

Anticipatory Intelligence Analysis: *Integrating Multiple Models for Joint Intelligence Preparation*

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Abstract

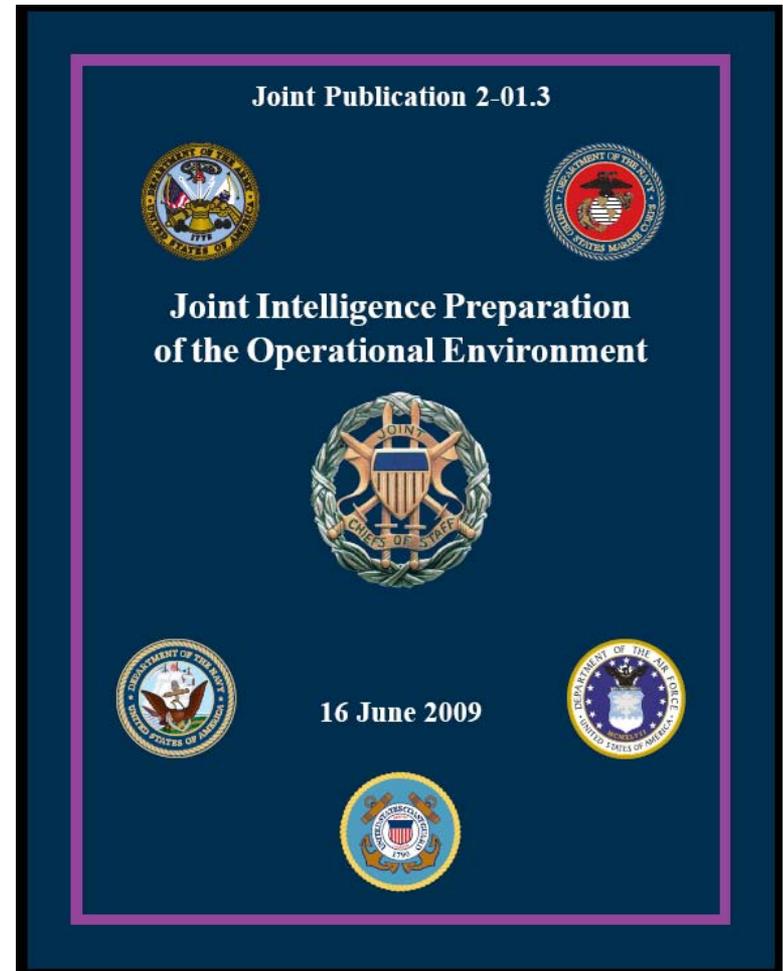
This paper introduces an approach to applying a composition of multiple computational models to support anticipatory analysis in the DoD Joint Intelligence Preparation of the Operating Environment (JIPOE) process. The approach applies a modeling framework that composes different modeling paradigms (e.g. agent-based, system dynamics, and Bayes network models) on a common interacting backplane to provide an integrated, time-based simulation. The approach is illustrated by a case study describing how the JIPOE process has been performed using an integrated computational model.

Topics

- The JIPOE Process and Computational Simulation
- The Role of a Modeling Framework in JIPOE
- HSCB Models and Composition to Support JIPOE
- HSCB PMESII Model Testbed (HPTM)
- Pathfinder Project: October 2009 JIPOE Integration Demo

