Complex Systems Analysis of Hybrid Warfare

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Outline

• Research Objective

• Methodology Overview: Complex Systems Analysis

• Introduction to the Toolset

• Context: Gray Zone Conflict in Moldova & Georgia

• Current Research

• Wrap-up & Next steps
Research Objective

- **Develop a framework and toolkit that decision makers can use to assess complex problem spaces.**

- *First year* focused on identifying conceptual tools, and documenting and testing them. *Second year* focuses on bridging the qualitative tools to quantitative tools.

- Presented research at Conflicts in the Gray Zone: A Challenge to Adapt conference in Budapest, Hungary, hosted by Hungarian Defence Forces General Staff, Scientific Research Centre.

- Improved methods to address problems that grapple with uncertainty.

- Develop language and tools that connect policy domain with engineering and tech domain.

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Policy planners, strategists, or military doctrine tend to categorize complex systems into silos, in attempt to reduce complexity via scientific approaches, reductionism, and structure. This breaks down relationships, behaviors, interactions, destroys linkages across space and time, and through over-simplification promises a false reduction of uncertainty.
Methodology Overview: Complex systems analysis

The toolset examines interactions within and between distinct systems, previously dealt with in isolation.

“You cannot meddle with one part of a complex system from the outside without the almost certain risk of setting off disastrous events that you hadn’t counted on in other, remote parts. If you want to fix something you are first obliged to understand...the whole system.”

Contributions

- Ontology resolution
- Operationalization of systemigrams
- Visualizations of unstructured spaces
- Reduce bias, reveal assumptions and viewpoints
- A method for bridging qualitative and quantitative methods
The project identified 33 conceptual tools for decision making strategy and 9 frameworks that provide foundational basis.
Context: Gray Zone Conflict

Gray Zone warfare: The *purposeful*, *aggressive*, *ambiguous*, and *integrated* use of multiple elements of power to achieve political or economic objectives, by a state or non-state actor, exceeding the threshold of normal national competition yet falling below the level of major interstate war.

“War below the lines”
Case Study: Moldova & Georgia

- Gaps in understanding links between Russian leadership’s *stated objectives* vs. Russia’s *actual foreign and security behavior*
- Both countries are gray zone conflict areas
- Russia’s intervention in Ukraine pretext for Moldova & Georgia?
- Results capture emerging trends in the complex system that may not be obvious without a systemic analysis and capture gaps in existing literature, or predictive models of system performance.
Example Diagram (Systemigram)

Russia’s Use of Gray Zone Warfare in Moldova

Legend
Example Diagram (Systemigram)

Russia’s Use of Gray Zone Warfare in Moldova

- Main actors
- Russia’s influence in the system
- Factors shaping policies and ownership/ control
Other tools tested

Problem and objectives tree

Stakeholder influence map
Current Research: Quantitative models

• Transform systemigrams into quantitative models

• Growing number of coding software and data tools to automatically extract stakeholders, sentiments, and events from multi-lingual databases and media publications on daily/real-time bases.

• Probe and test hypotheses against assumptions with conceptual tools and multilingual text-analytic techniques (using GDELT).

• Identify emergent correlations of sentiments and events behavior.

• Explore additional toolset computational & quantitative linkages: systems dynamics, social network, discreet event simulation, statistical modeling

• Research objective: The goal is a new generation of management planning and decision analysis tools that combines qualitative and quantitative approaches.
Background Information: the GDELT Database

- Global Database of Events Language and Tone
  - www.gdeltproject.org
- Contains events from online news sources
- Contains over 431 million events from 1979-Today, extracted from global broadcast, print, and online news sources in 100+ languages
- Events coded into Conflict and Mediation Event Observations (CAMEO) system, while capturing the world media through machine coding in near real-time
- 2K articles per 15min
- Hierarchical levels of granularity
- Accounts for supranational, state, sub-state, and non-state actors

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<tr>
<td>130</td>
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<tr>
<td>131</td>
<td>Threaten non-force, not specified below</td>
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<tr>
<td>1311</td>
<td>Threaten to reduce or stop aid</td>
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<tr>
<td>1312</td>
<td>Threaten to boycott, embargo, or sanction</td>
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<td>1313</td>
<td>Threaten to reduce or break relations</td>
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<td>1324</td>
<td>Threaten to impose state of emergency or martial law</td>
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<td>133</td>
<td>Threaten political dissent, protest</td>
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<tr>
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<td>Threaten attack with WMD</td>
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<td>Give ultimatum</td>
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CAMEO Event Code 13 (THREATEN), with lower-level codes
Measuring Systemigrams

How can we make a qualitative model into a quantitative one?
Iterative Refinement

