



Working Group 6: Integrated Monitoring & Modeling

**2016 ISCMEM Annual Public Meeting
National Science Foundation
Washington, DC
December 14, 2016**

Ming Zhu, Ph.D., PE, PMP, F. ASCE



WG6 Proposed Objectives

Coordinate ongoing and new research conducted by U.S. Federal agencies that focus on *the integration of monitoring activities and modeling approaches to reduce uncertainties and lifecycle costs of environmental cleanup and closure projects*



WG6 Proposed Goals

- Develop integrated, multi-media, multi-phase, multi-component, multi-scale coupled process models for environmental cleanup and closure applications
- Identify conditions for using multiple sets of different types testing/monitoring data of varying pedigree to identify and quantify sources of uncertainties of the integrated model
- Develop approaches for incorporating multiple sets and types of data into integrated, multi-scale environmental models, to assess and reduce estimation uncertainties
- Develop strategies for using integrated, multi-scale models to prioritize data acquisition and model improvement throughout the lifecycle of environmental cleanup projects, including:
 - Optimize monitoring programs for minimal cleanup time and/or total project costs
 - Develop strategies for validating integrated performance assessment/risk assessment (PA/RA) models using post-PA/RA testing/monitoring data



WG6 Participants (as of 2014)

- Todd Anderson, DOE SC
- Matthew Bates, USACE
- Richard Bush, DOE LM
- Boris Faybishenko, LBNL
- Mark Fuhrmann, NRC
- Pierre Glynn, USGS
- Mary Hill, U. Kansas
- Susan Hubbard, LBNL
- Gerry Laniak, EPA
- Joshua Linard, DOE LM
- Igor Linkov, USACE
- Tom Nicholson, NRC
- Feng Pan, U. Utah
- Yoram Rubin, UC Berkeley
- Andy Ward, DOE EM
- George Yeh, U. of Florida
- Charley Yu, ANL
- John Zachara, PNNL
- Ming Zhu, DOE EM



Interagency Performance & Risk Assessment Community of Practice

- Promote technical exchange and develop best practices for performance and risk assessments that are used to inform and support management decisions associated with regulatory compliance with CERCLA, RCRA, NEPA, DOE Order 435.1 and NDAA Section 3116.
- Provide technical inputs to support regulatory decisions on:
 - waste form development and implementation;
 - tank closure activities;
 - waste site closure activities;
 - in-situ decontamination and decommissioning;
 - soil and groundwater remediation; and
 - management of disposal facilities
- Governed by a Chartered Steering Committee; otherwise, self-directing.





