



Next Generation Modeling of Operational Effects



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Next Generation Models

CB Effects on Military Operations

Objective: Extend and improve the CBRN warfare effects on military operations methodologies and transition demonstrated technologies to the Joint Operational Effects Federation (JOEF) program

Areas of effort:

- Represent new operational and threat domains
 - **Mobile Forces Operations (such as Army and USMC units)**
 - **Toxic Industrial Chemicals/Materials (TICs/TIMs), nuclear effects and radiological operations effects**
- Improve decision support capabilities
- Improve and automate modeling of critical CONOPS / Course of Action Analysis and performance factors
- Improve analytical utility by enhancing post-processing capabilities



New Operational Domains – Mobile Forces

- Short-term development efforts to support JOEF Increment I Initial Operating Capability (IOC)
 - Convoy modeling for chemical threats
 - Conversion and integration of existing task network datasets from Army combat simulations
 - Other support TBD
 - Relevance, capability and maturity of current mobile forces applications will be assessed before any development begins
- Longer-term development efforts to support later increments of JOEF
 - Emergent behavior modeling
 - Exploring theater level modeling



Mobile Forces and CBRN M&S Status

- Fairly Robust Capability
 - **Macro-level physics-based models**
 - **Semi-empirical models**
 - **Deterministic and stochastic processes**
- Some Capability
 - **Human physiology**
 - **Situation awareness**
 - **Toxicology**
- Minimal or No Capability
 - **Soft factors**
 - **Human cognition and decision processes**
 - **Integrated stressor and casualty mechanism effects**
 - **CBRN within broader operational context**



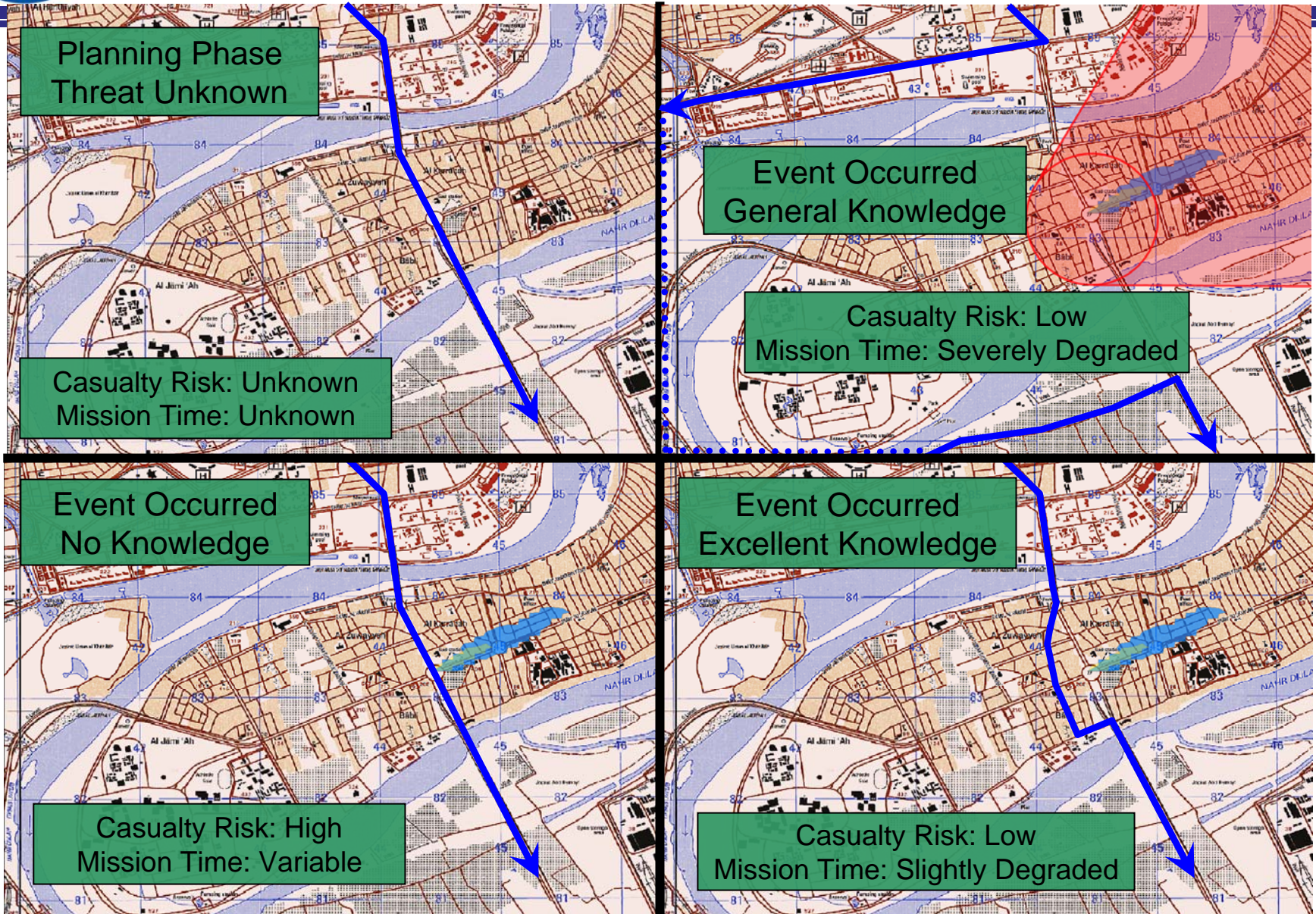
Mobile Forces – Convoy Encounters Chemical IED

