Dynamic Battlefield Visualization: Knowledge Management in a Complex, Emergent PMESII-PT Battlefield

Paper 162

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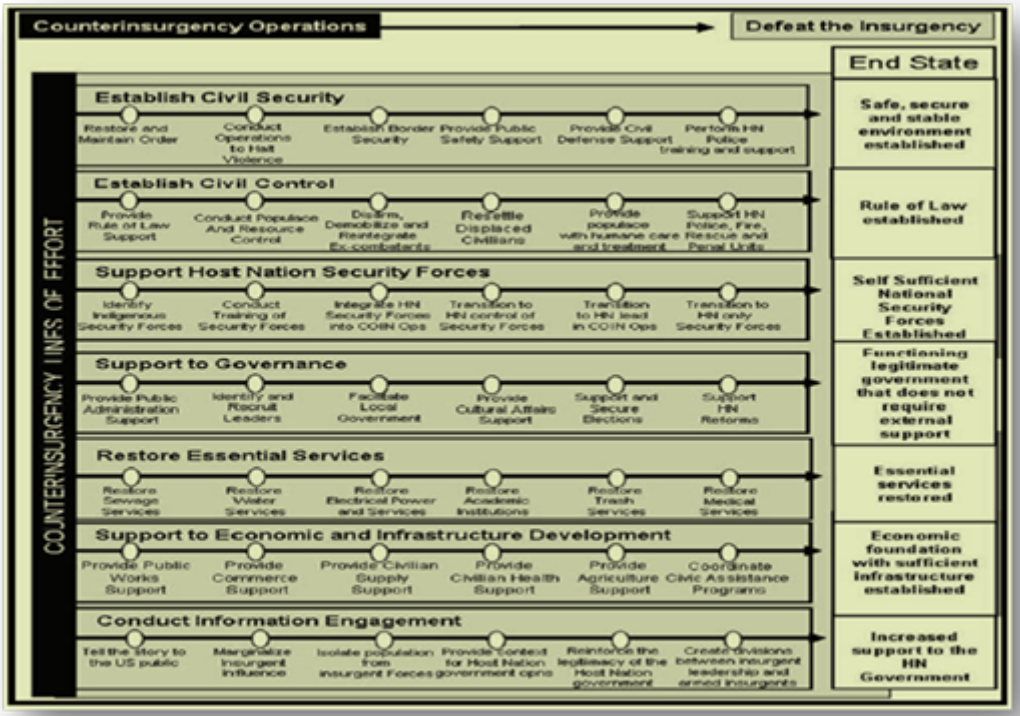
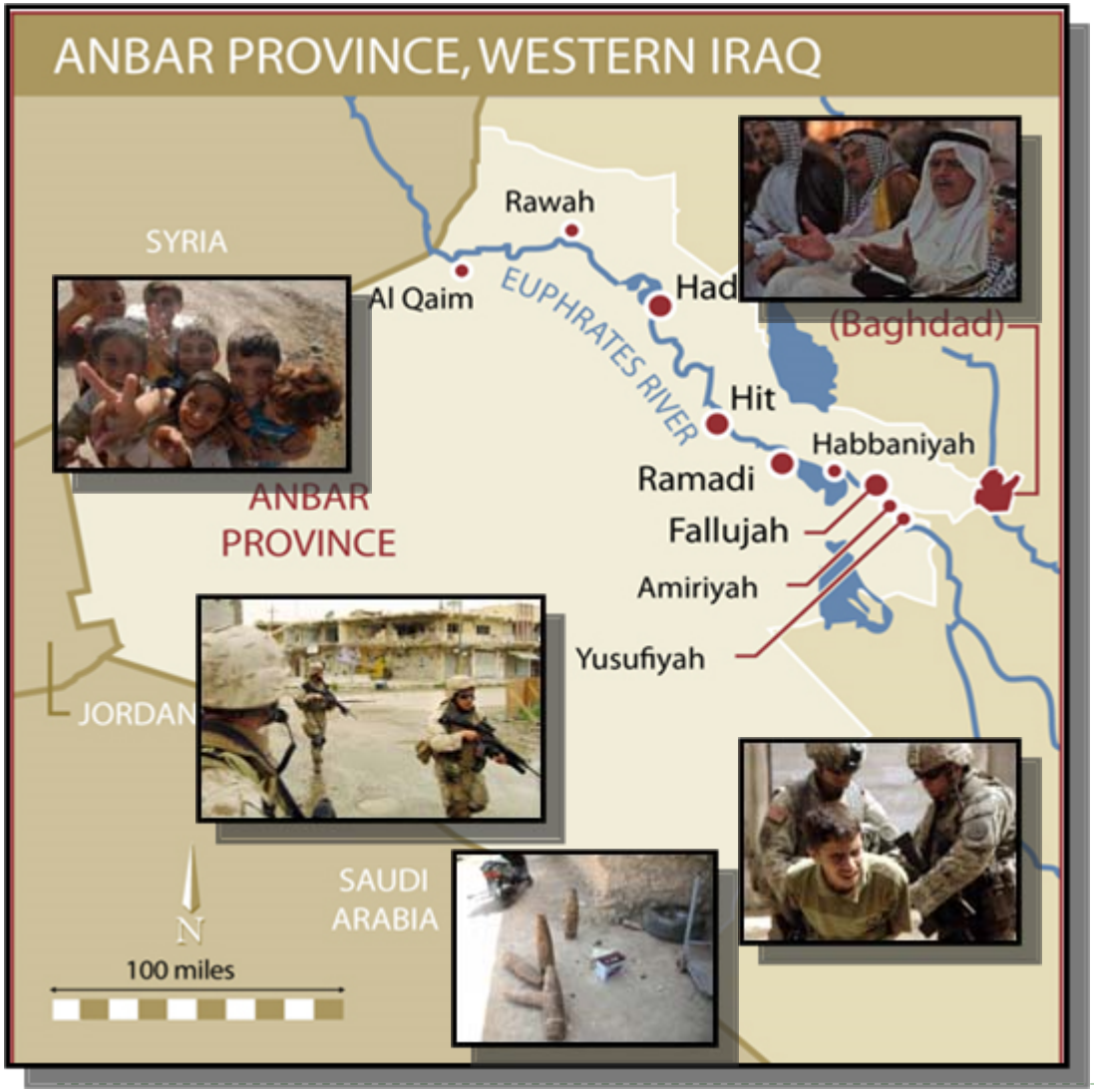
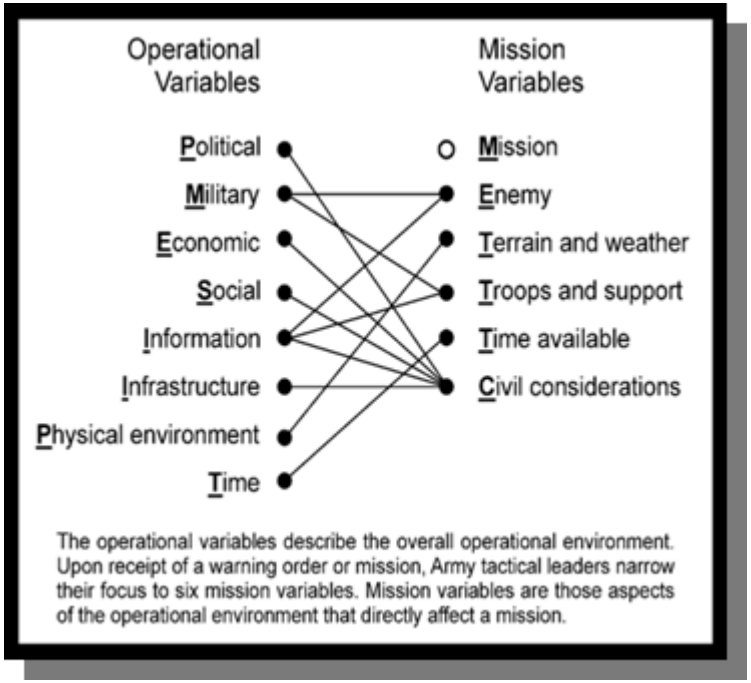
Visualization Defined

