Assessing Risks from Emerging Contaminants: Using Expert Elicitation and Group Decisions

A. Rak¹, W. Glaccum¹, and T. Pitrat²

¹Noblis, Falls Church, VA
²US Army Public Health Command, Aberdeen Proving Ground, MD

Disclaimer: The views expressed in this presentation are those of the authors and do not reflect the official policy or position of the Department of Army, Department of Defense, or the U.S. Government.
Outline

- Background on expert elicitation
- Phase I impact assessment process
- Identification of experts
- Elicitation methods
- Results
- Next steps
Expert Elicitation

“a formal process by which expert judgment is obtained to quantify or probabilistically encode uncertainty about some uncertain quantity, relationship, parameter, or event of decision relevance”

USEPA, Science Advisory Board, 2009
Some Applications of Expert Elicitation

- Regulatory settings
  - US Environmental Protection Agency
  - Nuclear Regulatory Commission
  - US Department of Agriculture

- Non-Regulatory settings
  - Department of Defense
  - US Army Corps of Engineers (Civil Works)
  - National Aeronautics and Space Administration
Application of Expert Elicitation to Emerging Contaminants

- **Over-the-horizon**
  - Review literature, periodicals, regulatory communications, etc.

- **Possible DoD impacts**
  - Monitor events; **Conduct Phase I qualitative impact assessment**

- **Probable high DoD impacts**
  - Conduct Phase II quantitative impact assessment; develop & rank RMOs

- **Risk Management Options (RMOs)**
  - Risk Management Options (RMOs) to ECGC
  - Approved RMOs become Risk Management Actions (RMAs)
Subject Matter Expert Elicitation in the Phase I Impact Assessment Process

Data Collection

+ Regulatory Analysis

Subject Matter Expert Input

= Phase I Impact Assessment
Identification of Subject Matter Experts
For Phase I Impact Assessments

**Internal**

- Government employee experts
- Experts under direct government contract

**External**

- Industrial/Commercial firms and consultants
- Commercial manufactures
Functional Areas for Impact Assessment

- Acquisitions / Research Development
- Testing and Evaluation
- Environmental Safety and Health
- Production, Operation, Maintenance, and Disposal of Assets
- Cleanup/Remediation
- Training and Readiness
Sub-Functional Area Assessment

- O1 - Infrastructure Improvements
- O2 - Production and Maintenance Operations
- O3 - Analytical Testing and Monitoring (env)
- O4 - Analytical Testing and Monitoring (matieriel)
- O5 - Material Handling, Storage, and Transport
- O6 - Waste Handling, Storage, Transport, and Disposal
- O7 - Personal Protective Equipment

- RT1 - System Specific
- RT2 - Training Activity
- RT3 - Location Specific

- E1 - Human Health
- E2 - Occupational Health
- E3 - Safety
- E4 - Environmental Health
- E5 - Community, Public or Worker Relations

- R1 - Material Availability
- R2 - Material Qualifications
- R3 - Industrial Base Equipment Suppliers
- R4 - Cost and Schedule
- R5 - Materials Laboratory Scale Activities

- C1 - New Site Identification
- C2 - Remedial Technologies
- C3 - Existing Sites
- C4 - Cost to Complete
- C5 - Property Transfer and Re-Use
# Types of Subject Matter Experts (SMEs)

<table>
<thead>
<tr>
<th>Functional Area</th>
<th>Total</th>
<th>SME</th>
<th>Non-SME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition / Research, Development, Testing, and Evaluation</td>
<td>30</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Clean Up</td>
<td>30</td>
<td>8</td>
<td>22</td>
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<tr>
<td>Environment, Safety, and Health</td>
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<td>21</td>
<td>9</td>
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<tr>
<td>Production, Operations, Maintenance, and Disposal of Assets</td>
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<td>11</td>
<td>19</td>
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<tr>
<td>Readiness and Training</td>
<td>30</td>
<td>4</td>
<td>26</td>
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</tbody>
</table>

Data from: Cadmium and Compounds, November 2009
Expert Elicitation Process (Probability)

Probability of Adverse Impact (1-5)

- **Definite**  > 80% Will definitely be affected
- **Probable**  51-80% Will probably be affected
- **Possible**  31-50% Will possibly be affected
- **Plausible**  11-30% Slight possibility of affect
- **Improbable**  < 10% Unlikely to have affect or no affect
Expert Elicitation Process (Severity)

Severity of Adverse Impact (1-5)

- **Unacceptable** increases in the number, type and degree of human health hazards for non DoD employees or offsite populations
- **Significant** increases the number type and degree of human health hazards for non DoD employees or offsite populations
- **Moderate** increases the number type and degree of human health hazards for non DoD employees or offsite populations.
- **Limited** increases the number type and degree of human health hazards for non DoD employees or offsite populations.
- **No** non DoD employees or offsite populations are considered at elevated risk as a result of DoD activities. Hazards are inconsequential.
Expert Elicitation Process (Confidence)

Confidence in Probability and Severity (1-5)

- **Certain** - Supported by facts and experience
- **Somewhat certain** - Supported by some facts, experience or anecdotal information
- **Not certain** - Intuitive answer based on similar situations
- **Somewhat unsure** - Intuitive answer but no basis
- **Uncertain 'guesstimate'** - No facts, experience or intuition
Emerging Contaminant Assessment System (ECAS)

Questions for Cadmium and Compounds

Functional Area Number: 1, EHS FY10
Functional Area Title: Environment, Safety, and Health

Question

QUESTION 1: Human Health: What is the risk that the revised toxicity values for cadmium and compounds will increase the number, type, and degree of human health hazards for non DoD employees or offsite populations as a result of DoD activities?