- Analytic Objective: quantify value of varying knowledge about the CW hazard to mobile forces
- Knowledge variants:
 - Precise definition of contamination with dynamic updates
 - No knowledge
 - ATP-45 hazard warnings areas
- Operational Options
 - Ignore hazard
 - Perform recon and adjust appropriately





Convoy Analysis – Knowledge Based Courses of Action





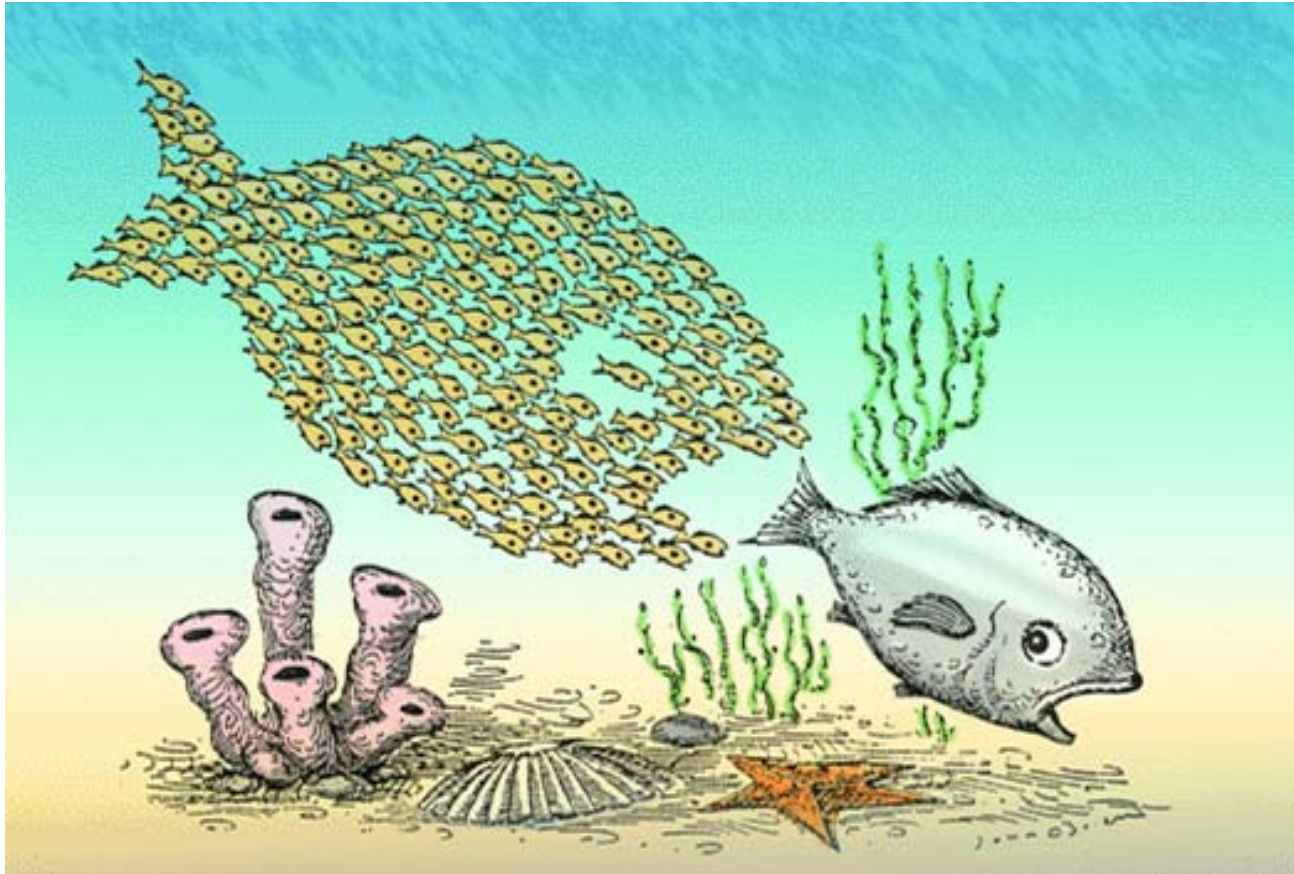
New Operational Domains – Analysis is Evolving