Visualization can be generally defined as the art and science of developing situational understanding, determining a desired end state, and envisioning how to move the force from its current state to the desired end state.

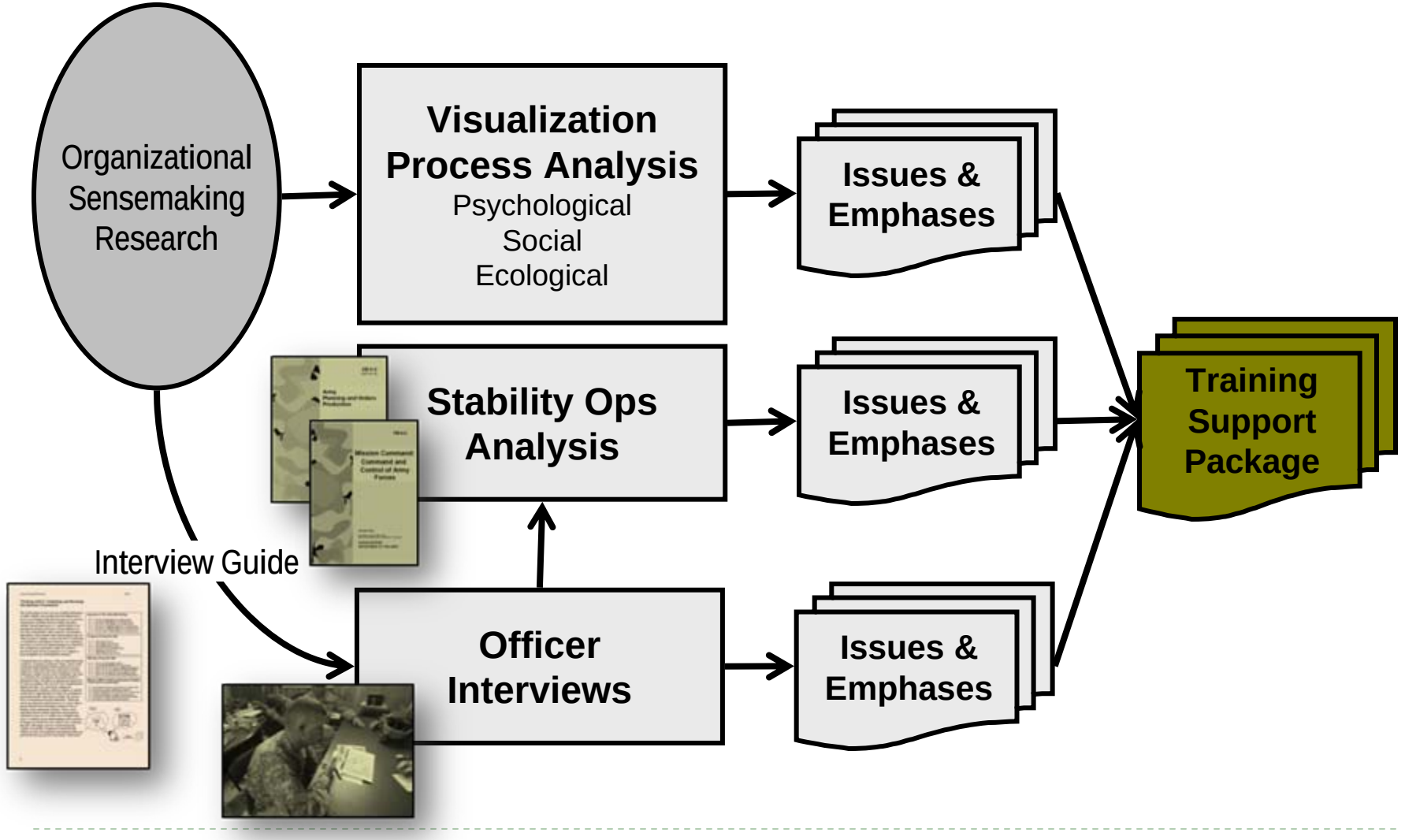


Visualization Challenge





Phase 1: Task Requirements Analysis



Visualization Characteristics

Battlespace Visualization

- Purposefully frames actions and links them with understanding and intent
- Is synchronized vertically across the commander and staff
- Balances intuition with deliberate reasoning according to past experience
- Structurally framed by doctrine to provide common ground of understanding
- Matched to the dimensions and levels of operational complexity
- Collaboratively constructed to achieve unity of purpose
- Continuously adjusted to revealed aspects and unpredictable adversary
- Supports and guides a larger planning and execution process

Levels of Visualization Thinking

PURPOSE What am I attempting to accomplish? How do I define my desired

FOCUS Where can the enemy be most effectively influenced to achieve the desired endstate? How do I define the center(s) of gravity?

SYSTEM EFFECTS How do I achieve this influence? What systems and functions support the center(s) of gravity?

