A System Dynamics model of the FM 3-24 COIN Manual

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Assess the Full Range of Military Operations

• Warfighting analysis – assess *proficiency*
  – Multiple scenarios
  – Wide range of variables within scenarios
  – Alternative CONOPs
  – Alternative campaign objectives
  – Force equivalencies/force substitution
  – Multiple analytical models

• Other force structure requirements – assess *sufficiency*
  – Day–to–day demands: Forward basing, forward presence, lesser contingencies, homeland defense, theater security cooperation
  – Peak demand of overlapping warfights
  – Sustained surge demand of post-hostilities operations
  – Force equivalencies/force substitution

• Analysis of *Irregular Warfare* challenges
Analysis Framework

Tools
- Workgroups
- Mission Analysis
- Data
- Models
- Scenarios
- Metrics
- Wargaming
- Interagency partners
- Senior Leader reviews
- Peer reviews
- Partner nations

Methodologies
- Intellectual approach
- Rationale
- Physical assumptions
- Philosophical assumptions
- Tank guidance
- SPG tasks

Study Objective
- Senior Leader insights
## Comparison of Traditional and Non-Traditional Analysis

<table>
<thead>
<tr>
<th>Conventional Campaigns</th>
<th>Non-Traditional Campaigns</th>
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<tbody>
<tr>
<td><strong>Characteristics</strong></td>
<td></td>
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<tr>
<td>Structurally complex, limited geographic focus, kinetic domain, means are predominately Military</td>
<td>Interactively complex; global focus; human, social, cognitive domain, means integrate all elements of National Power (DIME)</td>
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<tr>
<td>“Victory” clearly defined, quickly understood, well-established</td>
<td>Many on-going efforts to define “Victory” (JCS J5, SOCOM J3/J5)</td>
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<tr>
<td>Focused on Phase III Operations, approved MSFDs (MCOs)</td>
<td>More than Phase III Operations, draft vignettes, wargames for event list</td>
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<tr>
<td>Physics based, authoritative sources identified, JMEM (historical, published, formatted)</td>
<td>Perishable, culturally relevant, “soft” aspects, questionable reliability, no-JMEM equivalent</td>
</tr>
<tr>
<td>DoD centric, generally accepted; historic, repeatable validation</td>
<td>Expertise outside DoD; exploring non-DoD models; still in research mode; structural validation, “useful/credible”</td>
</tr>
<tr>
<td>Physical warfight outcomes, measurable and explainable</td>
<td>Identify “High Leverage” areas and trends; insights on capabilities “backed-out” and often not DoD</td>
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### Metrics

- **Conventional Campaigns**
  - JICM, ITEM, Thunder, ...

- **Non-Traditional Campaigns**
  - System Dynamics, Agent-Based Models, Wargames, ...

### Models

- **Conventional Campaigns**
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### Data

- **Conventional Campaigns**
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### Scenarios

- **Conventional Campaigns**
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- **Non-Traditional Campaigns**
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### Results

- **Conventional Campaigns**
  - JICM, ITEM, Thunder, ...

- **Non-Traditional Campaigns**
  - System Dynamics, Agent-Based Models, Wargames, ...
Analysis in Irregular Warfare

Triangulation Search in the Physical World
Uncertain distance with known error

Uncertainty Space in the Analytic World
Uncertain error with known distance

Efforts to refine the solution risk missing a fleeting opportunity to attack
Why System Dynamics Modeling?

• Characteristics of systems problems include:
  – Dynamic—changes over time and inherent system delays
  – Tendency to overshoot and crash or oscillate
  – Frequent over-reactions that drive exponential growth in costs
  – Multiple players, diverse interests
  – Interdependencies across borders and across disciplines
  – Proposed solutions that appear simple and are usually wrong
  – Very difficult to communicate!

• System Dynamics Modeling can add value in several areas. It provides a platform for…
  – Effectively framing issues and problems.
  – Representing the essence of the interdependencies that underlie system performance; minimize policy resistance
  – Reliably inferring the dynamics associated with a set of initiatives
  – Communicating—creating a single “sheet of music” to play

Excerpts from “An Introduction to Dynamic Modeling with STELLA & iThink” Workshop
• Various software and consultants being used within DOD
  – STELLA / iTHINK – modeling software
  – VENSIM – modeling software
  – PA Consulting / Boeing / VMASC / MIT – consultants using a mix of commercial and proprietary software to develop SD solutions
System Dynamics Software

- STELLA / iTHINK – isee systems – Barry Richmond
- Language of stocks and flows, graphics user interface
- Innovator in application to social systems – “STELLA in the classroom” to study Hamlet in High School
Building a Simple STELLA Model

Savings account
- Stock – savings
- Flows in – deposits and interest
- Flows out – withdrawals
- Simulation – what is the effect of various interest rates? How about deposits and withdrawals? Where is my leverage?