Interagency Performance & Risk Assessment Community of Practice

6 Technical Exchange Meetings since 2009:

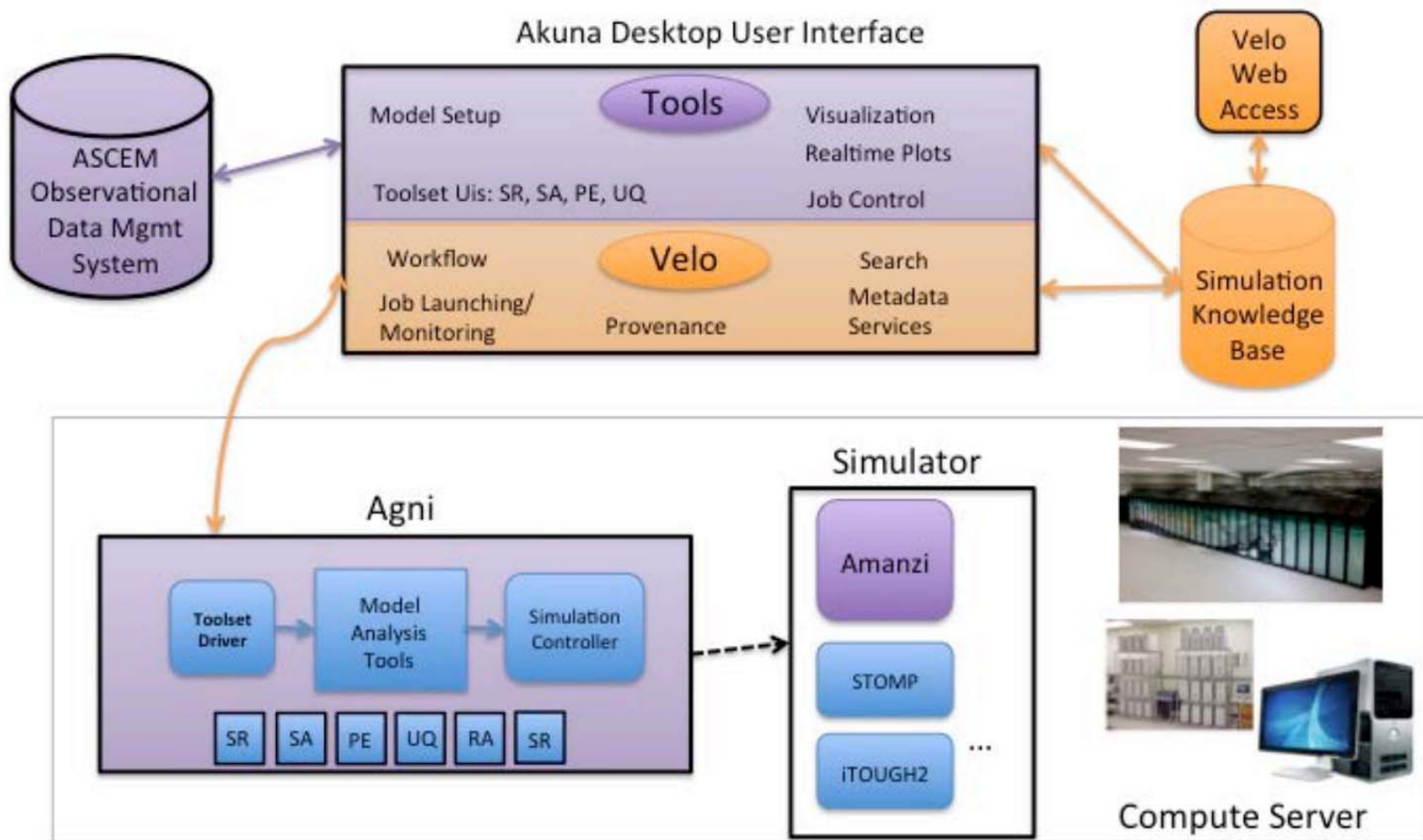
- **July 13-14, 2009: Salt Lake City** (<http://www.cresp.org/education/workshop>)
Theme: Engineered Systems for Closure and Near-Surface Disposal
- **April 13-14, 2010: Richland, WA** (http://srnl.doe.gov/copexchange/2010_pacop.htm)
Theme: ASCEM, CBP, and examples of modeling applications
- **May 25-26, 2011: Atlanta, GA** (http://srnl.doe.gov/copexchange/2011_pacop.htm)
Theme: 10 CFR 61 Update, Software QA, PA updates
- **December 11-12, 2014: Las Vegas, NV** (<http://www.energy.gov/em/downloads/december-11-12-2014-technical-exchange-meeting-las-vegas-Nevada>)
Theme: Risk-Informed, Cost-Effective Environmental Management Decisions
- **December 15-16, 2015: Richland, WA** (<http://www.energy.gov/em/december-15-16-2015-technical-exchange-meeting-richland-Washington>)
Theme: Interpretation of Performance and Risk Assessment Results
- **October 19-20, 2016: Germantown, MD** (<http://www.energy.gov/em/october-19-20-2016-technical-exchange-meeting-germantown-maryland>)
Theme: Probabilistic Risk Assessments; Release and Transport of Key Radionuclides





Use of ASCEM to Define End-State & Optimize Long-Term Monitoring

Advanced Simulation Capability for Environmental Management (ASCEM)