Back to Assigned Questions List

PART I: What is the probability that revised toxicity values for cadmium and compounds will increase the number of situations considered hazards, or change the classification of the type and degree of human health hazards non DoD employees or offsite populations are exposed to as a result of DoD activities?

<table>
<thead>
<tr>
<th>Probability (1-5)</th>
<th>Probability Descriptions</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite: &gt; 90%</td>
<td>Will definitely be affected</td>
<td>5</td>
</tr>
<tr>
<td>Probable: 81-90%</td>
<td>Will probably be affected</td>
<td>4</td>
</tr>
<tr>
<td>Possible: 61-80%</td>
<td>Will possibly be affected</td>
<td>3</td>
</tr>
<tr>
<td>Plausible: 31-60%</td>
<td>Slight possibility of affect</td>
<td>2</td>
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<tr>
<td>Improbable: &lt; 10%</td>
<td>Unlikely to have affect or no affect</td>
<td>1</td>
</tr>
</tbody>
</table>

Probability Comments
Example from Expert Elicitation

- Acquisition / Research, Development, Testing, and Evaluation

- Question 2 - Material Qualifications:
  - What is the risk that increasing international regulatory restrictions [e.g., REACH or RoHS] for cadmium and compounds will increase testing, specification, and evaluation requirements?

Data from Cadmium and Compounds, Oct 2009
# Expert Elicitation Data Summary

## Combined Functional Areas

<table>
<thead>
<tr>
<th>Probability</th>
<th>Severity</th>
<th>Cells</th>
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<tbody>
<tr>
<td>5</td>
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<tr>
<td>4</td>
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<td>Yellow</td>
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<td>2</td>
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<td>Yellow</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Green</td>
</tr>
</tbody>
</table>

- **Green cells**: Low probability and severity combinations.
- **Yellow cells**: Medium probability and severity combinations.
- **Red cells**: High probability and severity combinations.

**Legend**:
- E1, E2, E3, E4, E5, E6, E7
- R1, R2, R3, R4, R5
- O1, O2, O3, O4
- RT1, RT2, RT3
- ESH
- Human Health
- Occupational Health (civilian and uniformed)
- Safety
- Environmental Health
- Community, Public or Worker Relations
- Training Facilities (System Specific)
- Training Activities (Activity Specific)
- Military Readiness (Location Specific)
- Material Availability
- Material Qualifications
- Industrial Base and Equipment Suppliers
- Cost and Schedule
- Materials Laboratory Scale Activities
- Infrastructure Improvements
- Production and Maintenance Operations
- Analytical Testing and Monitoring
- Personal Protective Equipment (PPE)
- Waste Handling, Storage, Transport, and Disposal (HST&D)
- Personal Protective Equipment (PPE)

Data from Cerium and Compounds, July 2009
Phase I Impact Assessments Completed

- Tungsten
- Tungsten alloy
- Tetrachloroethylene (PCE)
- Dioxins
- 1,4-Dioxane
- Perfluorooctyl sulfonate (PFOS)
- Di-nitrotoluenes (DNT)
- Lead
- Nickel
- Hexavalent Chromium
- Cerium
- Trichloroethylene (TCE)
- Sulfur Hexafluoride (SF6)
- Polybrominated diphenyl ethers (PBDEs)
- 1,2,3-trichloropropane (TCP)
- N-nitrosodimethylamine (NDMA)
- Dichlorobenzenes
- Beryllium
- Naphthalene
- Perfluorooctanoic Acid (PFOA)
- RDX
- Cadmium (report in preparation)
- Antimony (report in preparation)
Next Steps

- Apply a continuous process improvement
- Integrate confidence measurements
- Continue outreach to improve breadth and depth of pool of subject matter experts
- Independent review of expert elicitation process
## Future Phase I Impact Assessment Subject Matter Expert Meetings

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>CAS NUMBER</th>
<th>PROJECTED MEETING DATE</th>
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<tbody>
<tr>
<td>Dinitrotoluene (DNT)</td>
<td>25321-14-6</td>
<td>July 2010</td>
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<td>Nanomaterials</td>
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<td>October 2010</td>
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<tr>
<td>Phthalate Esters</td>
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<td>January 2010</td>
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<td>1,4-dioxane</td>
<td>123-91-1</td>
<td>Future reassessment TBD</td>
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<td>Future assessment TBD</td>
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<tr>
<td>Cobalt and Compounds</td>
<td>7440-48-4</td>
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<tr>
<td>Nickel</td>
<td>7440-02-0</td>
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<tr>
<td>Tungstate</td>
<td>7440-33-7</td>
<td>Future reassessment TBD</td>
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Acknowledgements

- Office of the Deputy Under Secretary of Defense (Installations and Environment)
- Subject Matter Experts from across all of DoD including all four services and industry