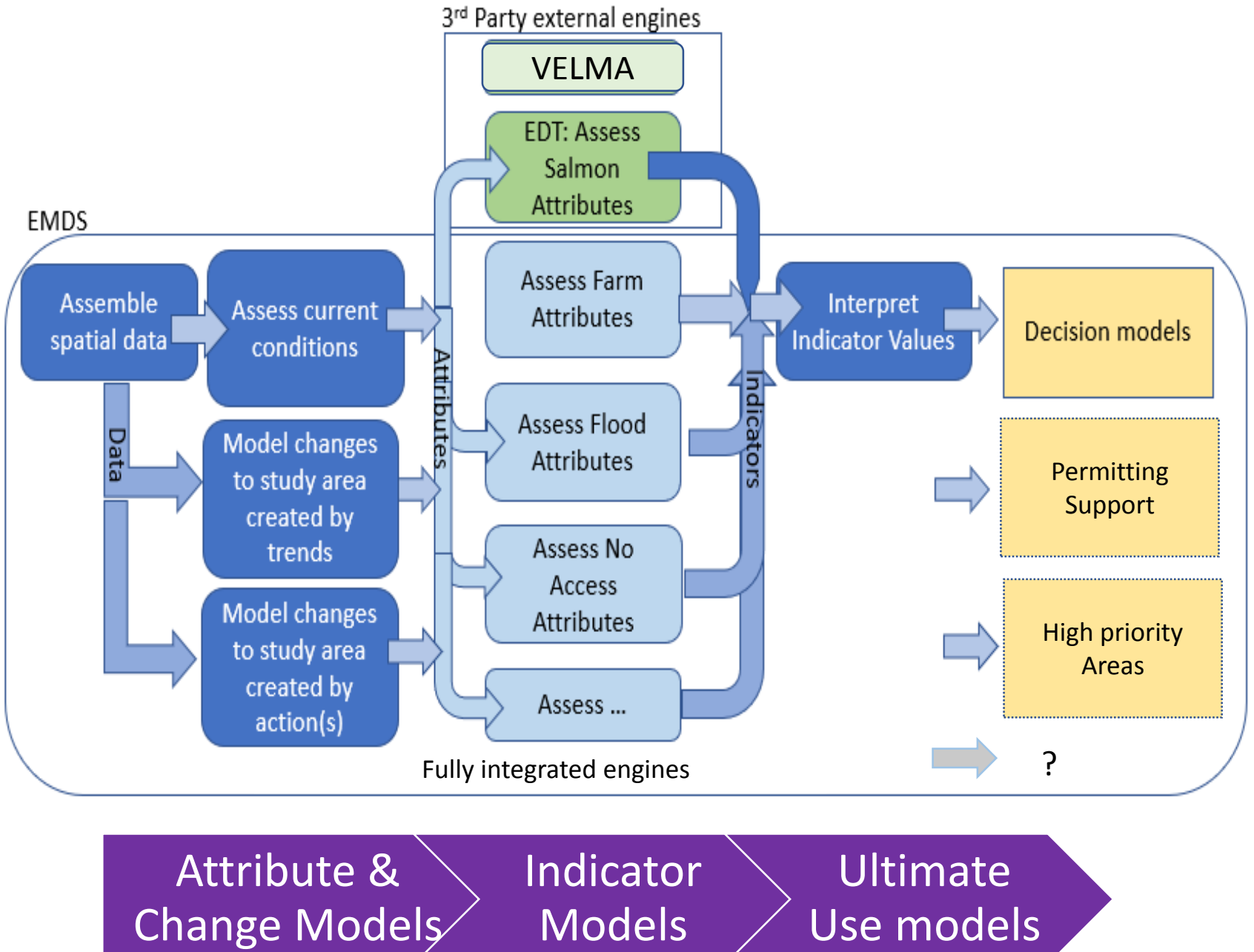
Example of an Attribute model

- Attribute: Surface Area of backwater
  - Prior to project - not functionally connected to the flood plain
  - After the project is implemented, a new area is functionally connected
- Data is depth at 25k cfs flood stage from SnoCo simulation (HEC RAS)
- Attribute Model: calculate the surface area south of Mann Road

Example of an Indicator model

- Increase in Floodplain Connectivity
  - Ratio of area of floodplain disconnected by revetments or levees from floodplain to the area of the natural flood plain
  - Is a measure of how impaired a floodplain is by human infrastructure
- Attribute data: area of floodplain AND area of back water
- (Change) in Indicator model: ratio of the two attributes