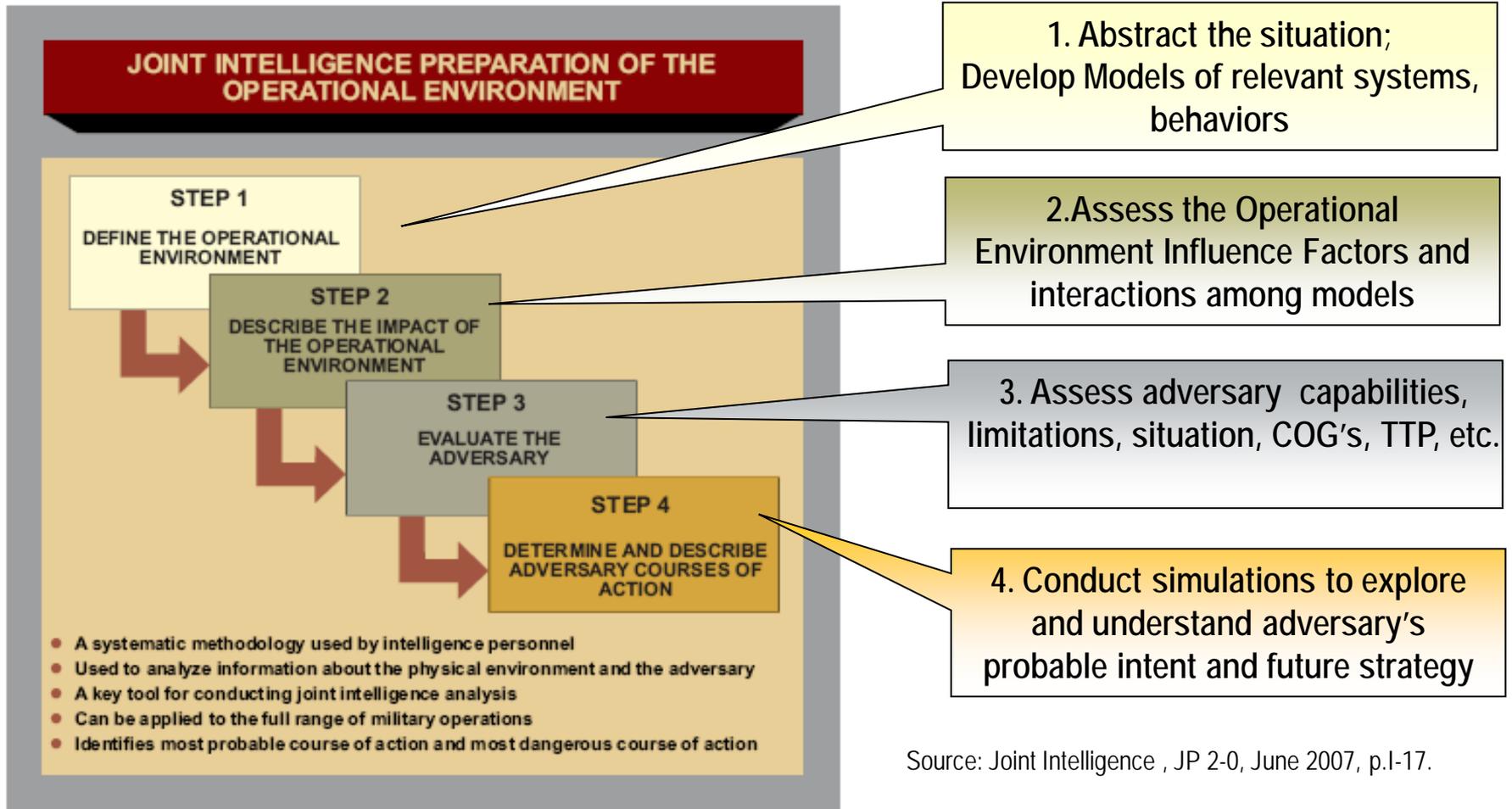
Joint Intelligence Preparation of the Operational Environment JIPOE

- Provide “..knowledge of the enemy, potential enemy and local foreign populations to Joint Force Commanders (JP-2.0).
- Newly issued JP 2-01.3 June 2009:
 - Emphasizes the need for analyzing relevant political, military, economic, social, information, and infrastructure variables to help describe the impact of the operational environment on mission accomplishment.
 - Special considerations for conducting JIPOE in support of stability operations and irregular warfare
 - Promulgates new definitions for “adversary template,” “adversary capabilities,” and “sociocultural factors.”