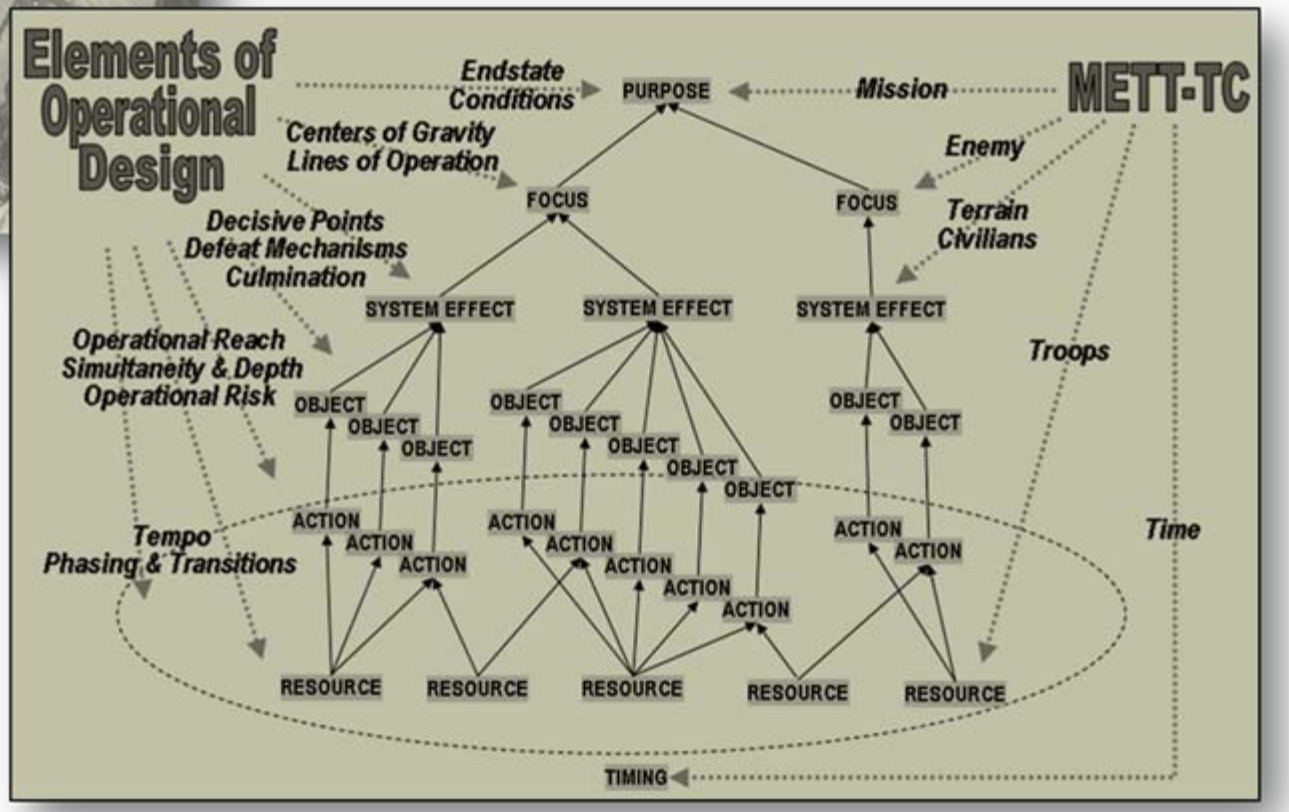
OBJECTS What specific units, groups, people, facilities, events do I need to target to defeat or manipulate these systems and functions?

ACTIONS What actions (lethal and non-lethal) do I need to take against these units, groups, people, facilities, and events?

RESOURCES What resources (troops, Joint/Interagency support) do I need to accomplish these actions?

TIMING What is the required timing and synchronization of these resources and actions?

Commander's Visualization Space



Issues Highlighted in Interviews

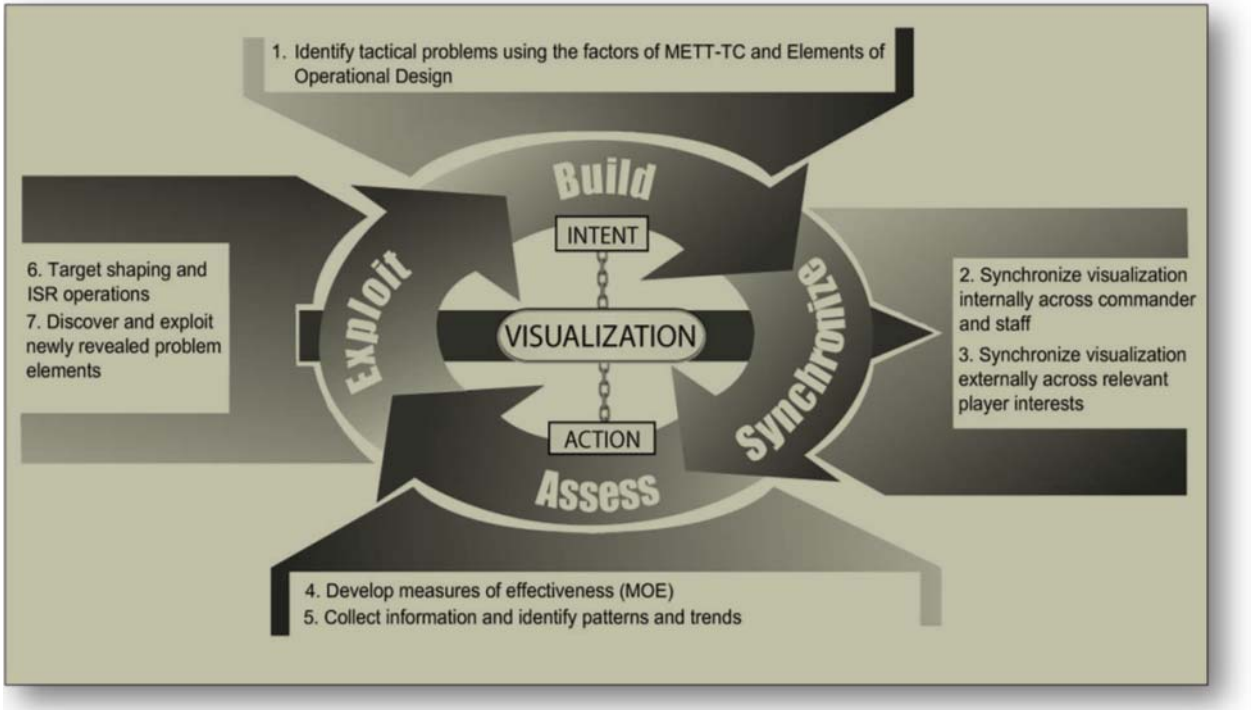
- 25 interviews with officers possessing relevant BCT/BTF command and staff experience
- Read-ahead survey form based on initial task model
- 2 hour interviews recorded for post-analysis

