

Analytic Gaming

Application & Evaluation in the Technosocial Predictive Analytics Initiative

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Background

The Technosocial Predictive Analytics Initiative

- ▶ Multi-project initiative divided into three focus areas:
 - ▶ Area1: Technosocial Modeling
 - ▶ Area2: Knowledge Inputs
 - ▶ **Area3: Cognitive Enhancement**

<http://predictiveanalytics.pnl.gov> for more information

Area 3 - Mission & Vision

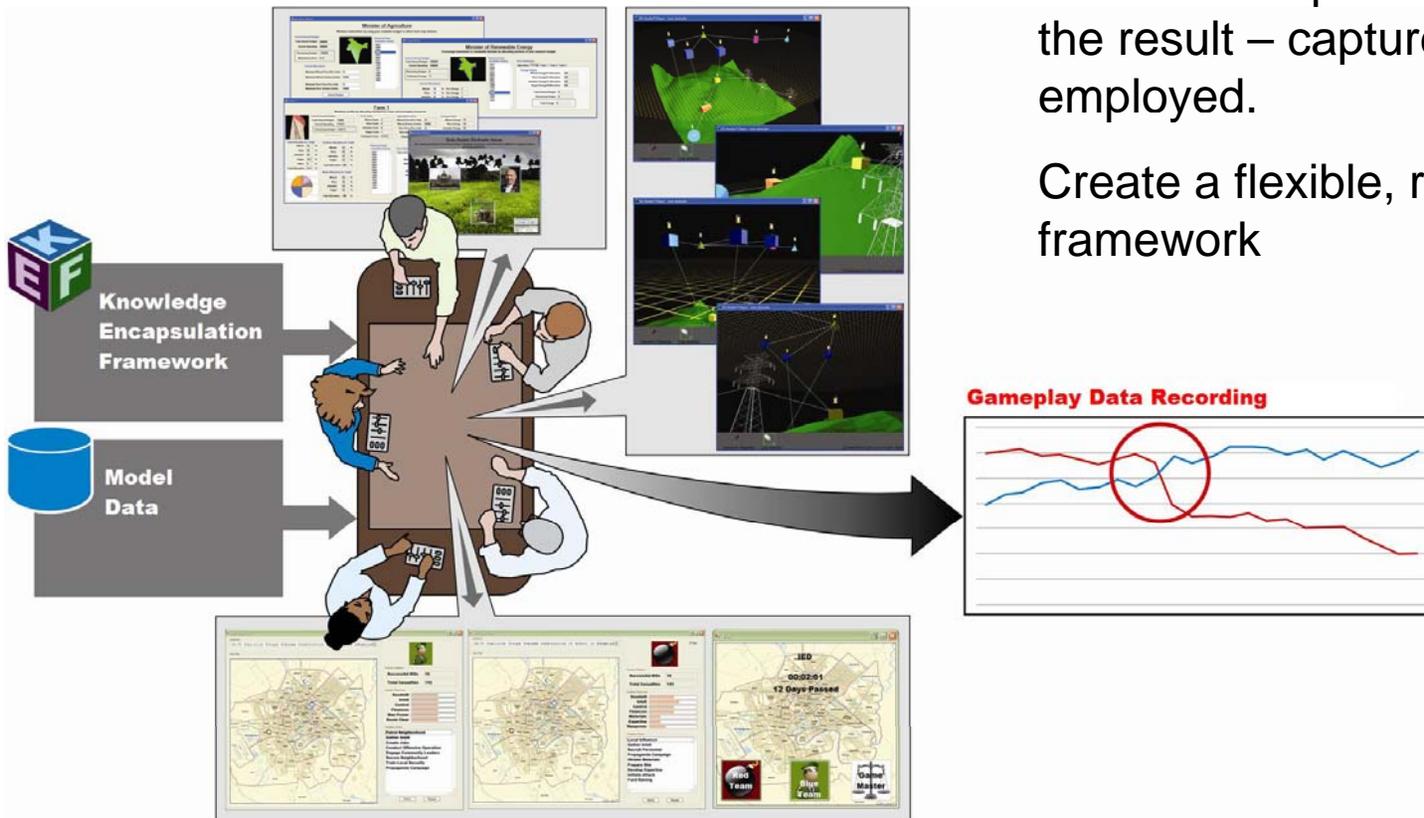
A new way to interact with the outputs generated and knowledge gained from models

Stimulate creative thinking

Engage multiple users collaboratively and competitively

Observe the process, not just the result – capture strategies employed.