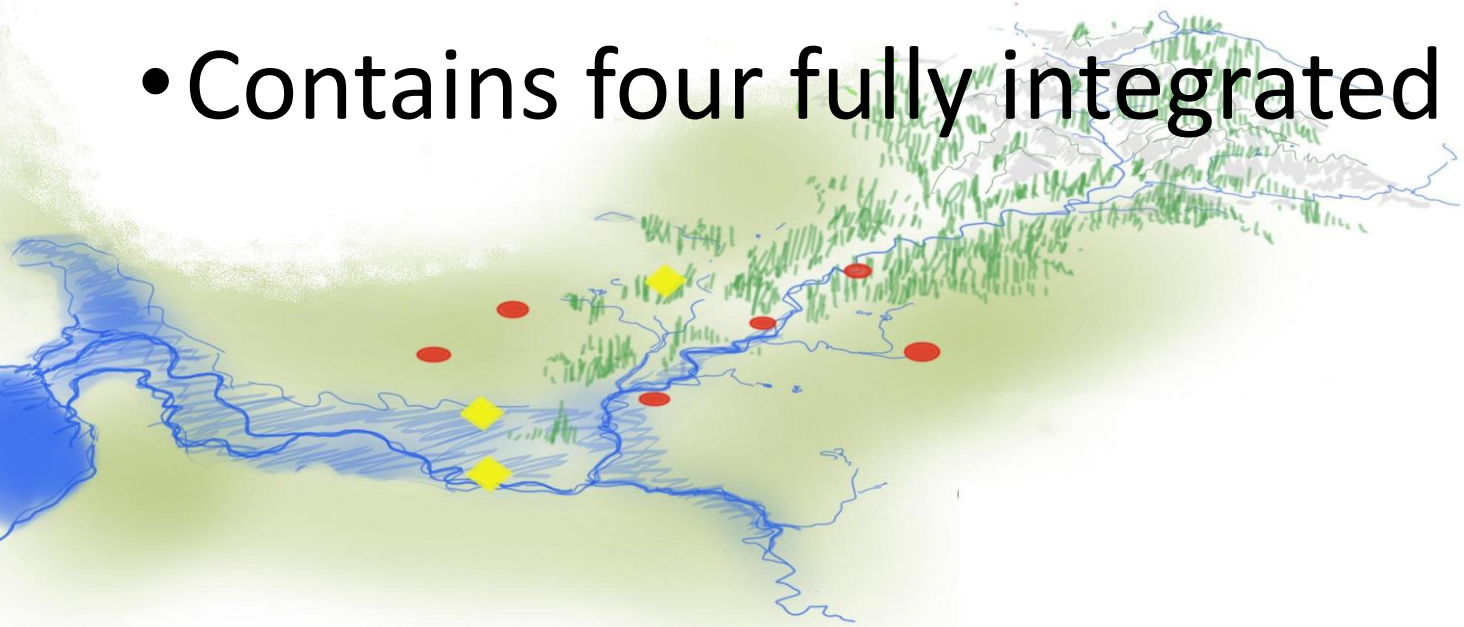




Attribute & Change Models → Indicator Models → Ultimate Use models

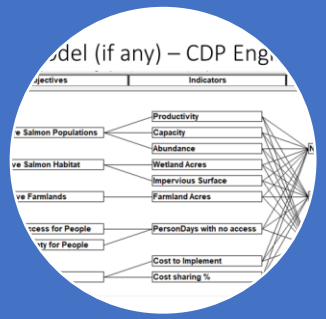
Why the EMDS *Open* Framework?

- It is an existing (20+ years) spatial decision support system for Forest Service
- Supports modeling (not a model!)
- Provides a base for others to build on or with
- Contains four fully integrated modeling engines

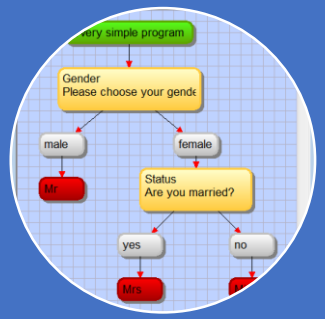


EMDS Internal Modeling Engines (supports collaborative model development - no coding needed)