- Visualizing effects of non-lethal actions on civilian population (center of gravity) / lack of doctrinal concepts and MOEs
- Reconciling multiple operational perspectives of military forces, interagency organizations, and intergovernmental elements in a common PMESII-PT battlespace
- Reconciliation of short-term operational objectives against short-term tactical actions
- Loss of operational focus during unit rotation / discontinuity of operations during unit handovers
- Managing multiple forms of verbal, written, graphic, and tacit knowledge

Visualization Task Areas

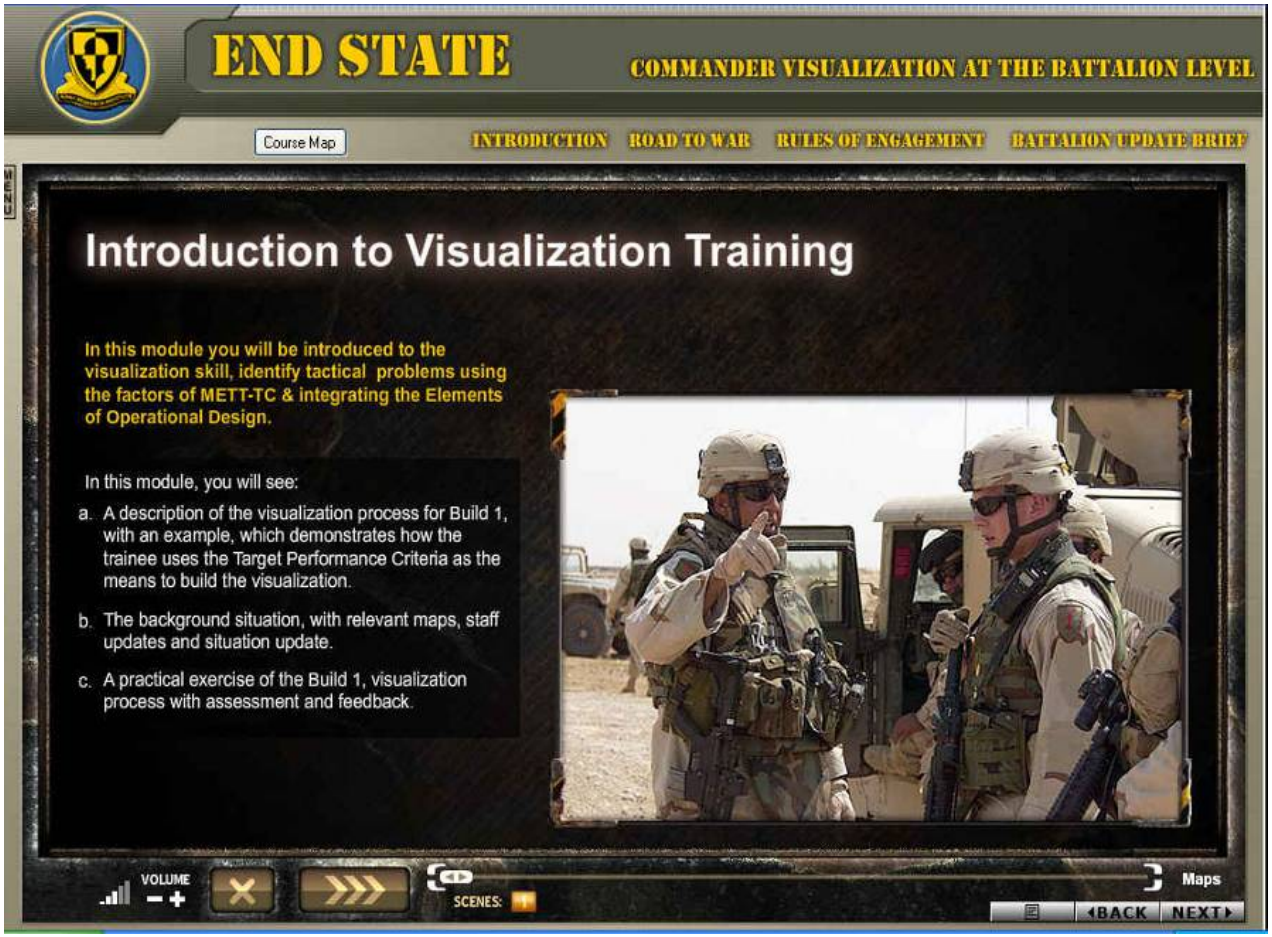
- **Build the Visualization Framework**
  1. Identify tactical problems employing METT-TC and Operational Design frameworks
- **Synchronize the Visualization Framework**
  2. Synchronize the visualization internally across Commander and staff to develop shared understanding
  3. Synchronize the visualization across relevant external players to accommodate multiple stakeholder perspectives
- **Assess the Visualization Framework**
  4. Focus collection of information and identify patterns / trends to discover operational variances and maintain a running estimate
  5. Develop meaningful measures of effectiveness (MOE) based on endstate objectives and 2nd-order consequences
- **Exploit the Visualization Framework**
  6. Target shaping and ISR operations to reduce risk/uncertainty and discover adversary weaknesses
  7. Exploit newly revealed problem elements to seize and maintain operational initiative

Training Development and Testing



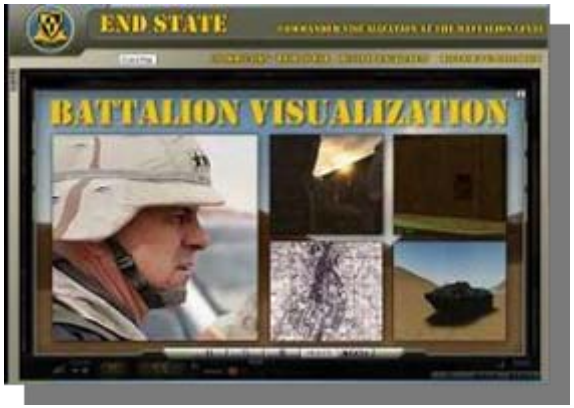
- ✓ **Deliberate practice of expert cognitive behaviors**
- ✓ **Multiple, realistic COE scenarios**
- ✓ **Built-in cues or triggers: ambiguous, critical, useful, irrelevant, and misleading**
- ✓ **Built-in performance measurement supports feedback**
- ✓ **Coaching/feedback via video or avatars of authentic mentors, instructors, and Soldier role models**