Create a flexible, reusable framework



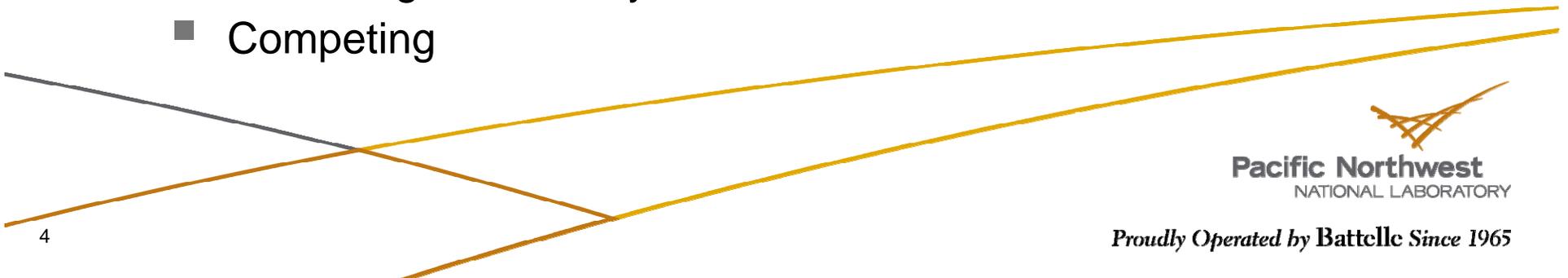
Why Gaming?

Merging disjoint styles of models in a common and relatable format.

- ▶ Provides a convergence point
- ▶ Natural “story telling” interface

- ▶ Let models do what computers do best
 - Number crunching

- ▶ Let humans do what they do “best”
 - Reasoning
 - Imagining
 - Becoming emotionally invested
 - Competing



Novelty of the Approach

- ▶ Emphasis on separation of game engine and model for re-usability
 - Investigation of methods of coupling games with specific types of models (e.g. Bayesian Network)
- ▶ Developing the Analytic Gaming process as an integral part of the *overall* modeling and analysis pipeline
 - Value of game creation, not just game play
 - Structured output capture

Definition of Analytic Games

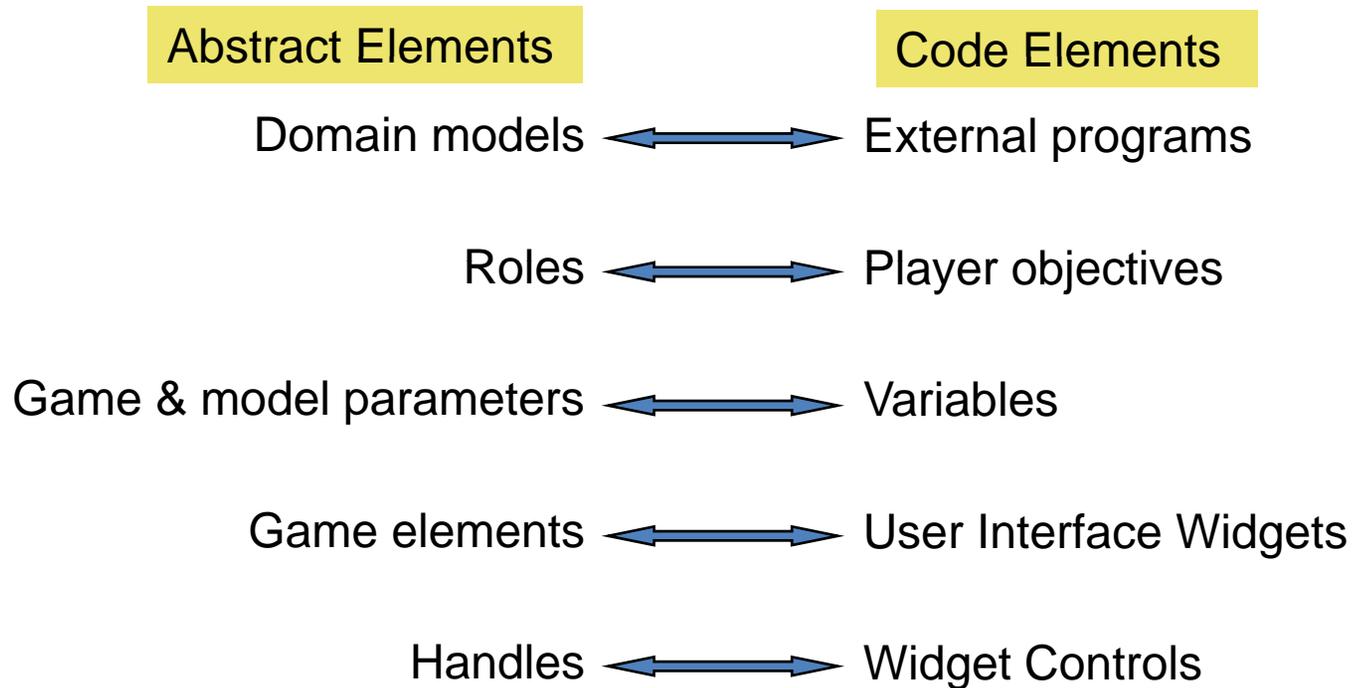
Defining “Issue-Driven, Model-Supported” Games