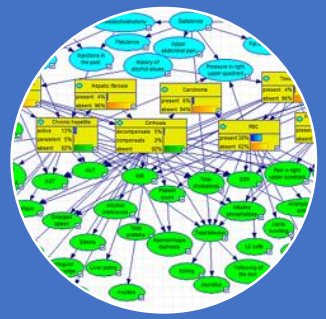
(Fuzzy) Logic Modeling



Multi-criteria Decision Analysis

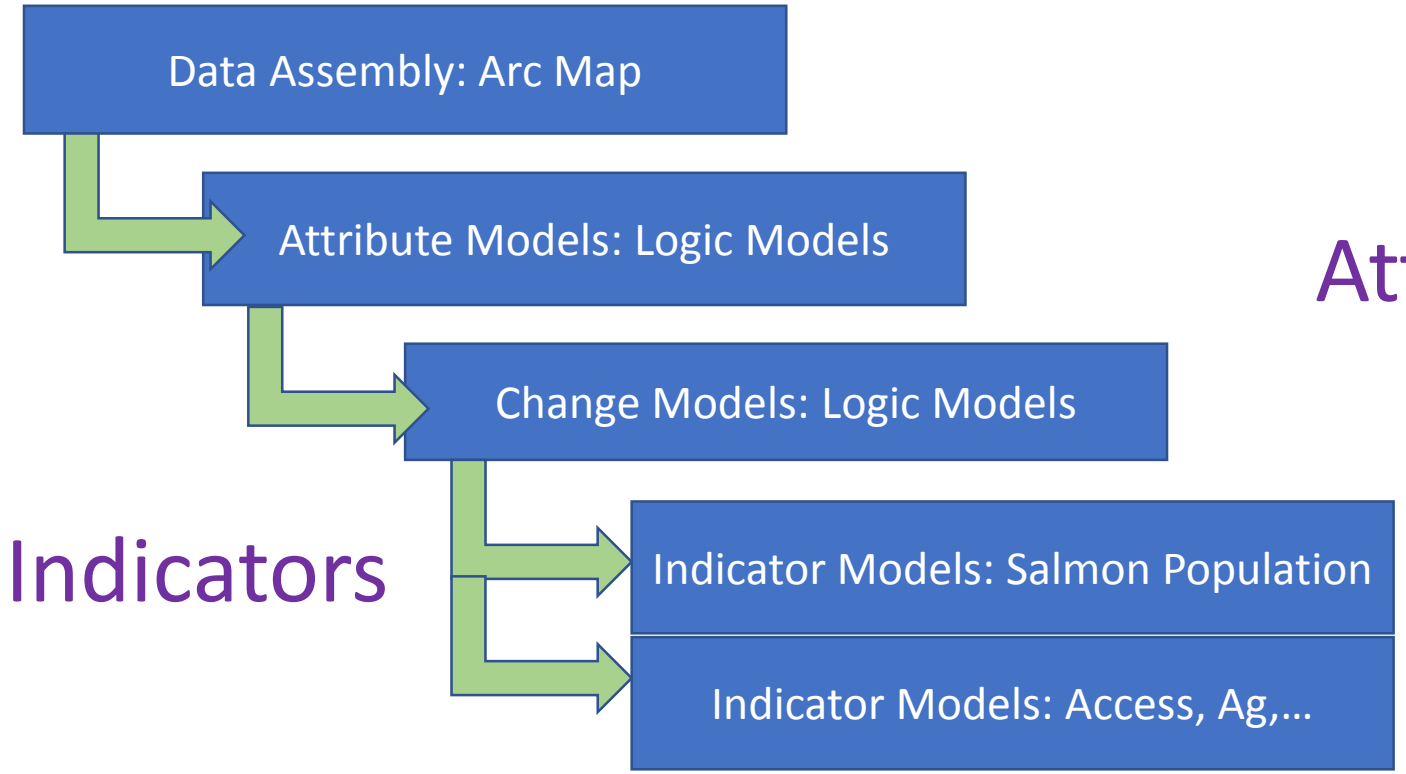


Decision Trees (Rules)