Joint Intelligence Preparation of the Operational Environment, JP 2-01.3 June 2009

JIPOE 4-Step Process and Computational Simulation

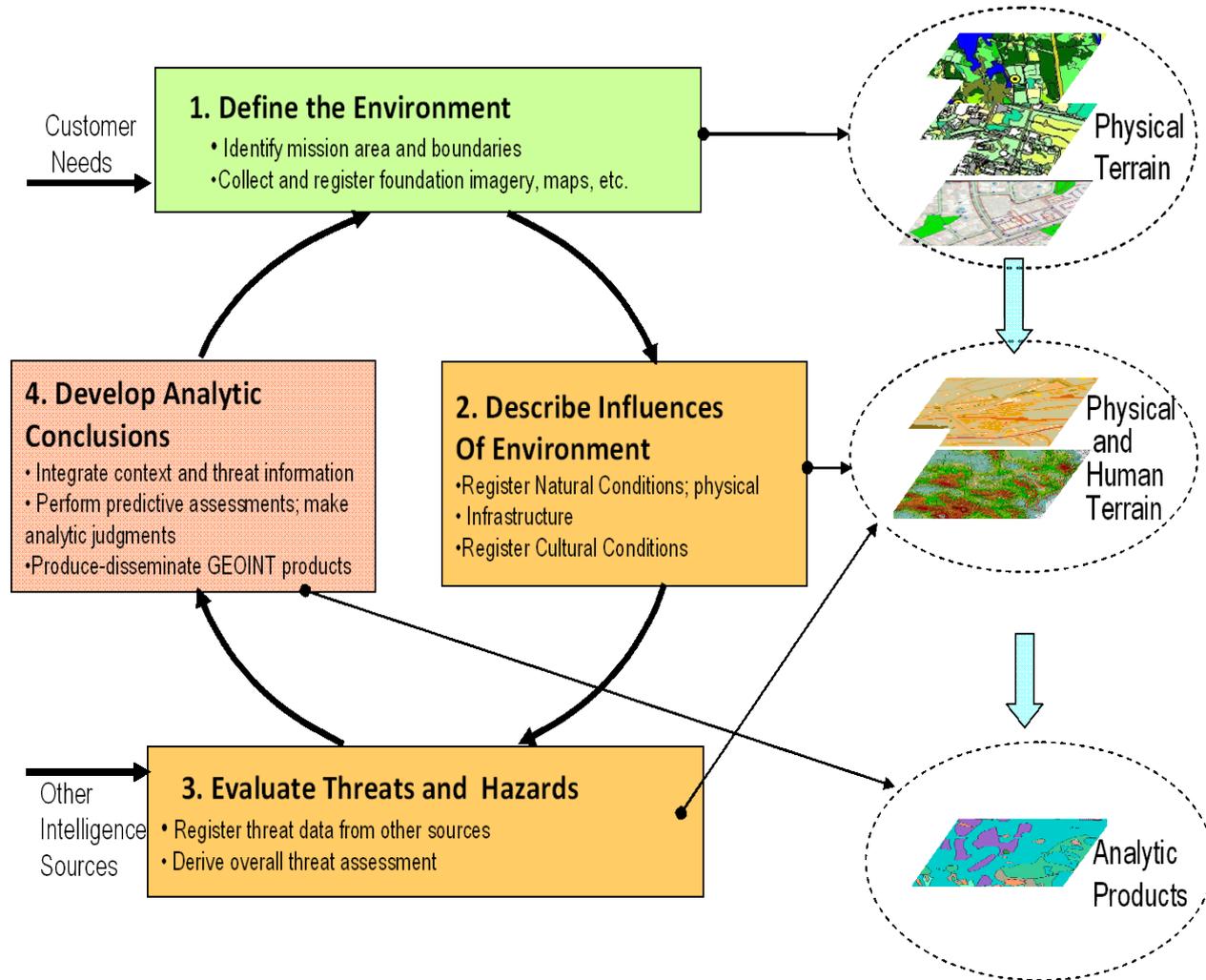


The Related Geospatial Process

- Four-Step process for Geospatial analysis
- NGA develops Human Terrain Mapping information to support JIPOE analysis
- The Process, like JIPOE, is a cycle