PC-Based Tutorial Lessons



Introductory Materials

Visualization Introduction



Road-to-War Briefing

Battlefield Update Briefing

Training Vignette Features

Video from Iraq

Realistic Animations

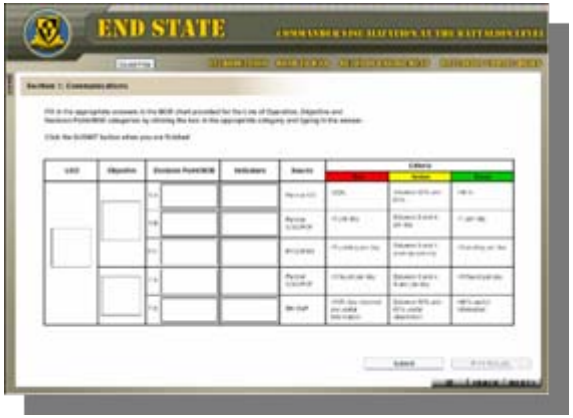
UAS Video

C2 Information Displays

Pre- and Post-Training Assessment

Students review situation

Students perform task skills



Students receive feedback

Training Effectiveness Evaluation

CONFIDENCE RATINGS

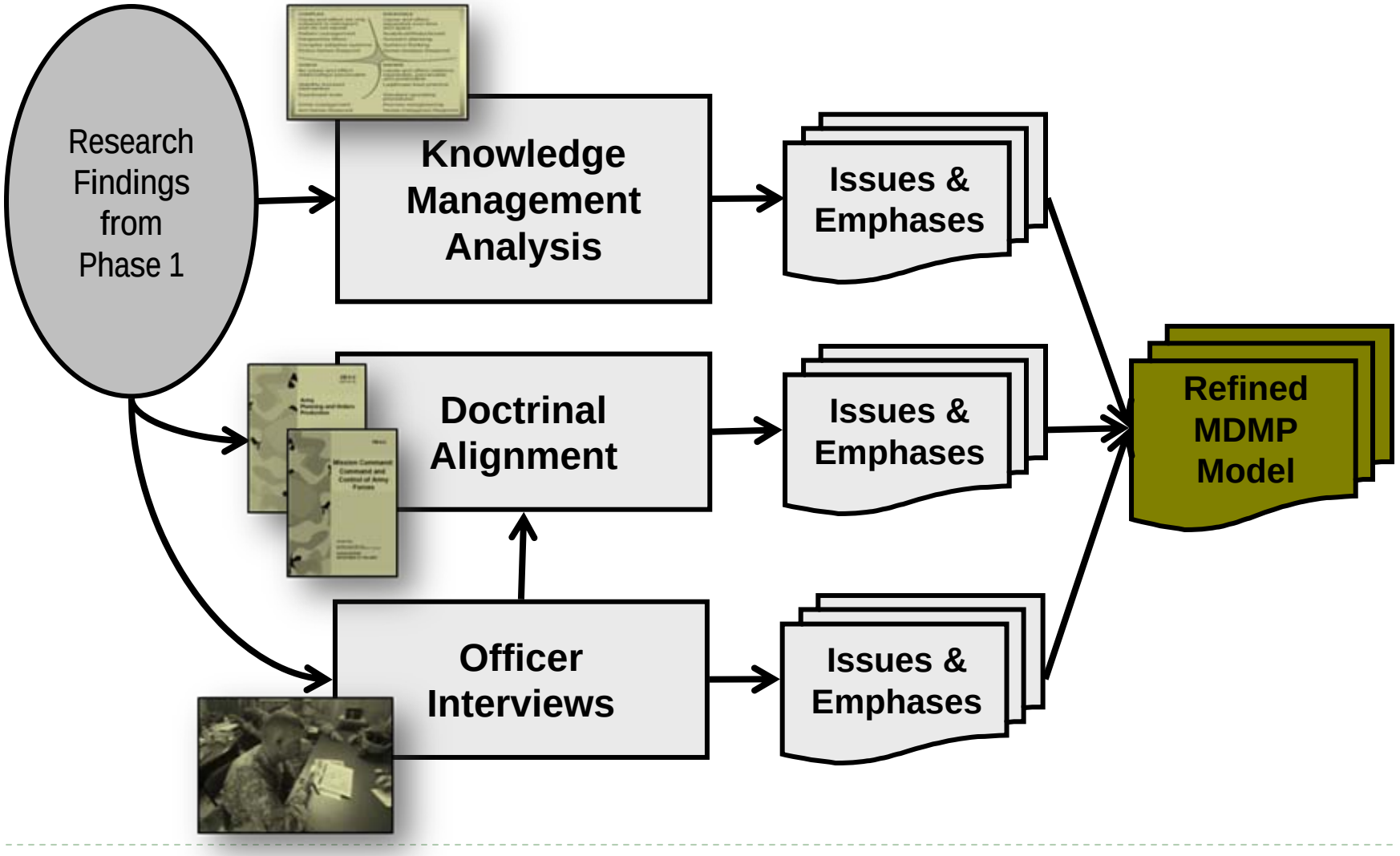
Visualization Skill Domain	Mean Rating	
	Pre-Training	Post-Training
Build	3.89	3.92
Synchronize	3.96	4.05
Assess	3.37	3.76
Exploit	3.04	3.71

