Information Driven Safeguards: A View from the Outside

Mark Maybury, John Griffith, Mark Brown, John Lovejoy, Eric Hughes, Dan Calle
Context

• Forward looking vision/roadmap
  – Tools, Processes, Enterprise
  – Analysis and Operations
• Future challenges
• Solution opportunities
IAEA Safeguards Today

"...The concept of considering the State as a whole provides the opportunity to take State-specific factors into consideration in all stages of safeguards implementation. The State level concept is implemented through information-driven safeguards; these are safeguards whose planning, conduct and evaluation are based on an ongoing analysis of all safeguards-relevant information available to the Agency about a State to focus verification activities in the field and at Headquarters. Such safeguards are responsive to changes in the analysis to ensure that the assurances provided to the international community remain credible and up-to-date."

Safeguards Implementation Report for 2009

“While safeguards have been moving to an information driven system, cultural change is also required in the way information is used ... Information sharing is increasingly important”

Eliminating Nuclear Threats: A Practical Agenda for Global Policy Makers, International Commission on Nuclear Non-Proliferation and Disarmament, November 2009.

*Emphasis added*
Challenges

- Increasing globalization (communication, transportation, commerce) drives interdependence and speeds nuclear material access and transfer
- State evaluation workload continuously increasing over past decade
- Increased information collection and evaluation to support additional protocols
- Understanding nuclear proliferation encompasses a wide range of technical and non-technical domains (e.g., nuclear, security, political, economic)
- Requirement for balanced approach leads to spreading of resources
- Workforce turnover over time creates experience, skill, and knowledge management challenges
- Budget constraints, time pressures
- Need to maintain quality, credibility, objectivity
# Transformation

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
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<tbody>
<tr>
<td>Manual</td>
<td>Automated</td>
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<tr>
<td>Analog</td>
<td>Digital</td>
</tr>
<tr>
<td>Static Reports</td>
<td>Continuous State Evaluation</td>
</tr>
<tr>
<td>Docs, Images, Samples</td>
<td>+Audio, +Video, +Social Media, ...</td>
</tr>
<tr>
<td>Monolingual</td>
<td>Multilingual</td>
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<tr>
<td>Individual, Aggregated Analysis</td>
<td>Collaborative, Distributed</td>
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<td>Inspector in Field</td>
<td>Inspector</td>
</tr>
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<td></td>
<td>+Virtual HQ Analytical Team in Field</td>
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<tr>
<td>Country</td>
<td>(Country +) Transnational</td>
</tr>
<tr>
<td>Experience, Skill</td>
<td>(Experience, Skill +)</td>
</tr>
<tr>
<td></td>
<td>Knowledge Management</td>
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<tr>
<td>Nuclear Recession</td>
<td>Nuclear Renaissance</td>
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Analytic Methods and Tools

**Collect**
- State Declared Information
- In-field verification activities
- Other sources including satellite imagery, trade, open sources

**Process**
- Indexing
- Machine Translation
- Geotagging
- Entity Extraction, Categorization,
- Name Deconfliction
- Event Extraction
- Multimedia Mining
- Document Clustering
- Summarization

**Visualize**
- Entity and Link Relationships (including networks)
- Events (financial, communications, physical)
- Concept strength in large data collections
- Temporal/Geospatial Phenomena

**Analyze**
- Temporal/Geospatial Analysis
- Entity-Relationship Analysis
- Change Detection Analysis
- Link, Network Analysis
- Transaction Analysis
- Structured Argumentation
- Competing Hypotheses

**Collaborate**
- Application Sharing
- White boarding
- Audio and Video Teleconferencing
- E-mail
- Wiki-type Environments
- Data Fusion and Analysis Laboratory
Multiple Levels of Collaboration

- Shared Intent
- Joint Work
- Coordination
- Shared Information
- Awareness

TEAM CLIMBERS

INDIVIDUAL CLIMBERS

Unsuccessfully attempt
Key Dimensions of a Roadmap for Information Driven Safeguards

• Information and Knowledge Enterprise
• Analytics and Operations
• Data and Tools
## Challenge Areas/Gap Analysis