Our abstract game definition is a set of:

- Domain models
- Model parameters
- Roles
- Game elements
- Handles

Construction of Analytic Games

Translating the abstract definition to code



Applying Analytic Games

To add value to the analysis process, gaming tools must go beyond answering 'what happened' and provide the analyst insight into 'why it happened.'

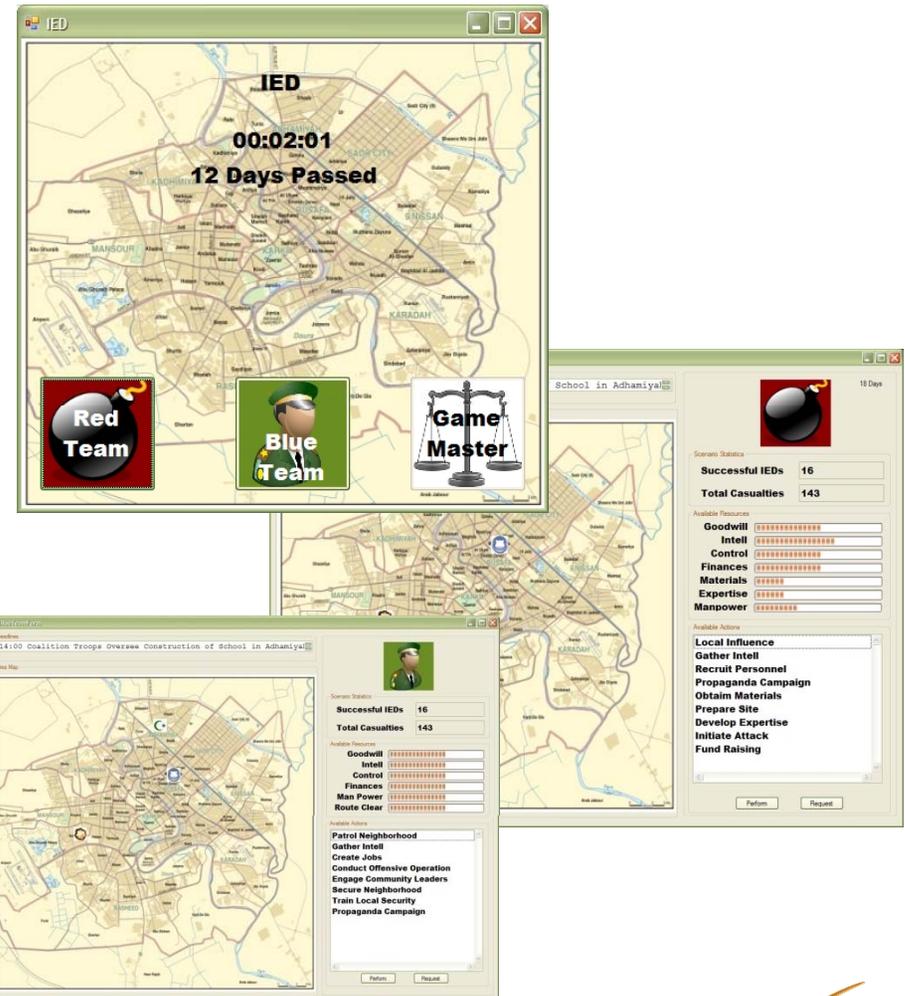
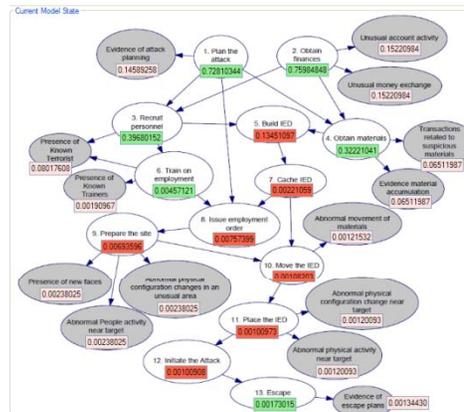
We enable this via:

- ▶ Leveraging the abstraction approach used to break down games into their components (e.g., "Game Elements," "Game Parameters," etc.)
 - ▶ Allows for game-independent recording functionality
 - ▶ Feeds to a repository, facilitating post-game analyses
- ▶ Doing so in a repeatable fashion

Proof of Concept Game

► “IED Game”

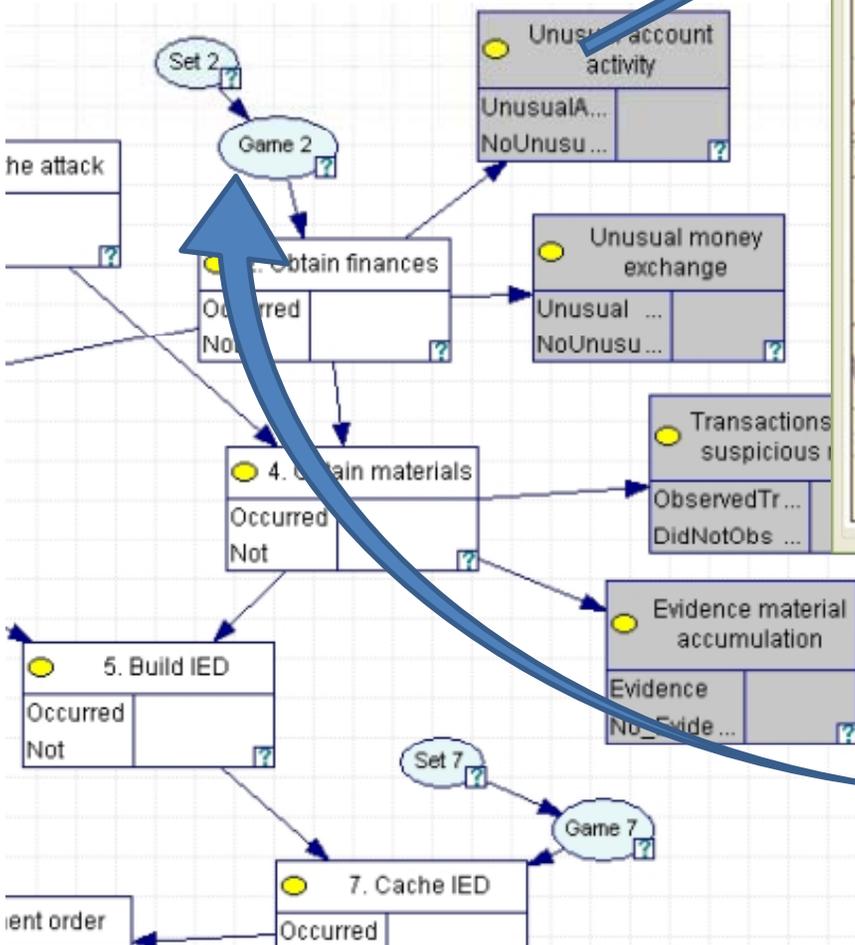
- “Real-time Simulation” style
- Issue-driven game: Exploring a Bayes net model of the IED “kill chain.”
- Players take on competing roles:
 - Blue team – goal to prevent IED attacks
 - Red team – goal to carry out attacks
- Resource management flow
 - Players allocate resources across predefined activities
 - Model effects of resource and activity states on chances of success for red team activities
 - Model chance of observable evidence