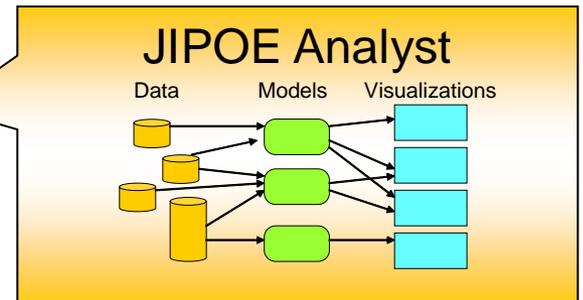
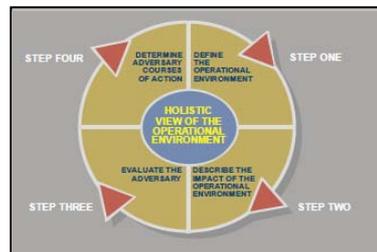
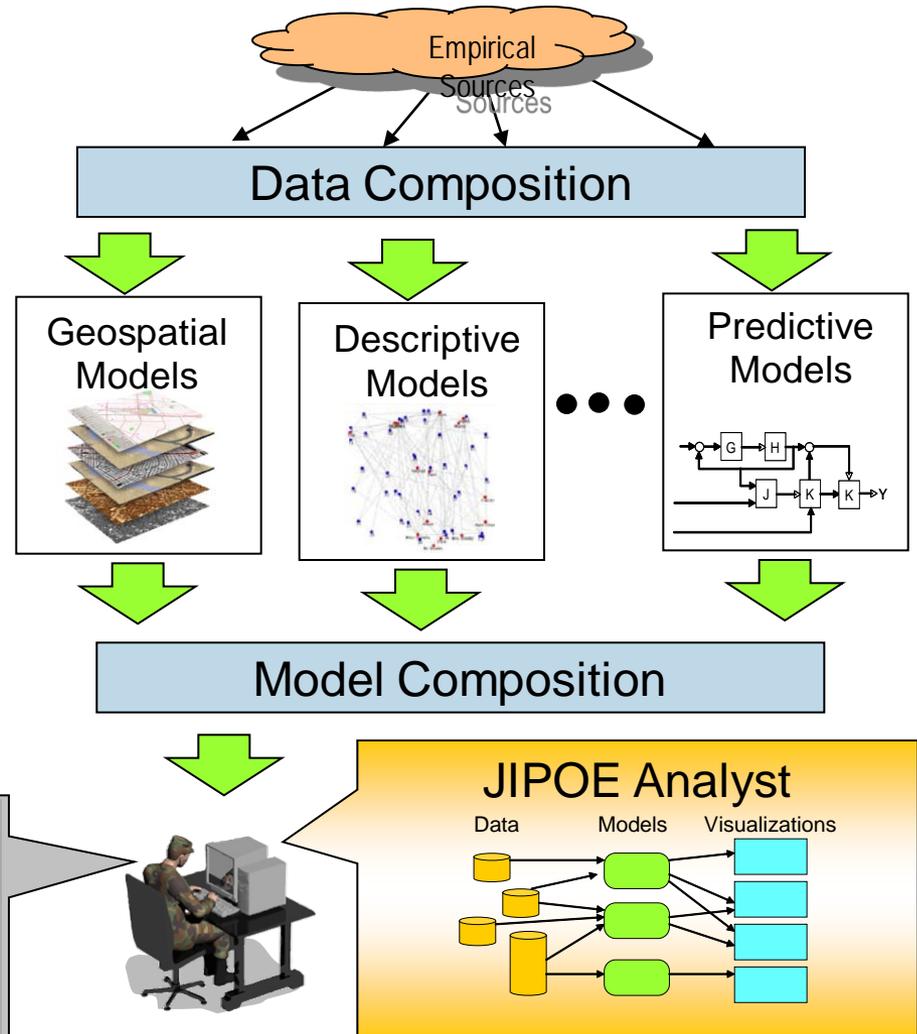
• **Sources:**