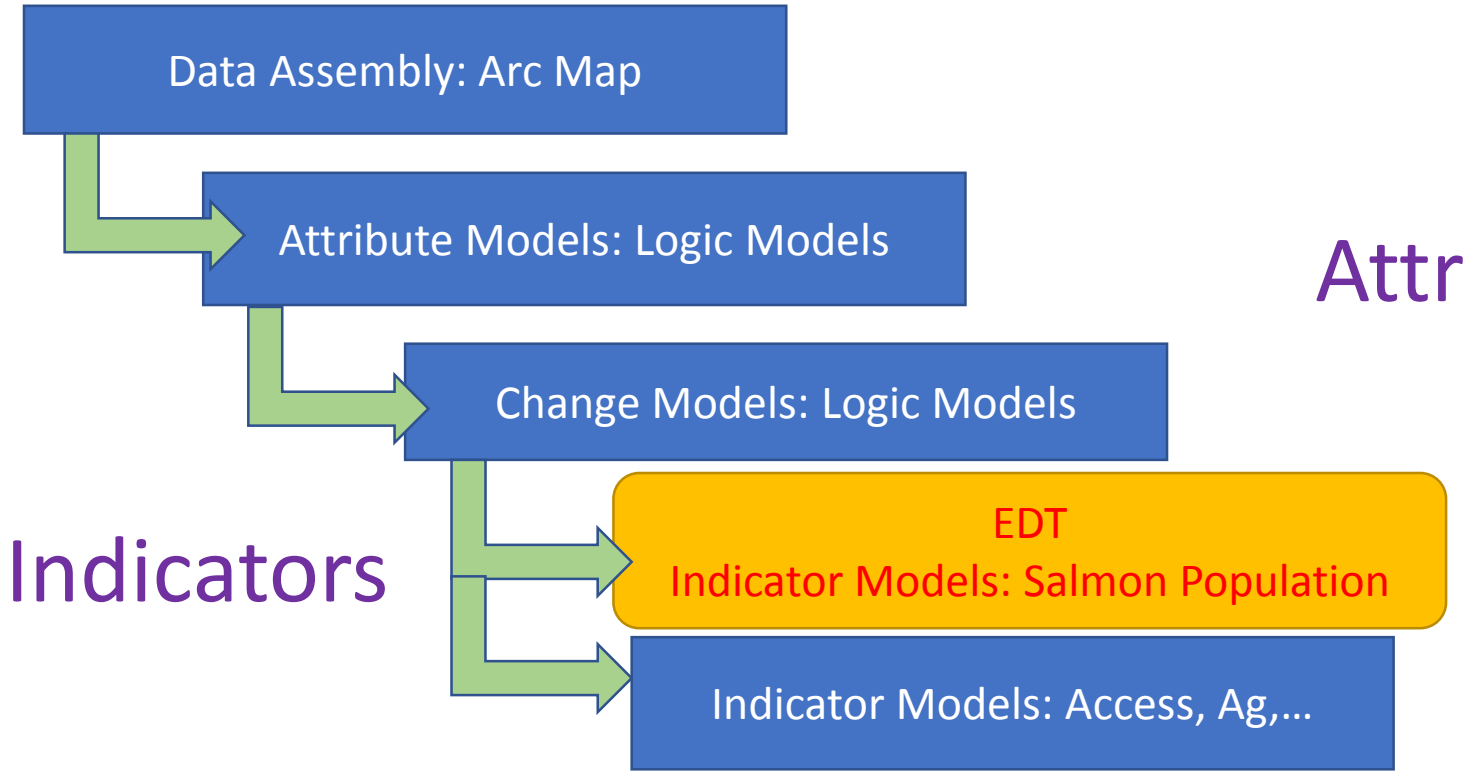


Bayesian Network

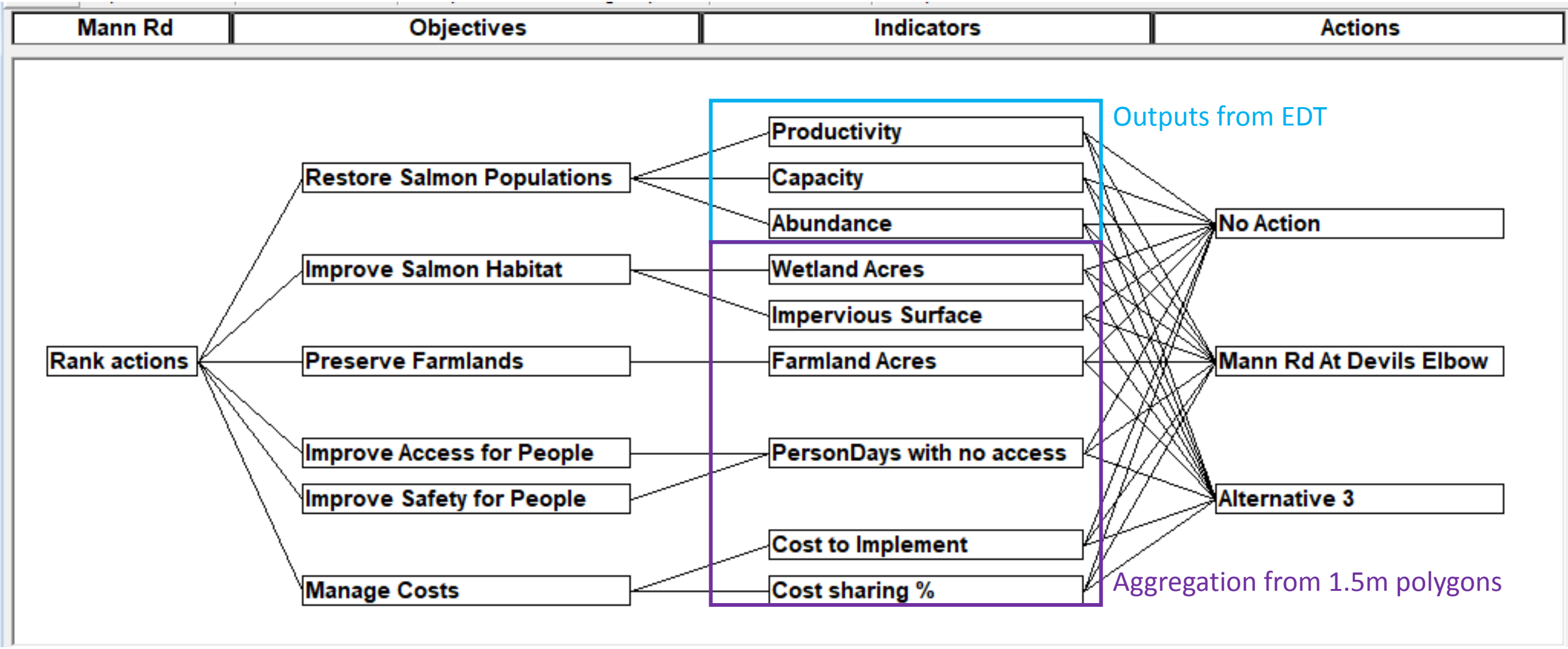
1st iteration models can be generated based on workflows of EMDS internal engines