PERFORMANCE ASSESSMENT

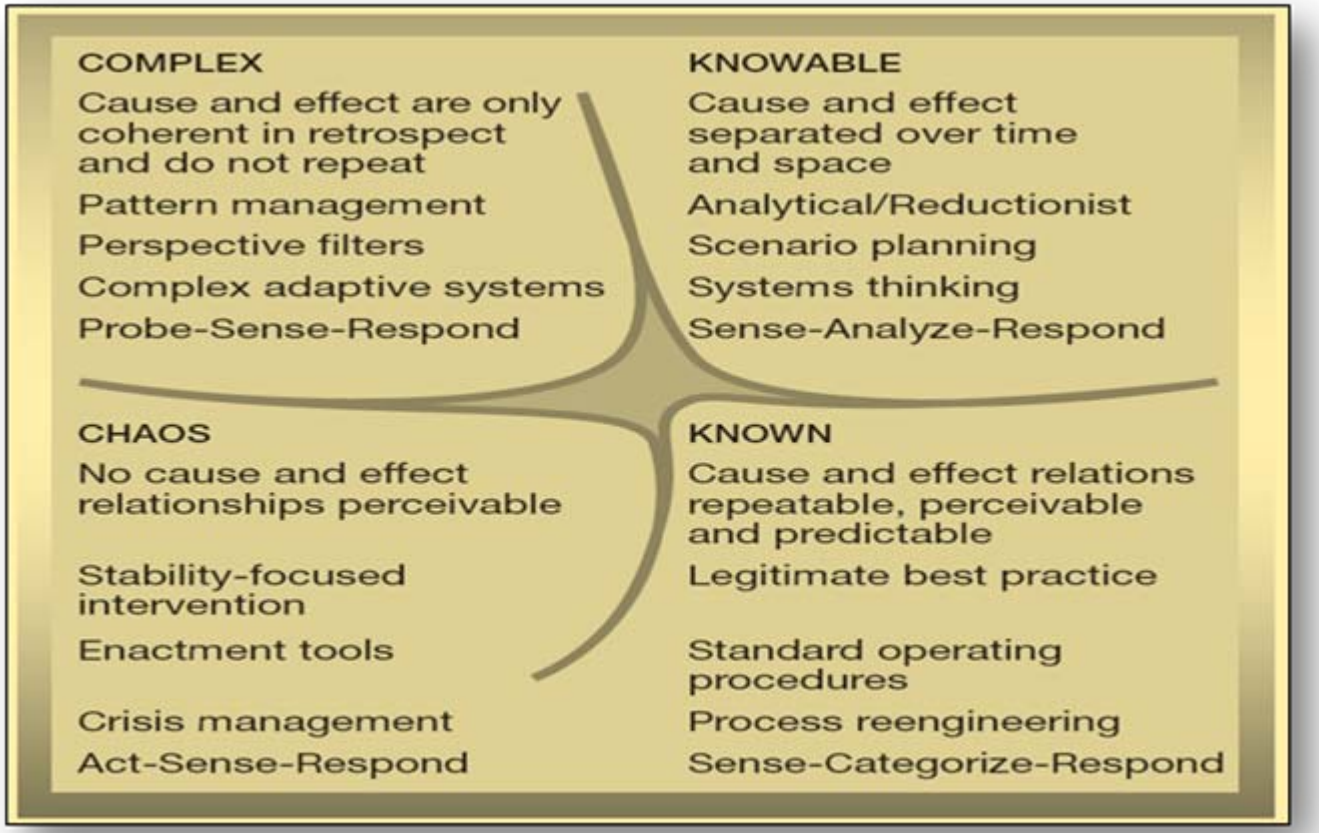
- Pre-test (*M* = 79.6, *SD* = 4.6)
- Post-test (*M* = 87.8, *SD* = 4.9)

(Wilcoxon's $Z = 2.533$, $p < .05$)

Phase 2: Refine the Visualization Model



Sensemaking Strategies



KURTZ & SNOWDEN, 2003

Forms of Sensemaking Knowledge

LOGICO-SCIENTIFIC KNOWLEDGE

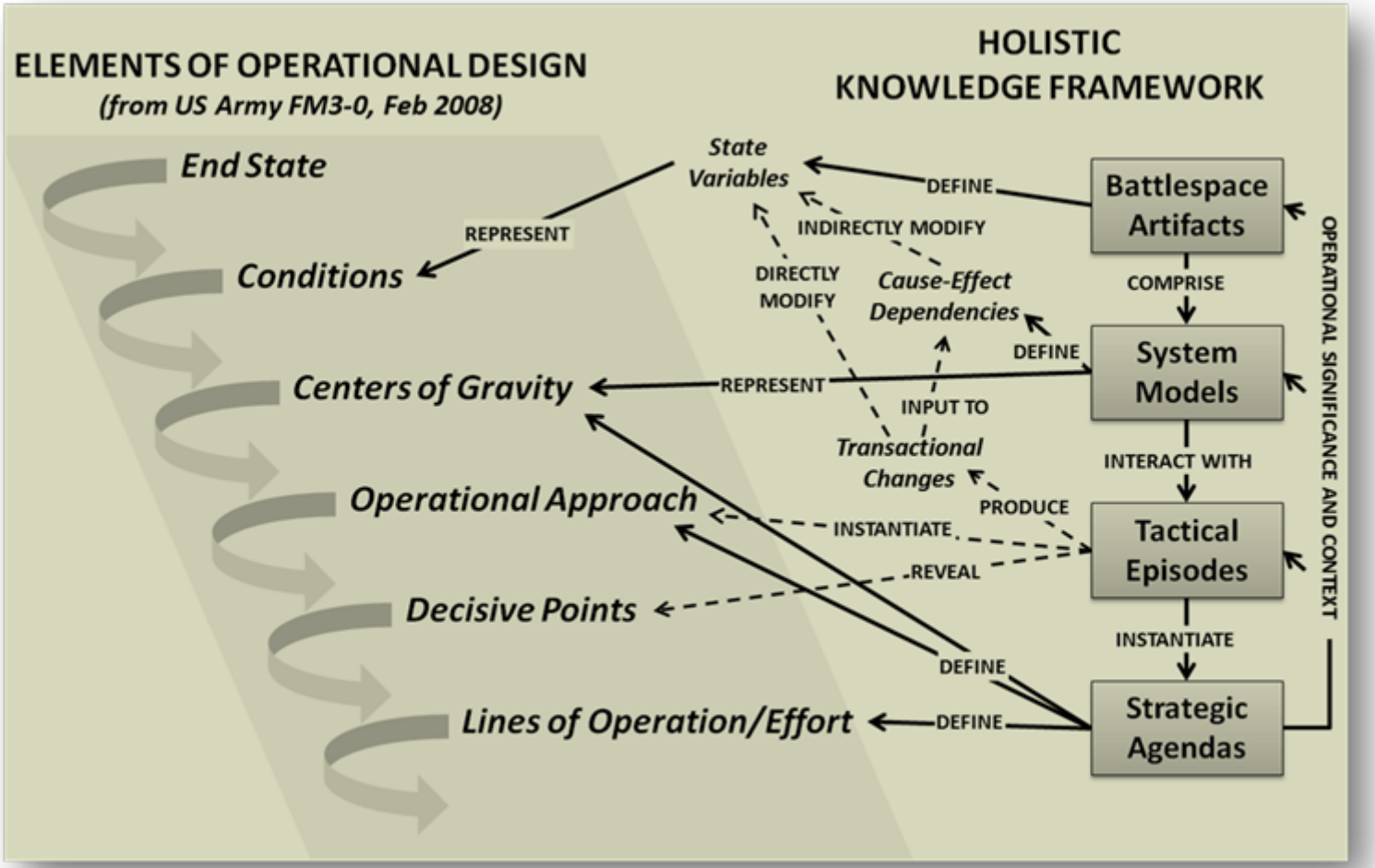
- Objective: Establish a body of universal truths
- Nature: Empirically validated truths, objective definition
- Method: Formal reasoning using predicate logic and proofs
- Application: Theory-driven, context-free, objective, ahistorical

