WM2015 Conference Panel Report

PANEL SESSION 127: **A Paradigm Shift – The Key to Optimal, Defensible & Transparent Waste Management Disposal & Environmental Remediation Decisions**

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This report summarizes the proceedings of the panel convened at the 2015 Waste Management Symposium to discuss a change in paradigm designed to ensure a structured approach to decision making. Various levels of stakeholder engagement and involvement need to be factored into a DOE EM process designed to implement sustainable decisions that carry with them the technical underpinning and basis for the alternative chosen. The need for a paradigm shift is predicated on the time cycle for the cleanup of the EM legacy to be completed, the pace at which technology changes and the financially demanding nature of the cleanup work.

This panel offered a different approach to communicating their views on the topics in that it was set up as a demonstration of a meeting in which various parties were asked to participate in a mock scoping meeting. The mock scoping session was facilitated by moderators who explained the concepts of each step as the "scoping meeting" was conducted. The audience was asked to participate in the development of the scope. In some cases, members of the audience took on roles of specialized public interest groups that helped illustrate the usefulness of using a structured decision analysis tool. The software framework program used in this demonstration is Guided Interactive Statistical Decision Tools, GiSdT – pronounced "gist').

The concepts and approaches of structured stakeholder interaction in decision analysis is presented in "*A Paradigm Shift – The Key to Optimal, Defensible & Transparent Waste Management, Disposal & Remediation Decisions – 15236*". The authors of the paper wish to acknowledge and express their appreciation to the panelists for their engagement during the preparation for the panel as well their candid feedback of the proposed shift in the current paradigm of science based to a combination of a science-based and costs/values based model.

Summary of Presentations:

This panel session highlighted GiSdT, a structured decision-making framework, the central part of a holistic and integrated approach to develop waste management, disposal, and remediation decisions. The human dimension component of decision making is defined as the process to engage stakeholders (DOE managers, regulatory agencies, members of the public, tribal members, scientists and engineers, and others) to constructively and responsibly engage with each other thus building an understanding of the environmental, social, political, and regulatory landscape. This input is then applied in conjunction with statistical models thereby offering various alternatives that can be further evaluated or modeled. This leads to the science-based component of the holistic and integrated approach, modeling with the ability to provide realistic (as compared to conservative) output. The Advanced Simulation Capability for Environmental Management (ASCEM) is one such model. The result of an approach that combines the human dimension with the science-based approach is the creation of a different and novel approach to decision-development.

Good decision-making is based on a balance of costs/values and the best understanding of the problem. Right now, there is an opportunity to affect a paradigm shift that brings new tools to the table to support more effective probabilistic modeling on the science-side of the decision equation, and introduce methods for evaluating costs and value judgments in stakeholder-driven structured decision making (SDM). This approach can be applied at several levels of decision making for waste management, including specific waste stream disposal decisions, optimal use of existing disposal facilities, and siting of new waste disposal facilities. For environmental management, the benefits include more effective resource management and cleanup. This approach could be used to manage environmental and waste management as an enterprise system.

The paradigm shift is aimed at optimized decision-making rather than compliance-based decision-making, although compliance objectives can be used as a floor or threshold for optimization, so that the optimal decisions also ensure compliance. This innovative approach, which is currently being applied in some EPA, FDA and DoD programs, is critical for addressing the complex environmental and waste management problems that remain with the limited budgets that seem inevitable.

The advantages of such a paradigm shift are potentially huge. The paradigm shift means building decision models that include science-based models and models of costs and value judgments that represent what is (thought to be) known about a problem (and the associated uncertainties). This is far easier to explain to stakeholders than the more traditional conservative deterministic, or even probabilistic, models. It is difficult to explain conservative models that do not relate to actual site conditions; “realistic” models are far easier to explain because they are based on a genuine understanding of the problem. This paradigm shift is also needed to provide a more level playing field for nuclear industry, to make better use of limited resources, and to help future generations address these same problems.

This paper and associated panel session (WM2015 paper number 15236, and panel session 127) are part of a companion series of papers and presentations given at WM2015. The series includes WM2015 paper numbers 15649 (structured decision making), 15650 (guided interactive statistics and decision tools), 15087 (stakeholder engagement), 15651 (sensitivity analysis), 15186

(Advanced Simulation Capability for Environmental Management (ASCEM) overview of modular computing framework for predicting fate and transport).

Technical Approach to Shift the Paradigm

The technical approach that serves as the basis for the paradigm shift can be termed stakeholder engaged structured decision-making (SDM). The steps involved in this stakeholder engaged structured decision-making approach can be summarized as follows:

1. Understand context
    a. Regulatory, social, and environmental setting
    b. Scientific setting
    c. Decision landscape
    d. Conceptual model
    e. Social network analysis
2. Define objectives
    a. Fundamental objectives
    b. Measurable attributes
    c. Value functions
    d. Objectives preference weighting
3. Identify decision options
    a. Define options
    b. Tie options to objectives
    c. Develop management scenarios (combinations of options)
4. Evaluate decision options
    a. Develop science-based models (probabilistic modeling) for each option and measurable attribute
    b. Perform uncertainty analysis
    c. Perform sensitivity analysis
5. Take action
    a. Choose optimal decision option or collect more data/information (including model refinement as necessary)
    b. Iterate if necessary