- Next generation models must consider expanding mission roles:
 - **Urban operations and complex environments**
 - **Close “contact” as well as close combat**
 - **Asymmetric threats**
- Next generation tools must provide integrated representation of multiple challenging factors:
 - **“Fog of War” - uncertainty and error**
 - **Stressors and enhancers**
 - **Environmental effects**
- Operational analysis requires a paradigm shift to address these challenges
 - New fundamental ways of modeling may assist in solving these problems



New Operational Domains – Emergent Behavior

Emergence happens when many simple things combine to form unexpectedly complex results.



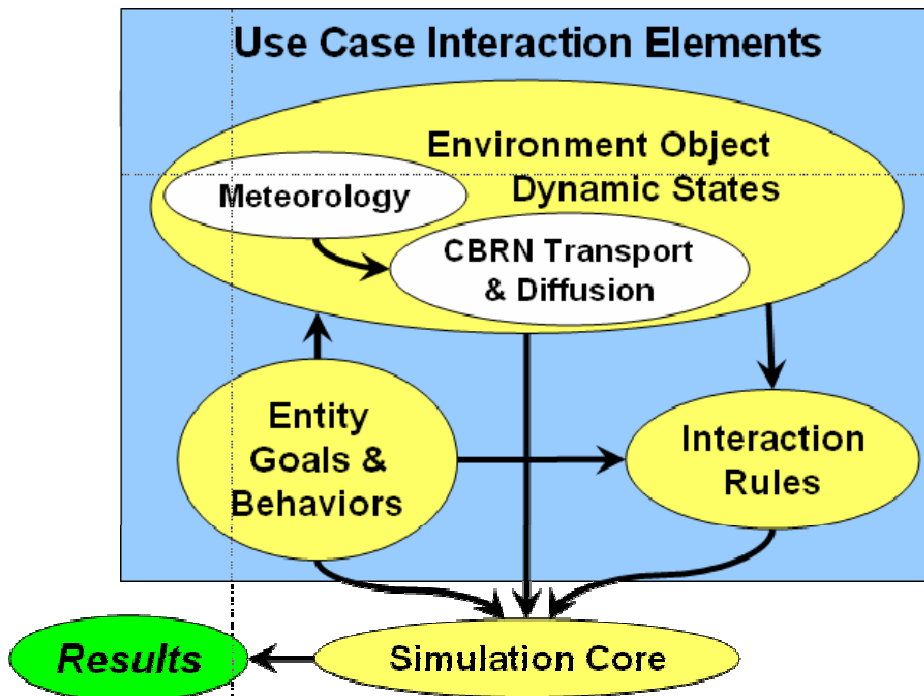
**From Xerox Palo Alto Research Center
Dynamics of Computation Area**



New Operational Domains – “Emergent Analysis” Approach

- The “emergent” paradigm will supplement rather than replace current methodologies
- Approach is not model specific
 - The STAFFS simulation model chosen for proof of concept