<table>
<thead>
<tr>
<th>AREA</th>
<th>NEEDS</th>
<th>CURRENT CAPABILITY</th>
<th>GAPS</th>
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<tbody>
<tr>
<td>Information and Knowledge Enterprise</td>
<td>• Need to maintain quality, credibility, objectivity</td>
<td>• State declarations, on site inspections, open source and remote sensing analysis, plus other information and techniques</td>
<td>• Efficiency and effectiveness via automation</td>
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<td>• Knowledge/Skill retention and (re)training</td>
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<td>• Resources</td>
</tr>
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<td></td>
<td>• Maintain workforce diversity</td>
<td></td>
<td>• Integrated architecture (operational, analytic, and technical)</td>
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<td>• Continuous state evaluation</td>
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<td>• Enterprise knowledge management (e.g., knowledge and expert discovery)</td>
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<tr>
<td>Analytics and Operations</td>
<td>• Process large scale, new sources</td>
<td>• Manual analyses and in country inspections</td>
<td>• Source validation and verification</td>
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<td>• Manage unstructured, multilingual data</td>
<td>• Limited inspection hours</td>
<td>• Remote training</td>
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<td>• Enable distributed teams</td>
<td>• Primarily individual analyses</td>
<td>• Remote and virtual inspections, analysis</td>
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<td>• Support heterogeneous users with large distribution of expertise</td>
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<td>• Secure, Cross Domain Information Sharing</td>
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<td></td>
<td>• More effective/efficient inspections</td>
<td></td>
<td>• Collaborative Analysis/Ops</td>
</tr>
<tr>
<td></td>
<td>• Integrate ops/analysis</td>
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<td></td>
</tr>
<tr>
<td>Data and Tools</td>
<td>• Manage large sets of data with mixed reliability</td>
<td>• Limited sources</td>
<td>• Multilingual and Multimedia Information Extraction</td>
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<tr>
<td></td>
<td>• Distributed and smart sensing</td>
<td>• Remote sensing</td>
<td>• Remote, distributed, smart sensing</td>
</tr>
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<td>• Scalable methods</td>
<td>• Primarily manual retrieval and analysis</td>
<td>• Data/Information validation and verification</td>
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<td>• Source pedigree and bias mitigation</td>
<td>• Emerging analytic tool capability</td>
<td>• Enterprise, Cross Domain Search</td>
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<td>• Data authentication</td>
<td>• Limited, on demand Machine Translation</td>
<td>• Multisource fusion, cross cueing</td>
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<td>• Real time sensing and processing</td>
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<td>• Geospatial/temporal analysis</td>
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<td></td>
<td>• Range of user expertise</td>
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<td>• Full suite analytics</td>
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## A Possible Roadmap for Information Driven Safeguards?

<table>
<thead>
<tr>
<th>AREA</th>
<th>NOW</th>
<th>5 Years</th>
<th>10 Years</th>
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| Information and Knowledge Enterprise | • State declarations, on site inspections, open source and remote sensing analysis  
• Additional Protocol           | • Digital, continuous state evaluations  
• Integrated architecture (operational, analytic, and technical)  
• Enterprise knowledge management (e.g., knowledge and expert discovery) | • Digital, continuous state declarations  
• Efficiency and effectiveness via increased automation |
| Analytics and Operations       | • Individual analyses and in country inspections  
• Limited inspection hours  
• Primarily individual and partially collaborative analyses | • Source validation and verification  
• Remote and distributed sensing  
• Remote training  
• Site modeling and simulation  
• Fully collaborative analysis | • Remote and virtual inspections, analysis  
• Secure, Cross Domain Information Sharing  
• Continual improvement in analysis and operations  
• Integrated, real-time in field verification and headquarters evaluation |
| Data and Tools                 | • Limited sources  
• Primary manual retrieval and analysis  
• Emerging analytic tool capability  
• Limited, on demand Machine Translation | • Enterprise Search  
• Cross Domain Search  
• Data/Information verification and validation | • Multilingual and Multimedia Information Extraction  
• Multisource fusion, cross cueing  
• Geospatial/temporal analysis  
• Full suite analytics  
• Smart sensing  
• Virtual reality/3D simulation |
Benefits

• Safeguards verification
  – More efficient and effective distribution of increasingly scarce resources
• Safeguards conclusions
  – Remain credible
  – Increasingly in real time
  – Increasing confidence
• Non-proliferation assurances
  – Improve confidence in international non-proliferation system
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