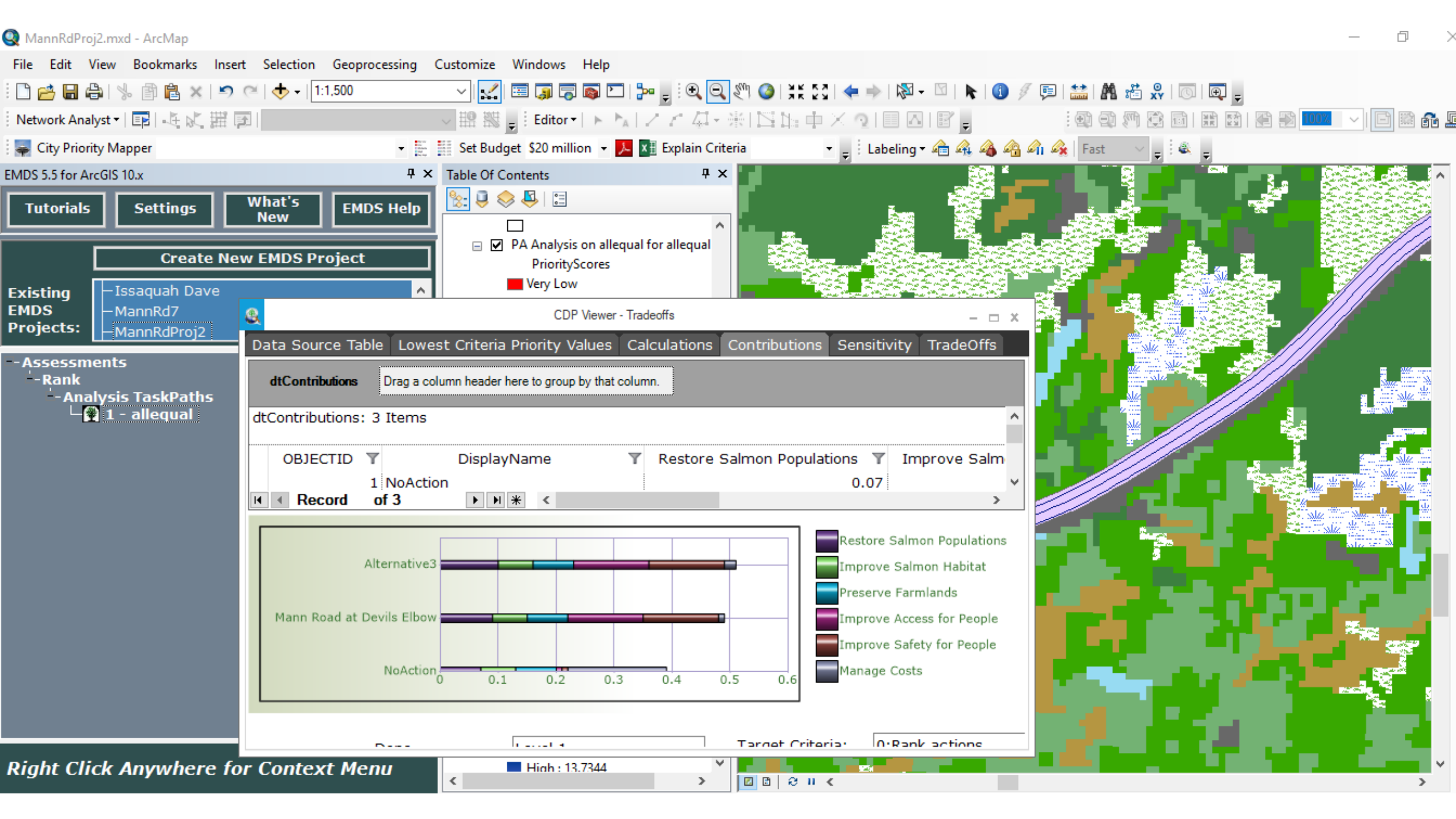


2nd iteration models can be generated based on more sophisticated 3rd party tools and models



Ultimate Use: Criterium DecisionPlus decision model




MannRdProj2.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:1,500
Network Analyst
Editor
City Priority Mapper
Set Budget $20 million
Explain Criteria
Labeling
Fast
EMDS 5.5 for ArcGIS 10.x
Tutorials
Settings
What's New
EMDS Help
Create New EMDS Project
Existing EMDS Projects:
Issaquah Dave
MannRd7
MannRdProj2
Assessments
Rank
Analysis TaskPaths
1 - allequal
Table Of Contents
PA Analysis on allequal for allequal
PriorityScores
Very Low
High : 13.7344
CDP Viewer - Tradeoffs
Data Source Table
Lowest Criteria Priority Values
Calculations
Contributions
Sensitivity
TradeOffs
dtContributions
Drag a column header here to group by that column.
dtContributions: 3 Items
OBJECTID
DisplayName
Restore Salmon Populations
Improve Salm
1
NoAction
0.07
Record of 3
Alternative3
Mann Road at Devils Elbow
NoAction
0
0.1
0.2
0.3
0.4
0.5
0.6
Restore Salmon Populations
Improve Salmon Habitat
Preserve Farmlands
Improve Access for People
Improve Safety for People
Manage Costs
Target Criteria:
0:Rank actions
Right Click Anywhere for Context Menu

UC#	Use case	Connected/ongoing Projects
1	Trends simulation	Tulalip Tribes Climate Change Adaptation Support (2018) & Large Scale process workshops (2018); Snohomish County CC Decision Support tool (2015-17)
2	Action (project) Assessment Tool	Scoping project (2017); Proposed NTA action (2019-2021)
3	Area Prioritization Analysis	Landscape Process Workshops (2018), Proposed NTA action (2019-2021)
4	Permit Analysis Support	Suquamish JRP Mapping Project(2018); ORIA(-2018), Proposed NTA actions (2019-2021)
5	Regulatory Harmonization Simulation	Proposed NTA actions (2020-2021)
6	Management Action Comparison Support	Proposed NTA actions (2020-2021)
7	Harmonization Plan Assessment tool**	Proposed NTA actions (2020-2022)

Summary

- We are working to support the Harmonization Initiative
- The EMDS Open Framework supports iterative, collaborative development of complex systems
- **Its only as useful as the people, models and tools we connect with**