Emergent Analysis Functional Approach



1. Generate multi-disciplinary use cases/scenarios reflecting analytic objectives
2. Define critical scenario elements in terms of interactions between subsets of:
 - Operational environment objects
 - Simulation entities
3. Implement in Simulation of Choice
4. Run many replications
5. Distill results



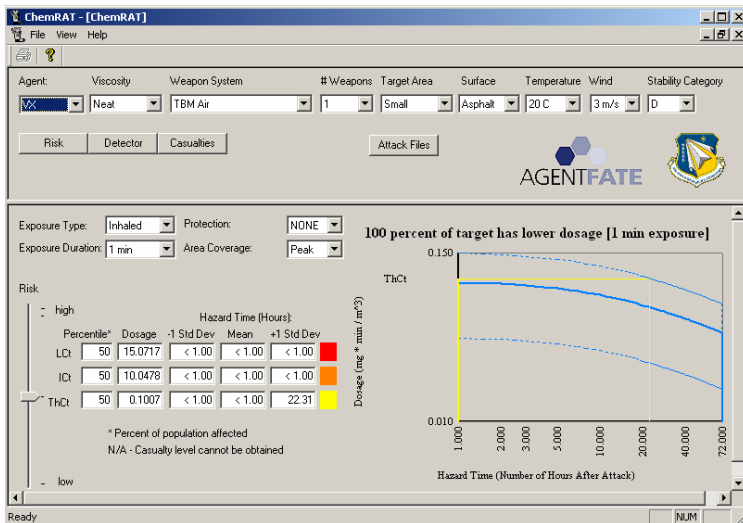
New Threat Domains – TICs/TIMs, Radiological & Nuclear

- TICs/TIMs modeling and dispersion will be handled by existing interfaces to T&D models
 - New Ops Effects modeling will be required due to large changes in volume of challenge, duration of release, and human response
- Suitable blast, thermal, electromagnetic pulse, particulate dispersion and radiological effects model will be selected in short term
 - Eventually these effects will be provided by the Joint Effects Model (JEM)
- Electromagnetic pulse and radiological effects may be difficult to model and quantify in terms of an operational effect

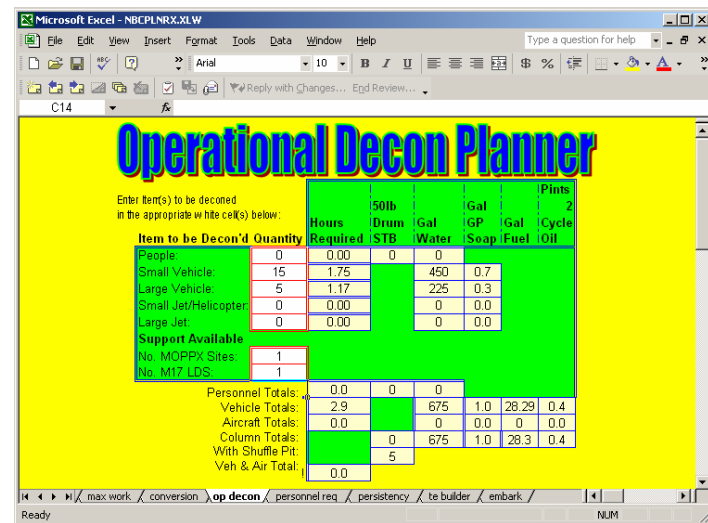


Improving Decision Support – Decision Tool Development

- Objective:** Provide easy-to-use tools that the warfighter will use real-time when situation specific CBRN questions arise
- Usability will be similar to the Chemical Hazard Estimation Method Risk Assessment Tool (CHEMRAT) and NPC Calculator tools
 - Short execution, training and setup times critical to success
 - Output must be situation specific and reliable