1. National System for Geospatial Intelligence – Geospatial Intelligence (GEOINT) Basic Doctrine, Publication 1-0, National Geospatial-Intelligence Agency, Sept 2006.
2. Geospatial Support to Intelligence Operations, JP 2-03, 22 march 2007.



Composable Models and Analysis

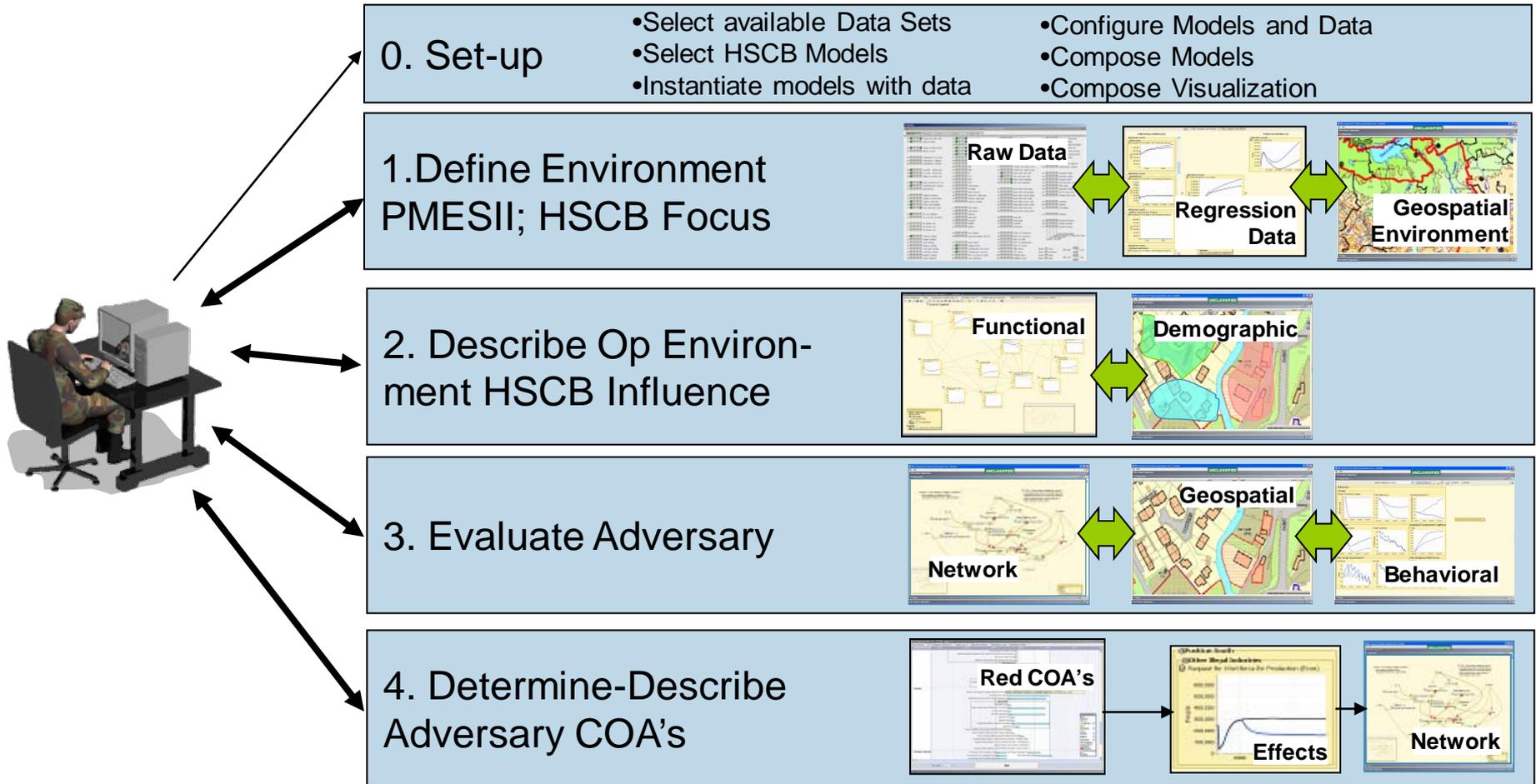
- A Composable JIPOE Capability
 - Compose the sets of empirical data to be used (data services)
 - Compose the models to perform JIPOE (model services)
 - Compose analytic methods and Visualizations (analysis services)
- Enables the JIPOE analyst to *compose* the data-models-visualizations
- Enables the analyst to conduct dynamic assessments of Red COA's