GiSdT provides a software platform for capturing inputs provided for each of these steps, which allows the decision model to be fully transparent and traceable. Technical defensibility is obtained by completing the SDM process. GiSdT forces quantification at each step (e.g., value functions, weights, probability distributions), requiring stakeholder engagement for specification of value functions and weights. The GiSdT implementation of SDM is essentially an implementation of Bayesian statistical decision analysis. This addresses multi-attribute utility and uncertainty characterized using probability distributions. This approach, using GiSdT technology, has been used by EPA on watershed management, brownfields revitalization, and coral reef management projects, and by other federal agencies such as FDA (food safety), DoD (UXO characterization), and NASA (climatology), as well as for some commercial applications. It is perhaps time to bring the same technology into DOE decision-making. This approach changes the focus of modeling from one of conservatism to optimization, which supports better decision-making. It engages stakeholders more effectively, so that value judgments and assumptions are addressed as inputs instead of as endpoints, and provides a structure to support

decision-making that allows decisions to be defensible, transparent and traceable.

Demonstration of Stakeholder Engaged Structured Decision Making

Once the facilitator outlined the process steps above the mock scoping session began. The paper provides the details of the steps outlined above and provides the decision landscape for disposal of a fictitious radioactive waste stream at a specific waste disposal facility. The decision to be made is how and where to dispose of the waste within the system for optimal sustainable effect.

The demonstration session included elicitation as would be performed in an actual discussion with the responses being captured in the software framework real time. The objective of the SDM elicitation is to encourage broad thinking about the problem so that all perspectives are entertained. Capturing the responses in real time enables the gathered group to seek clarification where needed and build upon each other's areas of interests or concerns. This process helps build meaningful relationships centered around shared beliefs and values.

The panel session was conducted as a mock elicitation with primary focus on the values-based modeling side of a decision analysis. That is, it focused on the first three steps of the stakeholder engaged, structured decision making process. The panelists played the role of stakeholders, while the audience effectively played the role of public stakeholders. The panelists and audience provided some feedback, most of which was positive and was aimed at potential uses. Highlights of the feedback follows:

- This has the potential to be a significant communication tool that could be used effectively to educate the public and stakeholders to the decision process.
- This approach could be valuable for gauging stakeholder involvement
- The approach provides the means to manage and tend to the emotion, complexity and technical challenges and to track all the "moving parts".
- This approach could be used to compare over the life cycle of the mission, not just each project.
- Application to existing EIS's would help the public understand our decision-development process. The tool allows soft science to be considered and weighted in the process.
- For NEPA, this approach would engage stakeholders much earlier in the process.
- This approach is more quantitative than other approaches that attempt to perform similar functions.
- Some help would be needed to facilitate this type of approach, at least for the first few cases.
- Clear potential in an environment of declining budgets and shorter decision-making time frames.
- Process of high potential value in complex systems with lots of moving parts.
- The tool's transparency can draw people into the decision making process.
- Documenting all inputs in such a structured fashion is critical for knowledge transition management.
- This approach shows citizens that their concerns are not only heard and captured, but also valued.
- This has the potential to quantify stakeholder's input and see now these inputs impact decisions. It could help blend what we have to do with what we can do.

- The paradigm shift moves from a transactional process to a SDM process that has iterations and dialogs that help build trust and form strong relationships among stakeholders.
- DOE considers the science-side and the stakeholders consider the alternatives. SDM can allow various insights from impacts on decisions when values are changed.

Some comments were also provided on the paradigm shift. For example, the paradigm shift was seen as one that moves towards starting with known factors and preferences and values instead of the technical solution; the focus is moved away from compliance based determinations only; probabilistic modeling is now placed in the right context and is required; ASCEM could be used to help explain results of the science-based models that support this type of decision analysis; stakeholders engagement/education happens throughout the process; and, requires simulation that underscores the value of the SDM process.

Another comment that was made addressed the potential for enhancing regulations such as Sec. 3116 and 435.1. Some waste management regulations are currently undergoing revision – the time is ripe for inclusion of an approach like this. There were some concerns about complexity of the process, however, for solving complex problems, perhaps some complexity should be needed – after all, these are not simple problems that have simple solutions. Some comments were also made that this approach to removing conservatism from science-based models might be difficult considering the current paradigm. The counterpoint is that the intent is not to remove conservatism, but to place it in the right context. The question remains, however, as to whether DOE is willing to be a change agent in this ongoing paradigm shift. Fortunately, other agencies are already being change agents in this regard, in which case, DOE would be catching up to EPA, FDA and other agencies.

Final Comments

Overall, stakeholder engaged structured decision making integrates Value-Focused Thinking, Bayesian decision analysis, and environmental fate and transport modeling to provide for transparent, efficient and defensible environmental and waste management decisions. The paradigm shift is important for several reasons, not the least of which is from a technical perspective it is the right way to solve decision problems, and all problems are decision problems. In the current world of environmental and waste management, budgets are being reduced and there is a preference for shorter time frames to completion. However, completion is not achievable with the current paradigm, as many examples have shown. The current paradigm includes conservatism, and ineffective stakeholder engagement that often leads to redo. Effectively engaging stakeholders through SDM, and placing conservatism where it belongs in value judgments rather than science, can open the door to more effective decision making, saving DOE money while ensuring the decision we make enable a sustainable approach to protection of human health and the environment.

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