NARRATIVE KNOWLEDGE

- Objective: Endow experience with meaning and intentionality
- Nature: Plausible explanations, bracketed by experience
- Method: Abductive just-in-time reasoning using story-telling
- Application: Meaning-driven, context sensitive, intentional, paradoxical

BRUNER, 1986

Mapping onto Operational Design

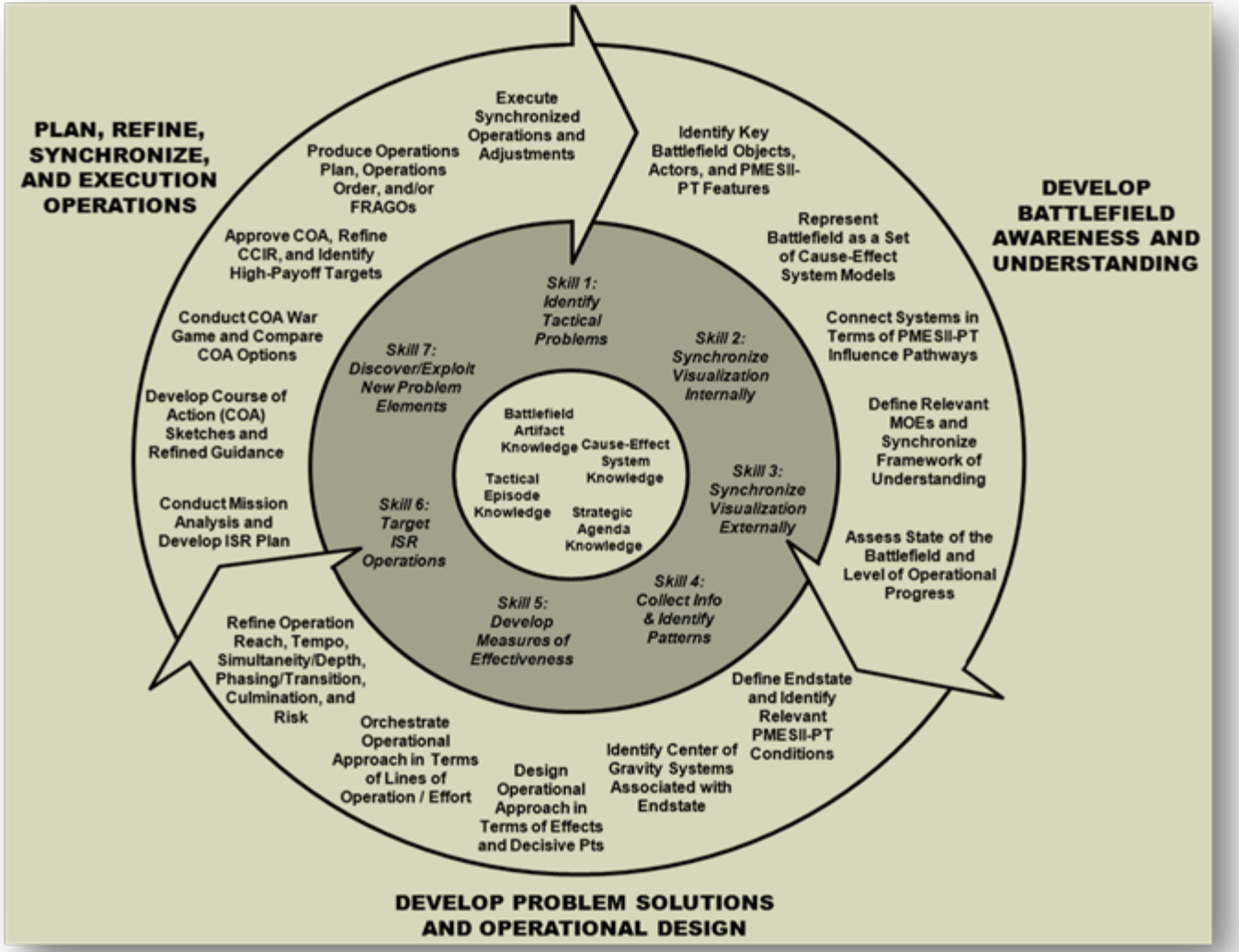


Issues Highlighted in 2nd Interviews

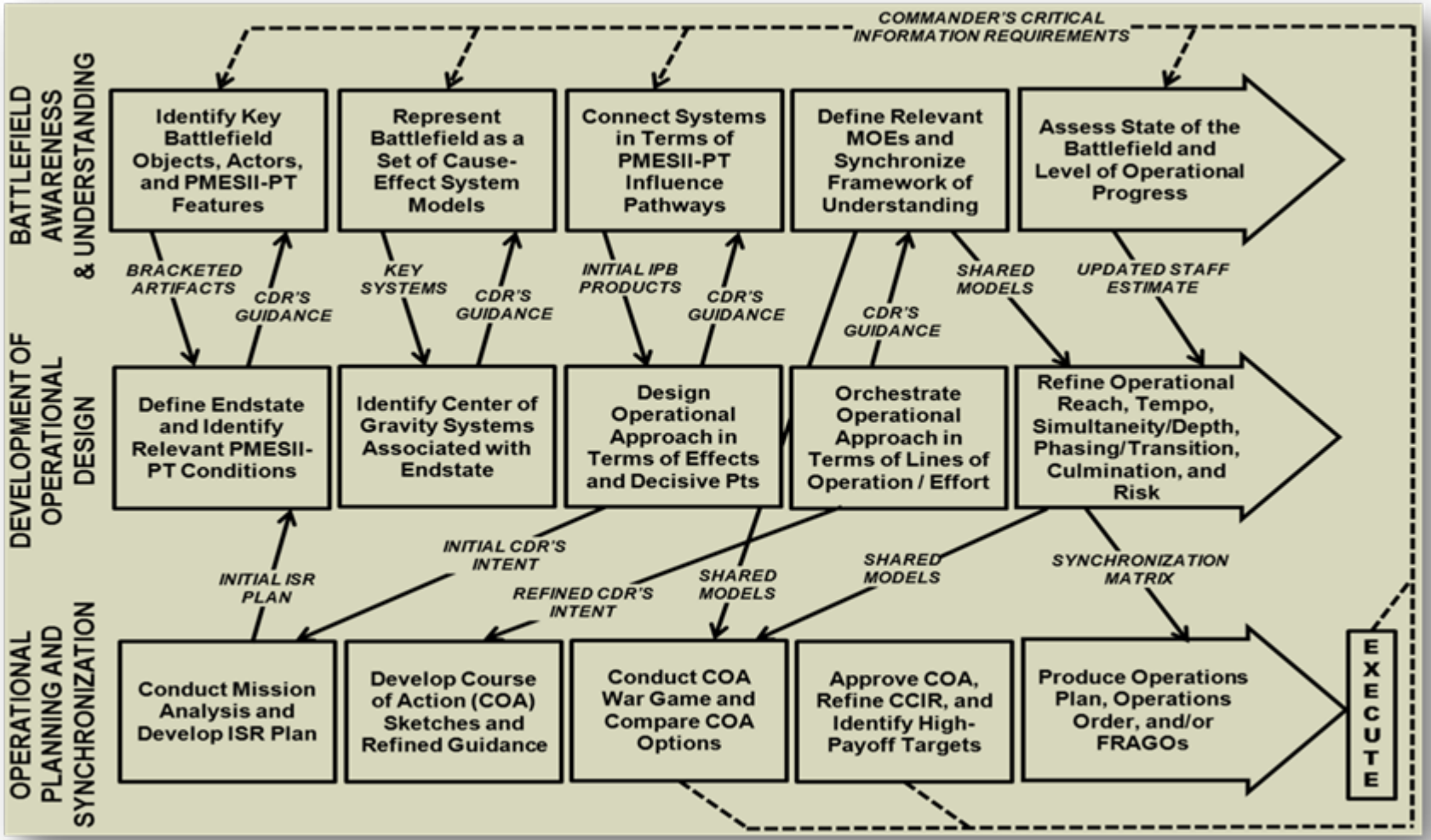
- 18 interviews with officers possessing relevant BCT/BTF command and staff experience
- 2 hour interviews recorded for post-analysis