Model Interaction

Read-Only GameElements

External Model

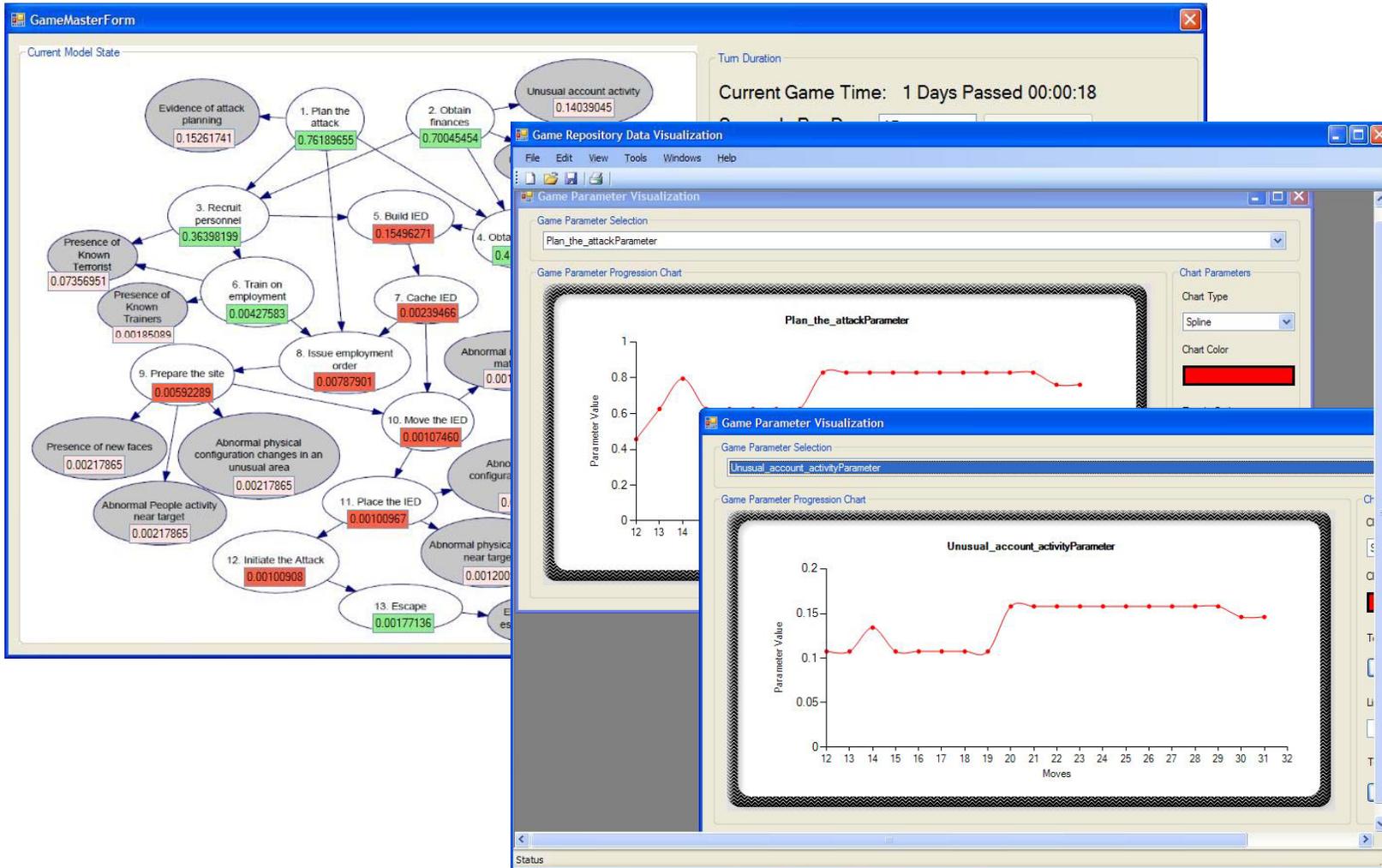


The screenshot shows the RedTeamForm interface. At the top, a red box highlights the text '14:00 Coalition Troops Oversee Construction of School in Adhamiyah'. Below this is an 'Area Map' showing a city layout. To the right, a 'Scenario Statistics' panel is highlighted with a red border, displaying:

- Successful IEDs: 16
- Total Casualties: 143

Below the statistics are 'Available Resources' (Goodwill, Intel, Control, Finances, Materials, Expertise, Manpower) and 'Available Actions' (Local Influence, Gather Intel, Recruit Personnel, Propaganda Campaign, Obtain Materials, Prepare Site, Develop Expense, Initiate Attack, Fund Raising). A red box highlights the 'Available Actions' list. A bomb icon is shown above the statistics, and a 'Handles' label points to the 'Available Actions' list.