Data integration is like ETL, an iterative process

- Formulate Queries
- Assess Coverage & Precision
- Make Dynamical System
Systemigram Edges map to SQL queries

SELECT 0, "DATEADDED", count(*) FROM export
WHERE ("Actor1Code"='MDA'
     or "Actor1CountryCode"='MDA'
     or "Actor1Name"='MOLDOVAN')
AND ("Actor2Code"='MDAGOV'
     or "Actor2CountryCode"='MDAGOV'
     or "Actor2Name"='MOLDOVA')
AND ("EventCode"='152'
     or "EventRootCode"='15')
AND "SOURCEURL" != 'unspecified'
GROUP BY "DATEADDED"
### Matching Articles to Edges

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Iterative Refinement
Quantitative Results

- Systemigram was coded into the CAMEO terms, then used a Python program and Postgres Database to automatically query the GDELT database to count the number of events relevant to each Systemigram node.
- Calculated the total number of events for that systemigram concept.
- We are able to identify specific events in the signals captured through the GDELT data system including significant Russian troop movements that we characterized as *Russian Peacekeepers Deployed to Alleviate Frozen Conflicts*.
- These visualizations of the systemigram state reveal which concepts are linked in temporally correlated ways.

**Figure: Example CAMEO coding from Systemigram nodes**

| Month   | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Total |
|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|
| 201612  | 25 | 6  | 44 | 13 | 2  | 50 | 41 | 2515| 5437| 54  | 4  | 80 | 12 | 20 | 20 | 4  | 1827|
| 201701  | 49 | 58 | 37 | 58 | 17 | 6  | 251 | 7056| 9861| 41  | 18 | 162| 72 | 20 | 4  | 1827|
| 201702  | 24 | 57 | 25 | 18 | 2  | 2  | 317 | 1661| 9589| 41  | 27 | 6  | 122| 32 | 4  | 20 | 1827|
| 201703  | 24 | 49 | 35 | 27 | 21 | 1  | 244 | 173 | 6558| 11034| 14 | 9  | 176| 24 | 4  | 43 | 18472|
| 201704  | 19 | 20 | 10 | 41 | 4  | 4  | 177 | 112 | 5118| 10430| 17 | 9  | 172| 22 | 7  | 2  | 1827|
| 201705  | 28 | 29 | 11 | 24 | 8  | 170 | 82  | 5900| 7779| 11  | 21 | 122| 48 | 6  | 14298|
| 201706  | 24 | 72 | 38 | 80 | 13 | 171 | 202 | 6452| 11060| 7  | 12 | 676| 96 | 1  | 13 | 1827|
| 201707  | 44 | 44 | 33 | 52 | 8  | 113 | 97  | 3323| 6540| 43  | 18 | 346| 74 | 9  | 10734|
| 201708  | 51 | 60 | 31 | 26 | 13 | 221 | 120 | 3504| 6825| 16  | 45 | 21 | 140| 32 | 17 | 10248|
| 201709  | 18 | 34 | 6  | 11 | 9  | 1  | 173 | 82  | 2577| 4548| 13 | 9  | 34 | 10 | 1  | 7038|
| 201710  | 13 | 34 | 6  | 26 | 3  | 3  | 165 | 123 | 3620| 7635| 22 | 6  | 76 | 16 | 15 | 11763|
| 201711  | 25 | 12 | 22 | 7  | 10 | 2  | 199 | 106 | 4956| 8776| 12 | 8  | 52 | 5  | 1  | 14193|
| 201712  | 12 | 16 | 10 | 10 | 2  | 4  | 193 | 119 | 3698| 5548| 8  | 3  | 64 | 16 | 15 | 9918|
| 201801  | 15 | 15 | 20 | 16 | 170 | 152 | 4850| 6646| 1  | 5  | 62 | 12 | 18 | 11958|
| 201802  | 10 | 4  | 17 | 11 | 4  | 296 | 186 | 6193| 10409| 3  | 50 | 12 | 6  | 5  | 17206|
| 201803  | 10 | 8  | 19 | 8  | 4  | 193 | 120 | 4511| 8186| 3  | 3  | 80 | 34 | 8  | 9  | 13399|
| 201804  | 18 | 18 | 13 | 6  | 151 | 163 | 2356| 5120| 10 | 42 | 10 | 7  | 324 |

Evolution of Moldova System Concepts 0-19 over the time between 12/2016-5/2018
Conclusions

• Qualitative Systems Models can be converted to Quantitative models with collaboration between SMEs and quant researchers

• Data integration must be iterative with the final analysis

• Systemigrams can be measured and analyzed based on OSINT data sources
Thank you!

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