CHEMRAT



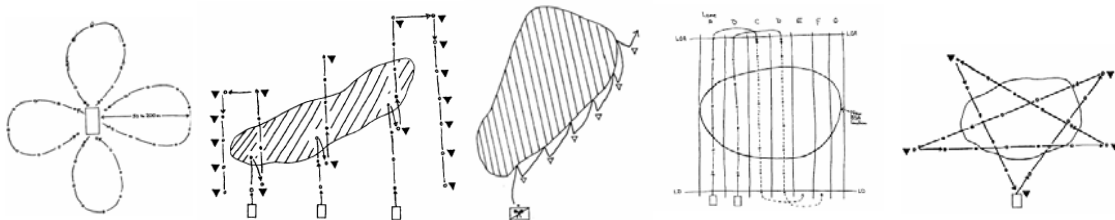
NBC Calculator



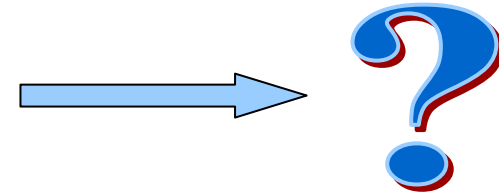
Improving CONOPS Modeling and Course of Action Analysis

- **Most planning activities take place given a fixed and well defined set of behaviors and a 'limited' number of solutions**
 - Task network modeling works well to address concerns for these problems
- **Other planning support can have numerous to infinite ways to solve a problem**
 - In the CB modeling, many of these activities are related to CB CONOPS and courses of actions
 - Traditionally to support specific and ground-up CB CONOPS development, new code would need to be written
- **This effort will minimize development required to do tailored, analysis of CB CONOPS development and Course of Action Analysis**

Existing NBC Reconnaissance Search Patterns



New Urban Search Plan?



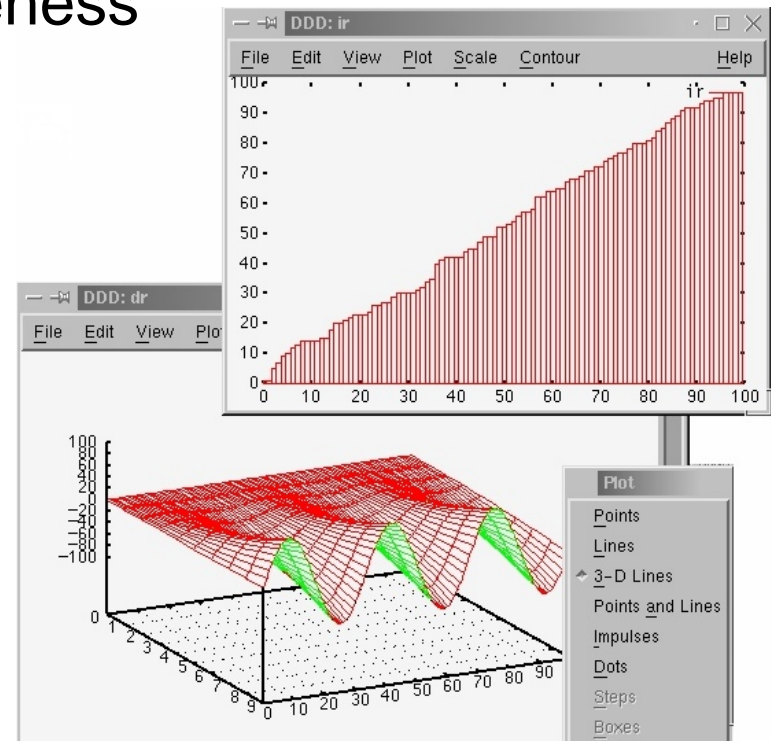
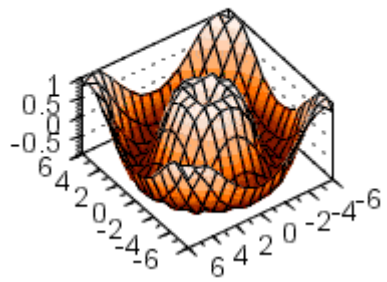
Development support for new plans should not require significant coding efforts every time a new plan is proposed

Figures taken from FM3-19



Enhancing Post-processing Capabilities

- Large simulations produce massive amounts of data
- In its raw form this data is generally difficult to navigate and understand
- Post-processing capabilities will assist in searching data for relevant Measures of Effectiveness
- This data will be displayed in formats relative to the uses of the simulation models





Conclusion

Next Generation Models will advance the state of CBRN modeling and simulation technology and will produce products that will support the JOEF acquisition program





Backups