Use of ASCEM to Define End-State & Optimize Long-Term Monitoring

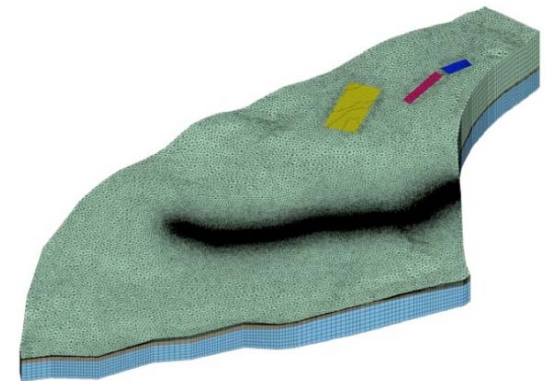
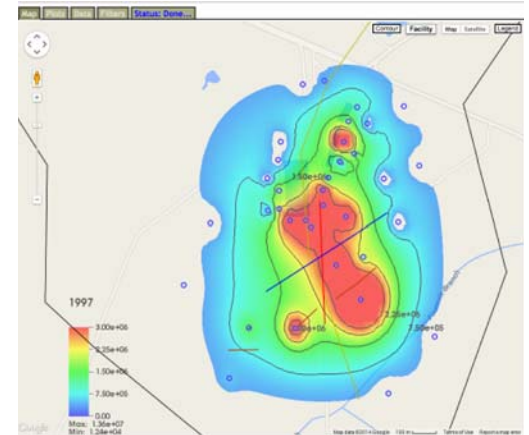
Carol A. Eddy-Dilek (SRNL) and Haruko M. Wainwright (LBNL)

Real/Virtual Test Bed at SRS F-Area

- Data analysis confirmed the feasibility of in situ monitoring
- ASCEM 3D flow and transport simulations quantified the correlations (spatially and temporally variable) but also the future trajectory
- UQ/sensitivity analysis: the long-term feasibility of monitoring

Cost-effective strategies for long-term monitoring of contaminants (including tritium)