Most of the things that concern people are entities that accumulate or dissipate over time – and we are concerned with trends. Unlike the simple example above, most don’t have a closed-form solution.
Using a STELLA-Based Presentation

• Begin with a cause and effect relationship diagram
• Expand into a model structure that captures all elements and assigns assumptions about relationships
• “Troubleshoot” model structure and validate against some sort of truth data…historical data, research, or in this case doctrinal theory
COIN operations must accomplish three tasks simultaneously:
- Influence insurgent-minded individuals to adopt a neutral disposition.
- Influence neutral-minded individuals to adopt a supportive disposition.
- Retain supportive individuals.

These operations are conducted in an environment where tensions and hostilities between groups may destabilize a society and provide opportunities for insurgents:
- This environment may suggest courses of action aimed at reinforcing or widening seams.
• An increase in Coalition funding will influence economic investment and development.
• A strengthened economy will influence movement from the insurgent- and neutral-minded groups toward the supportive group.
• An increase in Coalition funding will significantly impact the restoration of essential services.

• Improvements in the provision of essential services will influence movement from the insurgent- and neutral-minded groups toward the supportive group.
A government that is established, recognized, and that maintains a secure environment is in a position to

- Send a positive, credible message of success to the populace.
- Provide an environment that enhances stable employment of the workforce.
- Persuade insurgents and neutrals to consider becoming supporters.
An appropriate force mix, and correct operational tempo, timing, and synchronization will have very significant impacts on

- The restoration of essential services.
- The populace’s perception of security.
- The Government’s and COIN forces’ credibility in their communications efforts with the populace.
The Logical Lines of Operations from FM 3-24
The Basic Information Ops Loop
The Comprehensive Information Loop
The Comprehensive Information Loop
Support for Insurgency

Neutral Populace

Support for HN Government

Satisfaction with Essential Services

Expectations for Essential Services

Breakdown of Essential Services

Time to Develop Essential Services

Psychological Operations Effectiveness

Potential Fractiousness of Society

Essential Services

Governance

Economic Development

Time to Develop Governance

Economic Investment

Coalition Funding

Developing and Restoring Essential Services

Time to Develop Essential Services

Impact of Illegitimate Actions

Individual Competence, Judgment, and Ability to Execute

Appropriate Mix of Effort and Use of Force

Appropriate Strategic Emphasis

Perceived Security

External Material Support

Insurgent Acts of Violence

Total Force Density

Host Nation Security Forces

Insurgent to Force Density Ratio

Understanding and Knowledge of Social Structures

Coalition Force Density

Host Nation Force Density

Available Workforce

Intelligence

Time to Develop HN Security Forces

The Comprehensive Information Loop
Support for Insurgency
Neutral Populace
Support for HN Government

Essential Services
Psychological Operations Effectiveness
Satisfaction with Essential Services
Expectations for Essential Services

Time to Develop Essential Services
Developing and Restoring Essential Services

Governance

Time to Develop Governance

Economic Development

Economic Investment

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Insurgent to Force Density Ratio

Impact of Illegitimate Actions

The Logical Lines of Operations from FM 3-24
The STELLA Model - Interfaces
The STELLA Model - Structure

Population

Governance

Economic Development

Essential Services

Host Nation Security Forces

Security
The STELLA Model

Support for Insurgency
Neutral Populace
Support for HN Government

Run  Clear
Using the Model in Analysis

COA Option – Adjust Mix of Effort and use of Force to focus totally on security
  – Technology-driven and reactive cost imposing strategy
  – Ignores FM 3-24 recommended effort on non-security LLOs

Appropriate mix of effort set to a balanced focus on all Logical Lines of Operation

All effort focused on Perceived Security and Host Nation Security Forces, others zero

Waiting to start on the Non-Security LLOs until Security is established is an inherently flawed and self defeating strategy. The LLOs are too interdependent.
“One of the most important lessons in Afghanistan and in Iraq is that military success is not sufficient. Our efforts must also address economic development, institution building, the rule of law, promoting internal reconciliation, good or at least decent governance, public services, training and equipping indigenous security forces, effective, strategic communications, and more.”