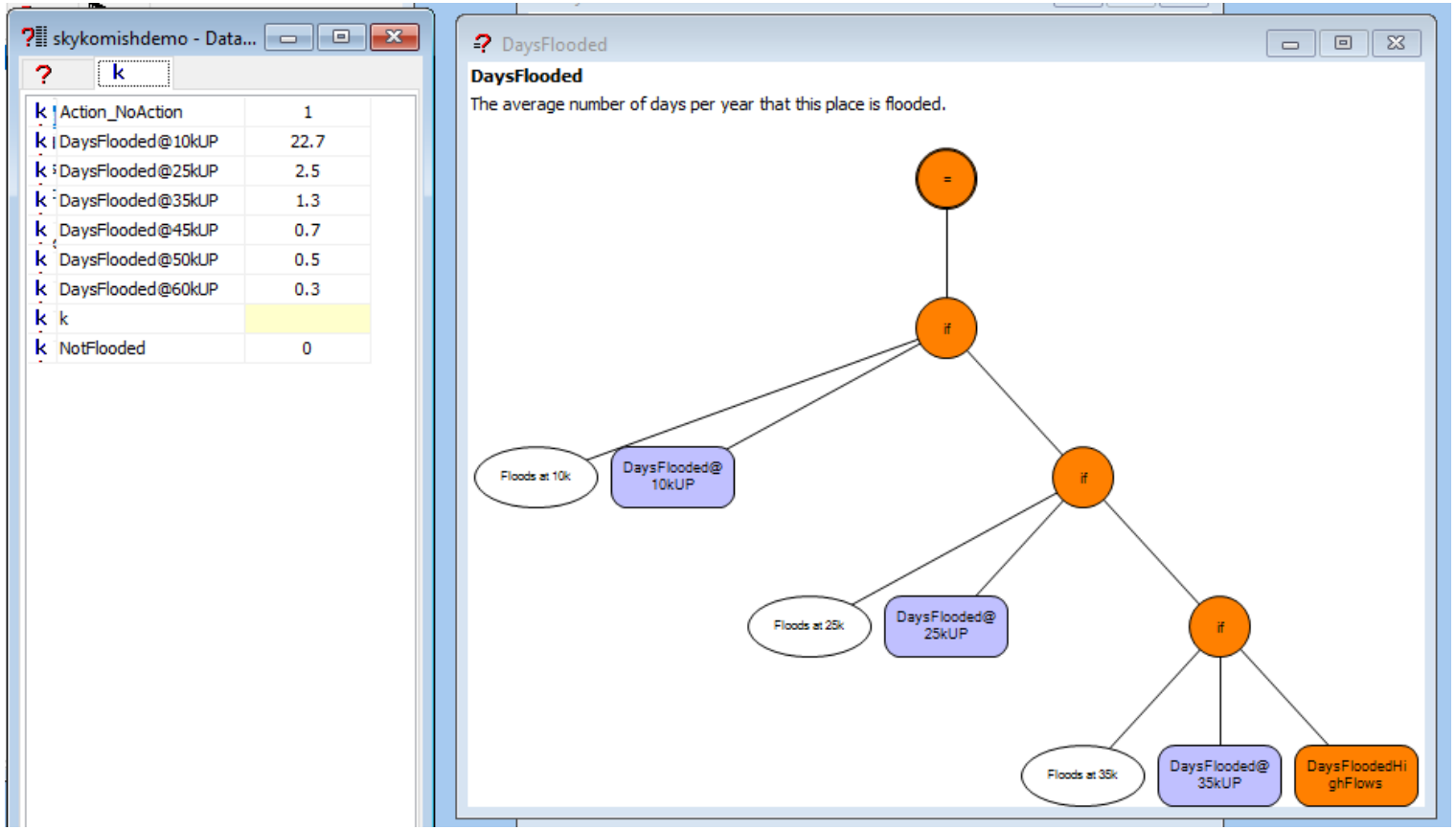
- Wikipedia article with many EMDS cases studies and papers at
  - https://en.wikipedia.org/wiki/Ecosystem_Management_Decision_Support

Questions?

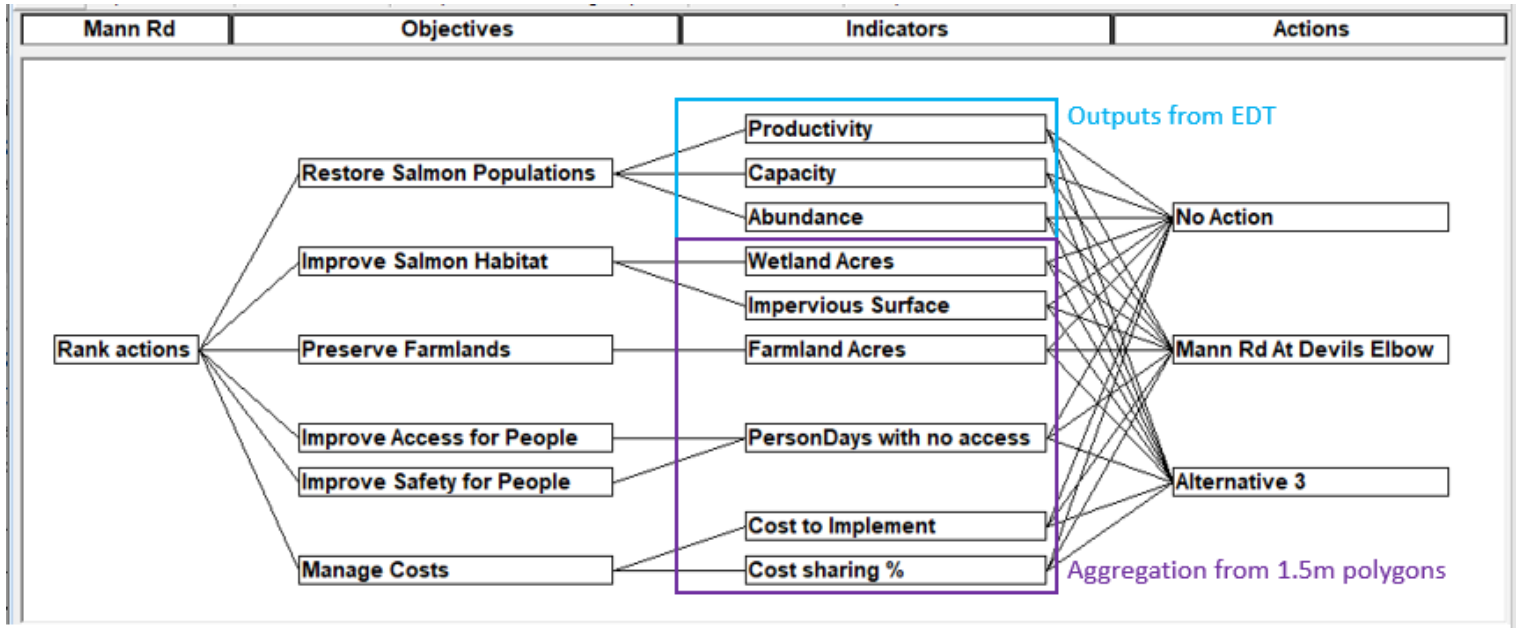
What stand alone systems should we be exploring for integration?
Where do you see possible areas for collaboration?
Are there other framework initiatives in the Salish Sea we should align with?