Why Compose Models in A Framework?

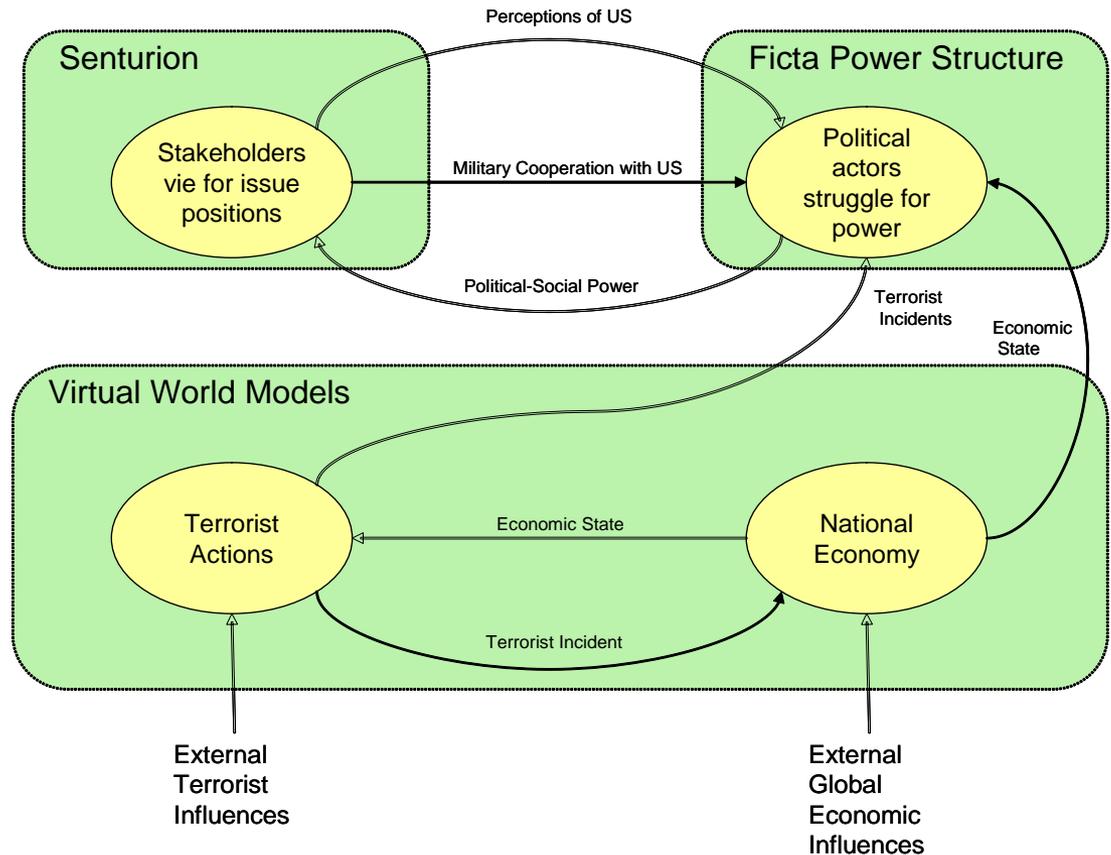
<p>1. Place Model in Op Context</p>		<ul style="list-style-type: none"> • Provide dynamic context • Common user perspective
<p>2. Compare Models and Perspectives</p>		<ul style="list-style-type: none"> • Comparative analytics • Alternative hypotheses • Multiple perspectives
<p>3. Combine Interacting Models (e.g. PMESII)</p>		<ul style="list-style-type: none"> • Interacting dynamics among models across domains • Dynamics and effects viewed in a common visualization framework • Exploration of causality
<p>4. Compare and Combine</p>	<p>(2 and 3, above)</p>	<ul style="list-style-type: none"> • Multiple hypotheses of complex domains