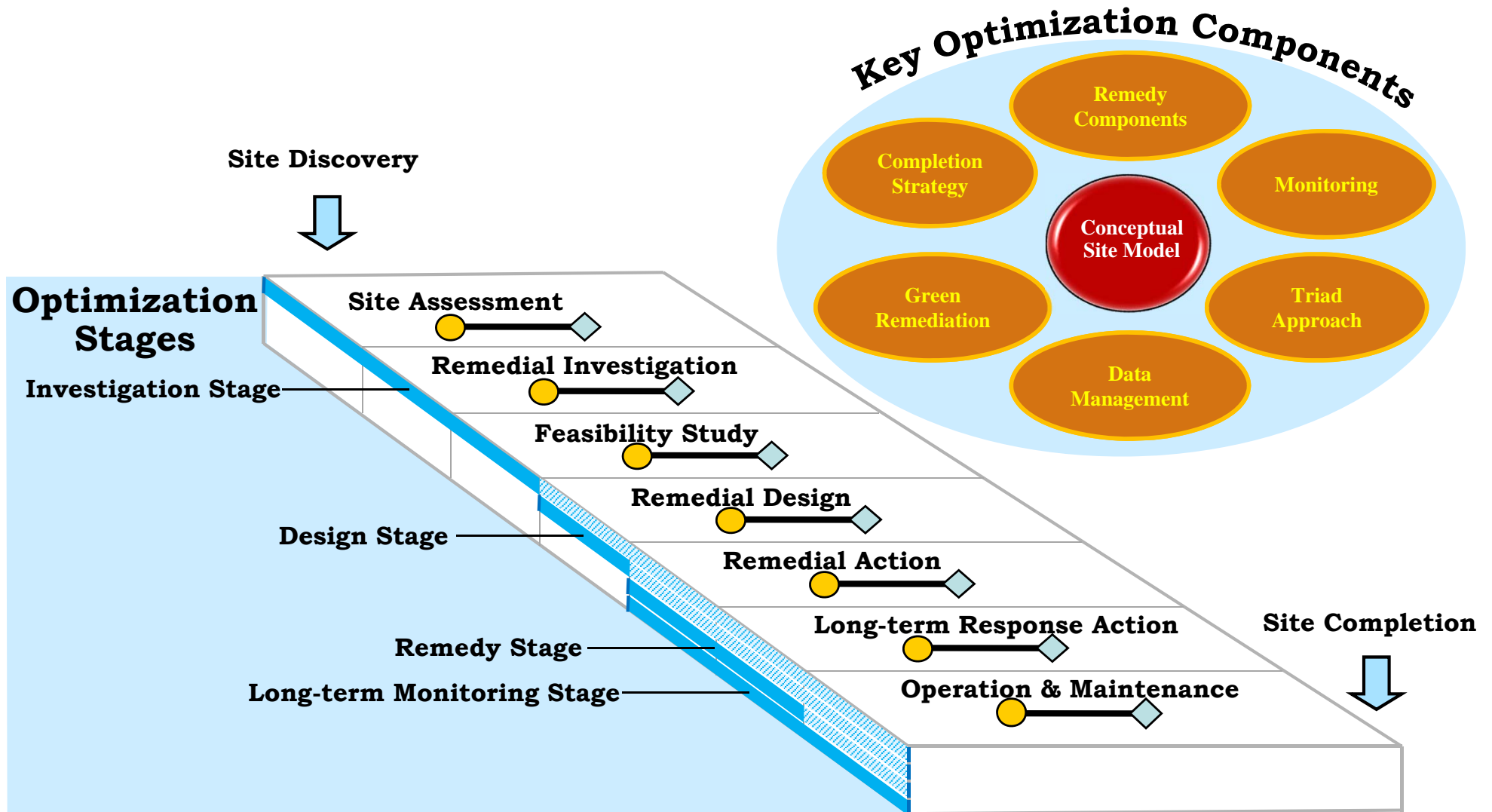
- In situ sensors, data streaming and data analytics for automated continuous monitoring
- Advanced technologies: geophysics, fiber optics, UAVs
- Data Analytics: QA/QC, correlations between master variables and contaminant concentrations
- Integrated approach (data + modeling) for system understanding/estimation





Implementing Optimization in the Superfund Program

Kirby Biggs (USEPA)



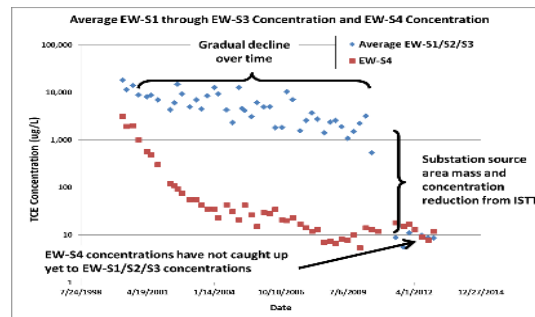


Implementing Optimization in the Superfund Program

Kirby Biggs (USEPA)

What is Reviewed during LTMO:

- Changes in COC concentrations
- Rate of mass removal
- Effluent discharge
- Evaluate costs and effort
- Environmental footprint
- Containment
- Monitoring network



Groveland Wells, MA

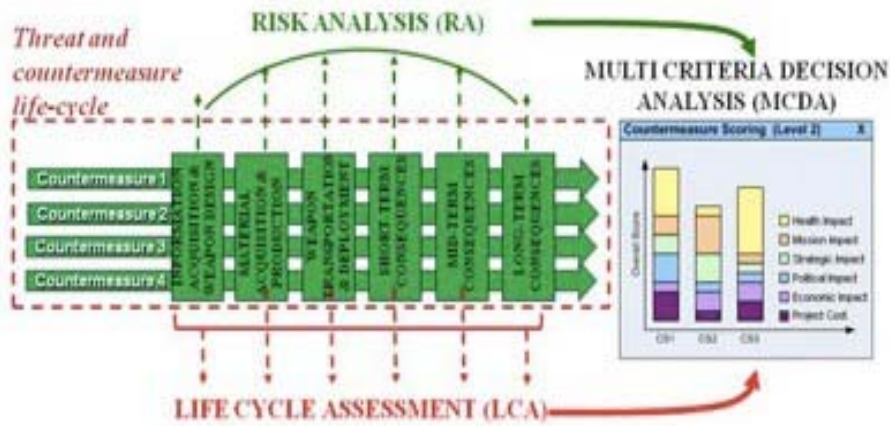
Common Findings:

- CSM needs update
 - Conditions since end of active remedy
 - Sources
 - Low and high permeability zones
 - NAPL
- Endpoint and metrics for site completion need better definition
- Need for improved data management, analysis and reporting

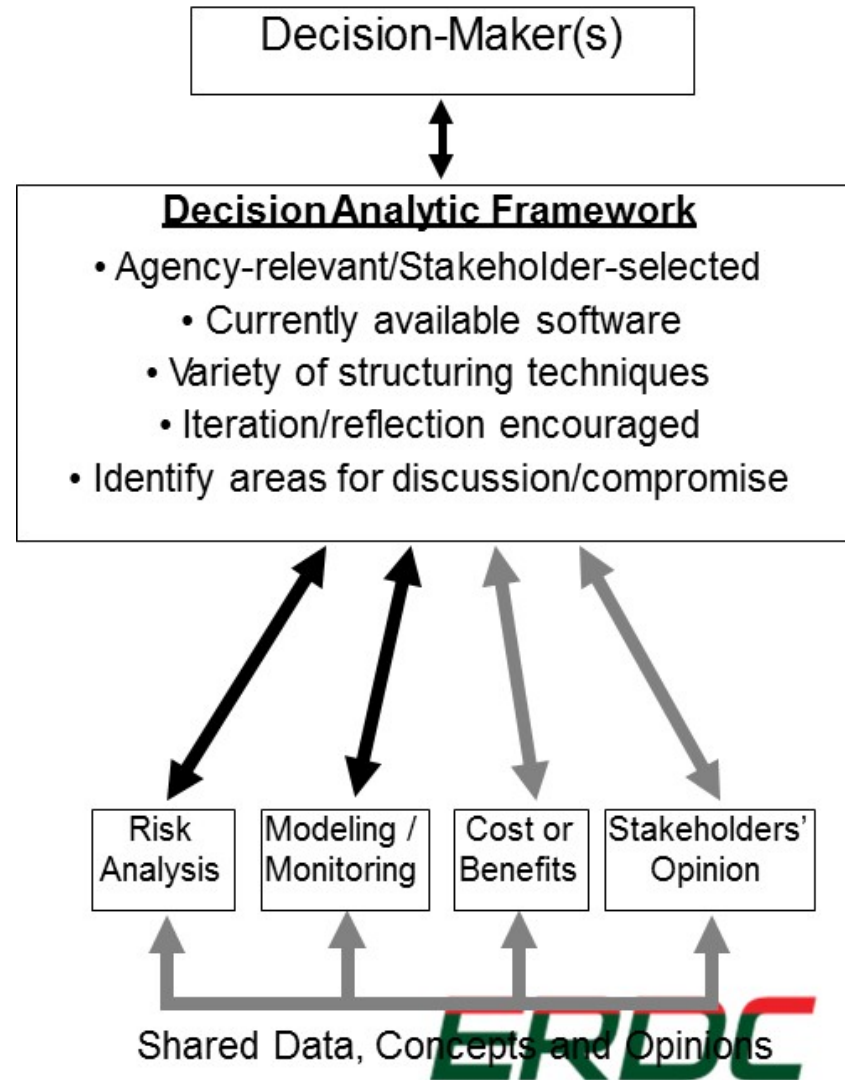
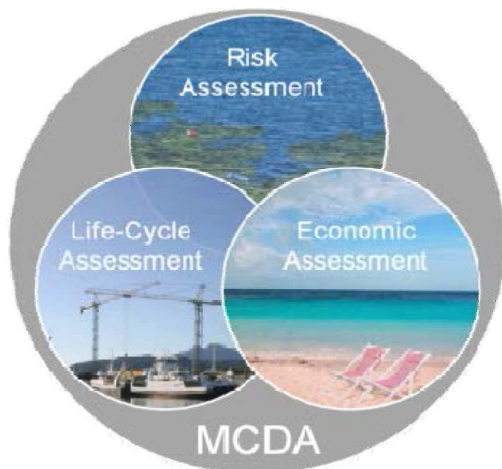