- Misuse of intuitive (RPD) reasoning and abbreviated MDMP when it is not supported by relevant operational experience
  - Traditional MDMP viewed as a time-consuming, pro forma exercise
  - Continuous series of FRAGOs cannot substitute for deliberate reevaluation of operational requirements and strategy
- Failure to adequately transfer situation awareness and understanding between rotating units
  - New unit experiences steep learning curve
  - Adversaries learn to exploit operational seams
- Operational objectives poorly articulated
  - Reactive operations consist of disconnected series of tactical engagements and effects (*e.g.*, “Ground Hog Day” syndrome)
  - Consequence management consumes considerable resources

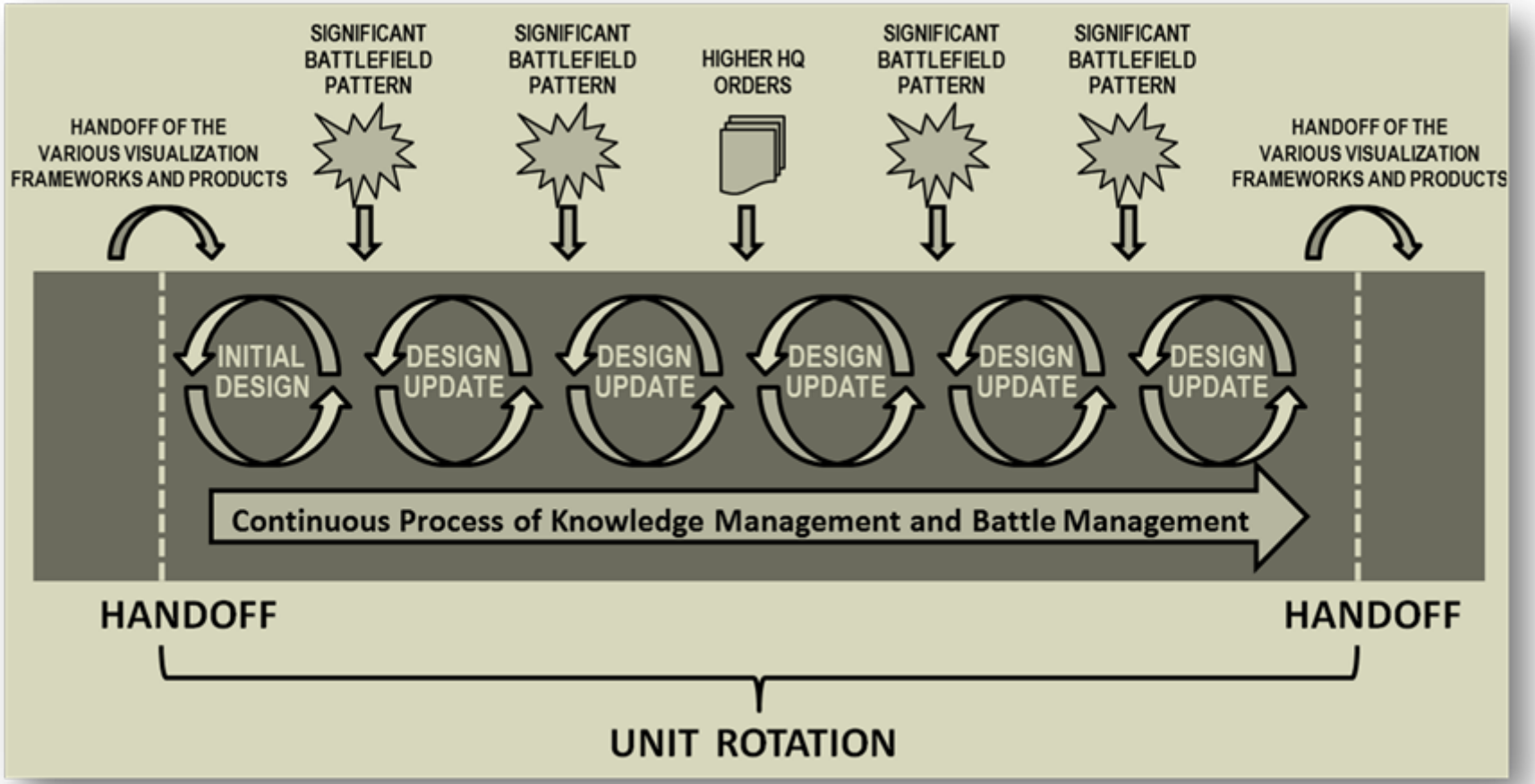
Continuous Visualization Cycle



Flow of Knowledge in Battle Rhythm



Transfer of Visualization between Units



Questions ?