JIPOE in the HSCB PMESII Model Framework (HPMF)



Case Study: Modeling Ficta

- **Situation – Phase 0 (Shaping)**
- 3 Year Period: 2007-2010
- Economy - marginal growth (1%)
- Government -weak institutions and ineffective rule of law with high and growing corruption.
- Trade - stable, with a potential for decline
- Maritime Security faces rising piracy, as emerging insurgency-terrorist groups gained strength from external support and some internal recruiting.



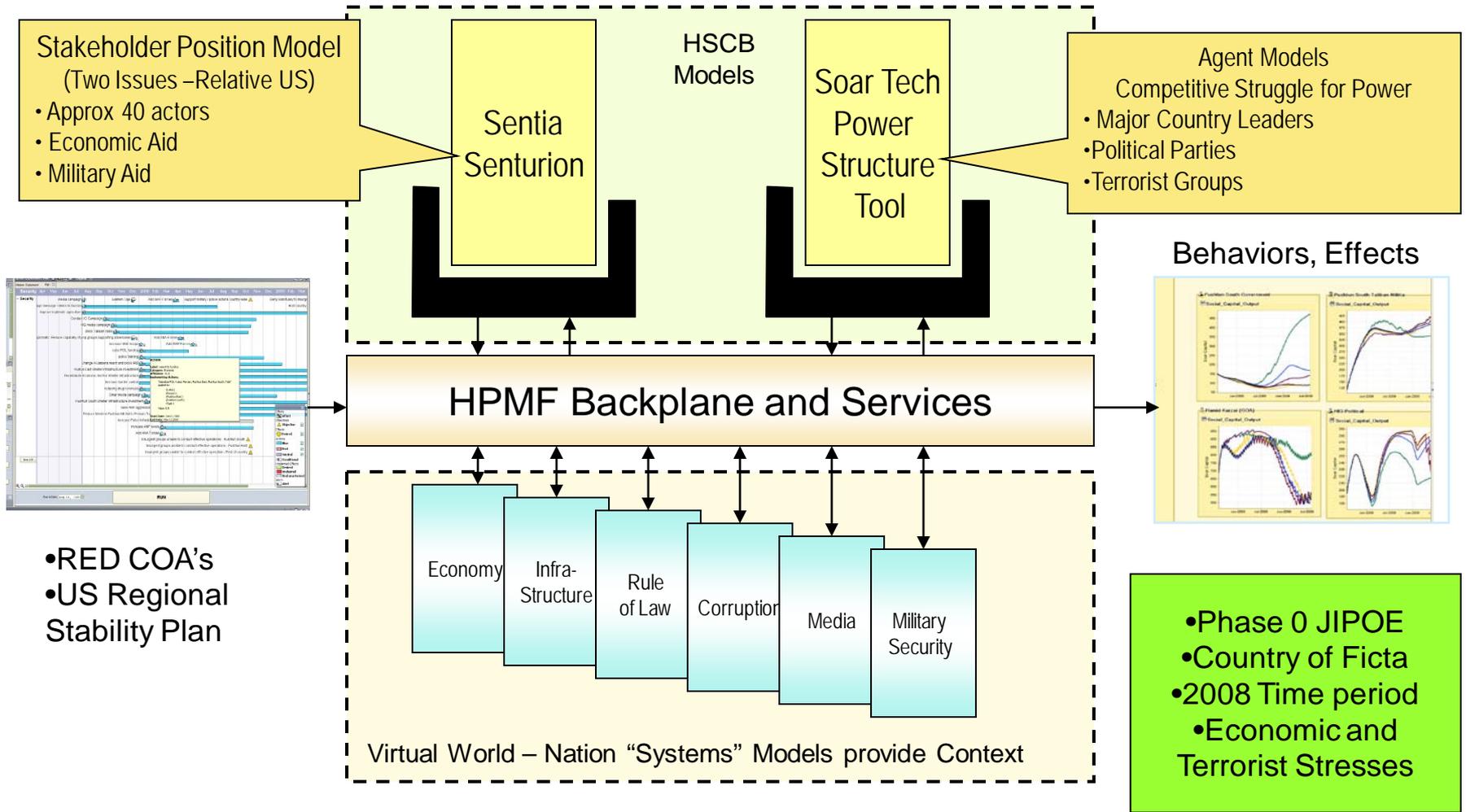
Ficta HSCB Models

HSCB Model:	Sentia Senturion™ Political Landscape Model	Soar Technology Power Structure Simulation
Model function	Political landscape Model: simulates how the policy positions of competing interests evolve over time by cooperating (bargaining) and competing, tracking the dynamics of shifting opinion.	Power Structure Model: simulates competition for relative political-social power in a network of interacting agents.
Focus of Model	Policy Positions	Political-Social Power
Complementary integration of the two HSCB models	<ul style="list-style-type: none"> • Senturion focuses on aggregate positions of many actors and their interactions relative to their interests on multiple, concurrent issues. • Power Structure Simulation focuses on the competition of networked individual actors, based on their relative goals and abilities to gain political-social power. • Competition for power changes a stakeholder’s influence in the political landscape. Relative positions of key leadership actors in the political landscape affect their support among other actors. 	
Simulation Paradigm	Agent-based simulation	Agent-based simulation