Multi-Criteria Decisional Analyses

Ignor Linkov & Matthew Bates (USACE)



Integrating Risk Analysis, Life Cycle Assessment, and Multi-Criteria Decision Analysis models for decision making

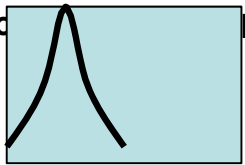
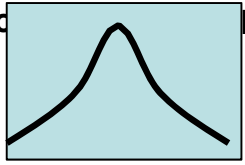
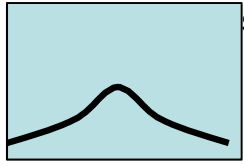




Multi-Criteria Decisional Analyses

Ignor Linkov & Matthew Bates (USACE)

How to combine these criteria? (weights)

	Criteria 1	Criteria 2	Criteria 3	Criteria 4
Alt.	How to interpret these data/results? (normalized scores)			
Alt.	Monitoring Results	Stakeholder Preference	Economic Cost	Non-monetary benefit
Alt.		Stakeholder Preference	Economic Cost	Non-monetary benefit
Alt.		Stakeholder Preference		Non-monetary benefit

How to compare these alternatives?
(MCDA evaluations)



IAEA MODARIA II WG1

- 32 participants from 13 countries
- Focus on risk-informed decision analyses for NORM and legacy waste sites
- Consider case Studies for 4 sites in Belgium, Ukraine, and USA and potentially China.
- Interim Meeting: June 2017, Brussels, Belgium
- Technical Meeting: Oct. – Nov. 2017, Vienna, Austria

<http://www-ns.iaea.org/projects/modaria/default.asp?l=116>



IAEA

International Atomic Energy Agency



Tessenenderlo Site, Belgium



Pridneprovsky Site, Ukraine



LANL MDA G, USA



IAEA MODARIA II WG1: Proposed Tasks for Risk Assessment

- Develop improved methodologies for radiological impact assessments
 - FEP screening
- Improve assessment models
 - Source terms
 - NORMALYSA, RESRAD, others
- Conduct model–model and **model–data comparisons**
 - **Model-data comparison for selected sites**
- Apply methodologies to existing sites and facilities
 - 4 selected sites
- Train end users (regulators, operators, other stakeholders) on use of codes when they attend MODARIA meetings or through TC



IAEA

International Atomic Energy Agency

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IAEA MODARIA II WG1: Proposed Tasks for Decision Analyses

- Document decision making process for lessons learned
 - MDA-B land transfer after completion of cleanup at the LANL site, USA
 - Closure of mine Zirovskivrh, Slovenia
 - Closure of the Beaverlodge uranium mine and mill tailings site, Canada
- Develop lists of “prevailing circumstances” and site specific situations
 - Review non-nuclear (mining, chemical, oil/gas, construction) best practices
 - List of contributing factors
- Develop methodologies and toolsets for formalized decision analysis
 - Consider application of the DA methodologies to case studies
 - Define end-state and optimize monitoring program using high-performance computing codes
 - Develop structured decision making framework with participation of interested parties



IAEA

International Atomic Energy Agency

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Upcoming Events

- March 2017: WM2017
- March 2017: P&RA CoP Steering Committee Meeting on sidelines of WM2017
- June 2017: IAEA MODARIA II Interim Meeting
- October 2017: P&RA CoP Annual Technical Exchange Meeting