Data Capture and Analysis



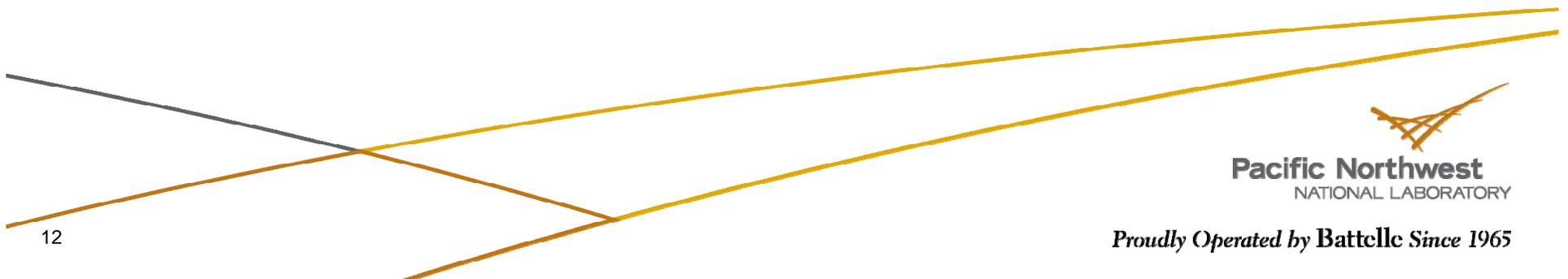
Evaluation

Three stages of evaluation

1. Per Build

2. Per Use

3. Per Analysis



Evaluation – Per Build

Example questions look at nature of models and appropriate mapping onto an Analytic Game

Model nature:

- ▶ Who can be expected to understand the subject matter?
- ▶ Does the model expose parameters that can be modified?
- ▶ Is the model trusted by expected players?

Game mapping:

- ▶ Are player roles clearly defined to provide control of the right set of handles?
- ▶ Do the roles correspond to a real person or persons?
- ▶ Do handles match factors that those persons could manipulate in the real world?
- ▶ Does the model provide adequate coverage of the target game, and/or does the game definition support human Game Master intervention?

Evaluation – Per Use

Questions deal primarily with the users and game play experience

- ▶ Do users understand their roles, and possess adequate knowledge to play their roles?
- ▶ Are users able to carry out tasks in the game environment?
- ▶ Are users able to discern what is happening in the game environment (and is it believable)?
- ▶ If the underlying model does not address a course of action, can a Game Master intervene to keep the game flowing?
- ▶ Did players identify insights that they gained while playing?

Evaluation – Per Analysis

Questions deal with the ultimate utility of a game and encompass the entire life cycle of game conceptualization, development, and play.

- ▶ Did the Analytic Gaming process identify knowledge gaps?
- ▶ Are there patterns across game play instantiations that indicate particular strategies?
 - ▶ Did players explore a range of strategies?
 - ▶ Do they align with known/expected strategies? If not, are they feasible?
- ▶ Were there particular moments within game play when significant shifts occurred in the game environment?
 - ▶ Can specific player actions be identified as causes?

Future Work

- ▶ Complete and refine the IED Game prototype (currently “alpha”)
- ▶ Investigate other types of models and games
 - Generalize and document additional game \leftrightarrow model interface techniques
 - Games using our framework with composable models
- ▶ Define and build additional games for the Technosocial Predictive Analytics Initiative
- ▶ Further work on data (and interaction) capture and post-game playback/analysis tools and techniques
- ▶ Evaluations
 - Is the process illuminating? (both the game and the process of defining the game – in terms of expanding knowledge about a problem domain as well as providing useful feedback for modelers) Quantifiable?

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