Key Social Theories	Game theory, decision theory, spatial bargaining, and microeconomics	Social capital and political power competition; agents gain and apply social (political) capital to achieve relative power goals
HSCB Behavior Modeled	<i>Aggregate behavior</i> of actors relative to a space of policy interests.	<i>Individual behavior</i> of actors who perceive the environment, make decisions and compete for relative power

Ficta: Contextual Environment Models

Model	Model Type; modeling tool	Description
Event Generator	Bayesian Network;Netica	Models major and minor violent and nonviolent events per week, based on grievances, violence, and mobilizing structures.
Economy	System Dynamics;Vensim	Models economy and related infrastructure activities. Key outputs include GDP growth, unemployment rates, and poverty rates.
Media Influence	Agent Based;custom BAE systems modeling tool	Models the influence of media sources, via channels, on the attitudes of target audiences (relative to specified themes associated with positions in the Senturion model)
Rule of Law	System Dynamics;Vensim	Models the legal system, including police, prisons, and judiciary.
Military	System Dynamics;iThink	Models military force readiness positioning and effects.
Corruption	System Dynamics;iThink	Models the non-legitimate flow of finances in the underground economy, and collateral effects.

Case Study Implementation



Summary

- Composable Architecture will allow service-based integration and use of HSCB and Environment models to enhance the JIPOE Process:
 - Reduce manual management of diverse data sources
 - Provide rapid use of data and models to perform (JIPOE Steps 1 and 2)
 - Allow more expansive analysis of the Adversary(JIPOE Step 3)
 - Enable true dynamic analysis of Adversary COA's and effects (JIPOE Step 4)