Thank you!

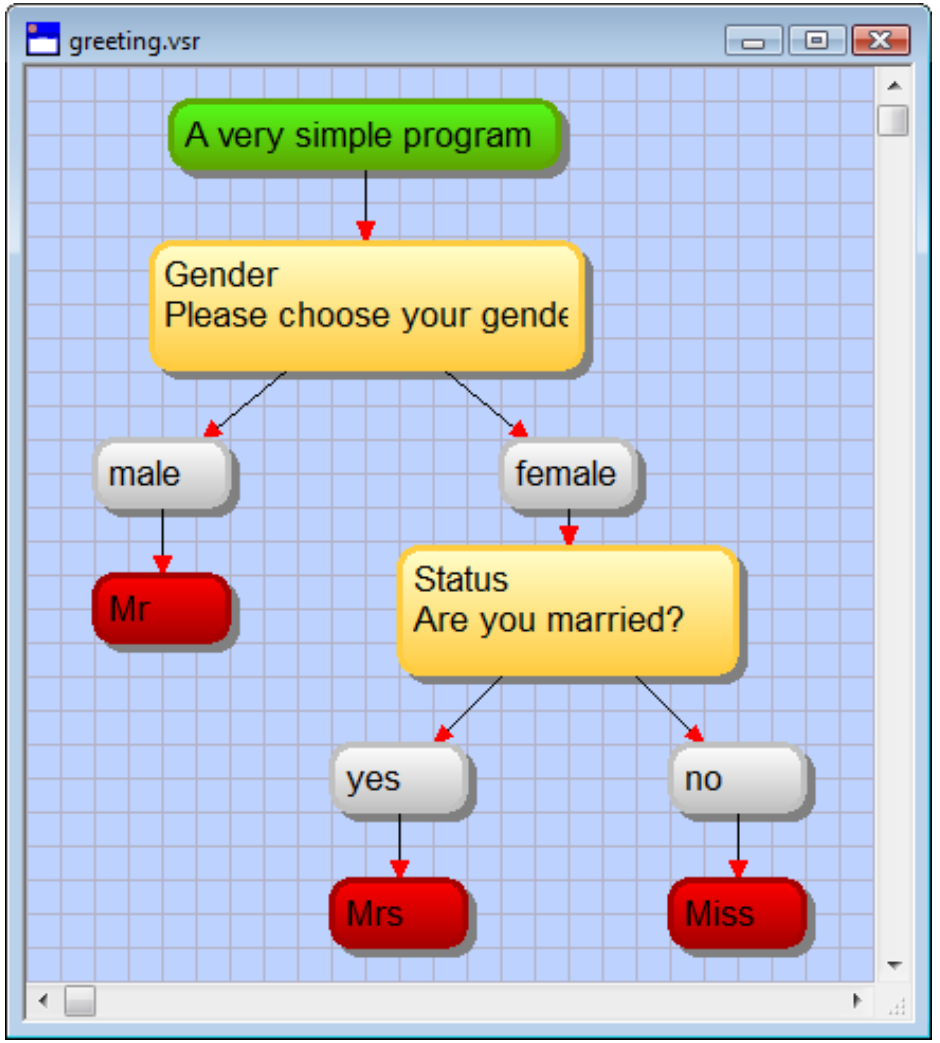
Internal Engine: NetWeaver Logic Model



Internal Engine: Criterium DecisionPlus Decision Hierarchy



Internal Engine: VisiRule Decision Tree



Internal Engine: Smile Bayesian network