Secretary of Defense Robert Gates, 29 January 2008
Manning and Funding held sufficient through the entire period

A **sustainable** peace – we remain involved and remain invested as intervener
Manning and Funding get ramped down as Host Nation capacity increases
A *durable* peace – one left to thrive as a better version of itself with less cost to us
Manning and Funding get ramped up as needed to face crises
No peace – mired in strife at the same cost to us as Kilcullen case over the period
Coalition Input – the long slow grind

Eventually the corner is turned – assuming no return to major hostilities
Requires persistent sufficient investment many times longer despite greater losses
Is It Working?

Christian Science Monitor – October 2nd 2007: “Violence dropped dramatically” Credit for success is given to efforts that directly map to FM 3-24
Contextual Mapping helps metrics point towards the appropriate LLOs.

What can you say about these except “I hope they start getting greener”?

To be useful, metrics need a contextual mapping, which infers a framework.
Campaign Design

TRADOC Pamphlet 525-5-500
“Commander’s Appreciation and Campaign Design”

• Commander’s Appreciation
  – Need to develop a shared understanding of complex operational problems
  – Structured problem framing (and re-framing!)

• Problem structure
  – well structured (structurally complex, linear): professionals agree on how to proceed – apply the Science of War
  – ill-structured (interactively complex, non-linear): professionals disagree on how to solve this problem – apply the Art of War

Topic of Army ‘Stand-To’ e-newsletter, 1 Feb 2008

To access TRADOC Pamphlet 525-5-500 go to: http://www.tradoc.army.mil/tpubs/pamndx.htm
A System Dynamics View of Campaign Design

**Commander's Appreciation and Campaign Design**

- **Gap in "State of Affairs"** between what is and what ought to be
- **Concern to lessen or a Military Action to achieve an end state**
- **Complex Operational Problem (unstructured problem)**
  - Resolving the natural tension between the formulation of strategy and the planning for its implementation
- **Commander's Appreciation**
  - Problem framing—and its military use during a campaign
  - Linear phenomena that can be controlled
  - Professional consensus and authoritatively prescribed in doctrine
  - Professional soldiers can agree

**Science of War**

- **Art of War**
  - Understanding is not a matter of capturing reality sufficiently correctly, but it is a matter of constructing an interpretation that is sufficiently useful in dealing with reality
  - Intuition and Genius (harmonious combination of courage, powers of intellect, and strength of will)
  - Link near-term actions to the strategic aim of the campaign
  - Mutually respectful competition of opposing ideas (candid and free)

**Operational Design**

- 1) Seeks to explain the qualitative relationships embedded within complex problems
- 2) Arranges operations in space and time and identifies capabilities and resources
- Giving a Complex Problem enough structure so that further planning can lead to useful action
- Analysis of the Mission (breaking it down into specified, implied, and essential tasks)
- Detailed plan for action (blueprint)

**Operational Engineering**

- Detailed series of executable missions that directly affect allies, adversaries, and the environment
- Simultaneously building and understanding of the problem through the creation of a conceptual solution or design
- Operational Problem (well or medium structured)
- Reframing as understanding expands
- Operational Art
  - An iterative process that integrates ends, ways, and means across the levels of war
- Operational Design
  - Link near-term actions to the strategic aim of the campaign
  - Agreement on a Shared Starting Hypothesis

**Operational Art**

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A Framework for Success

Three Completely Different entities – The DoD; The USIP; and Dr. Paul Collier, an Oxford Economist with a lifetime of working aid issues in Africa

Safe and Secure Environment
Rule of Law
Stable Democracy
Sustainable Economy
Social Well Being

Security
Laws and Charters
Trade
Aid

Security
Host Nation Security Force Development
Governance
Economic Development
Essential Services

Since these disparate groups can agree on the problem statement and solution path, how are we in the USG working together to operationalize the answer?
Success will be less a matter of imposing one’s will and more a function of shaping behavior of friends, adversaries, and most importantly, the people in between.”

Secretary of Defense Robert Gates, 10 October 2007

“You don't kill or capture your way out of an industrial strength insurgency.”

Gen. David Petraeus, 14 September 2008