Advancing *System of Systems Dynamics (SoSD)* in the Cyber Intelligence (CYBINT) domain

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Introduction #1

- Offer response to contemporary CYBINT challenge(s)
- Further develop frameworks + related concepts = for advancing System of Systems Dynamics (SoSD) in Cyber Intelligence (CYBINT) domain in globalised circs.
- Build on ‘System of Systems Analysis’ (SoSA) approaches >>> offer a joined-up comprehensive systems-based approach
- Help subsequent ‘System of Systems Engineering’ - (SoSE) efforts - i.e. ‘mission accomplishment’ thru transforming devs + to better capture enterprise-relevant characteristics, notably the SoSD involved.
- Aim = for realising greater contextualisation potential relating to CYBINT missions + in closely assoc. areas beyond.
Introduction #2

- Throughout **maintain focus on:**
  - **sustained delivery of intelligence reqs of ‘3Rs’ =**
    - ‘getting the **right intelligence/information**, to the **right person/people,** at the **right time**’ +
  - **Continuing to simultaneously better meet + consistently sustain over time in cyber enterprises >> all of highly-pressing customer/end-user intelligence delivery criteria of ‘**STARC’ =** ‘Specificity, Timeliness, Accuracy, Relevance and Clarity’**

- **Esp. pressing reqs to realise during contemporary ‘Big Data’ + ‘Cyber’ age - esp. where areas, e.g. ‘attribution’ in cyber contexts = remain difficult.**
Introduction #3

• Conclusions = designed to offer overall suggestions >>>
potential viable utility in CYBINT work - however precisely configured/ calibrated/scaled (spatially/temporally).

• Esp. while **wide-range of practitioners** strive to navigate several **multi-functional operations (MFOs)** ranging from ‘war’ to ‘peace’ + cover full-spectrum of diverse concerns, e.g.:

  ➡ crisis management, peacekeeping and humanitarian operations, counter-insurgency (COIN), counter-terrorism (CT), counter-proliferation, and the countering of transnational organised crimes, etc.

• Simult. as all above MFOs = occurring in **both virtual (cyber) + physical (sea, air, land, space) domains** during overall era of **globalised strategic risk (GSR)** + unfolding in ‘complex co-existence plurality’ (CCP) environments.

• Ultimately, a **constant feedback process of ‘context appreciation’ + ‘solution fashioning’** = important.
5x domains of activity, with cyber(space) linking:
Current positions #2

• **Recap/summary:** Currently use/rely on **SoSA** approaches, breaking-down ‘problems’ in op. spaces into readily graspable different dimensions of, e.g.:
  
  • ‘PMESII’ (‘Political, Military, Economic, Social, Informational and Infrastructural’), e.g. used by NATO;
  
  • ‘PESTLE’ (Political, Economic, Sociological/Social, Technological/Technology, Legal/Legislative, Environmental), e.g. used by EUROPOL;
  
  • ‘DIME’ (Diplomatic, Information, Military, Economic);
  
  • ‘HSCB’ (Human, Social, Cultural, Behavioural), e.g. as both used by US Military;
  
  • ‘STEEP(L)’ (Social, Technology, Economic, Environmental, Political, [Legal]), e.g. as used in commercial/business intelligence contexts, etc.

• + rather than **subsumed singly within one** of these categories >>> CYBINT domain **involves all different dimensions collectively + needs to** for best capture + tackling of problems, challenges, etc.
Current positions #3

Depiction of System of Systems Analysis (SoSA) - figure IV-2 from US Joint Chiefs of Staff, J-P 3.0 (Aug. 2011), p.IV-5 (my additions)

The Interconnected Operational Environment

- (inc. society/cultural/human factors)
- (inc. intelligence dimensions)
- (inc. resources, supply and technology factors)
- (inc. commercial/industry issues)
- (inc. policies and strategies, government ministries/agencies, etc.)

Figure IV-2. The Interconnected Operational Environment

Legend:
- COG: center of gravity
- DP: decisive point
- COG Node
- Node
- Link
Pathways forward #1

- Found: SoSA approaches *alone* = not adequate
- Many different approaches = instead proposed.
- Most viable = **Build on SoSA approaches + better harness SoSE** approaches in CYBINT domain.
  - e.g. Use ‘target-centric’ intelligence analysis approach - cf. Robert M. Clark
  - Got to **keep qualitative + ‘human factors’** well inside the overall CYBINT loop.
- Advance **interconnected, joined-up ‘systemic’ model** = helpful for subsequent **SoSE + synthesis + sense-making efforts**.
- Namely, advance a **‘SoSA+SoSE’ (SoSD) approach**
Pathways forward #2

- That last **SoSD model** inc. covering 8x systemic attributes or variables:
  1. internal influences/factors;
  2. rationale;
  3. types + forms;
  4. conditions + terms;
  5. trends;
  6. functions;
  7. external influences/factors; +
  8. effects + outcomes.

Pathways forward #3

- + inc. covering 8x levels of (inter-)activity/implementation:
  1. Ideological
  2. Theoretical
  3. Strategic
  4. Policy
  5. Operational
  6. Tactical
  7. Individual (as ‘professional’)
  8. Personal

- + ack. ‘Reach’ concepts >>> ‘under-reach’ + ‘over-reach’

- Need realise ‘optimised reach balance(s)’ in CYBINT enterprises

(cf.A.D.M. Svendsen (2012), Understanding the Globalization of Intelligence, e.g. p.12, etc. + A.D.M. Svendsen (2012), The Professionalization of Intelligence Cooperation.)
Pathways forward #4

+ inc. covering geospatial = physical, not just virtual dimensions of cyber - e.g. as given in this figure.

• Captures ‘M4IS2: multiagency, multinational, multidisciplinary, multidomain information sharing and sense making’, which ranges across ‘eight entities [of] commerce, academic, government, civil society, media, law enforcement, military and non-government/non-profit.’ (Segell, 2012)

• Shows importance of + doing RESINT + COLINT in CYBINT.
### Fusion approach #1

Overall ‘Situational Awareness’ Evaluation (SoSA/G-J2)

**CONTEXT APPRECIATION** - Observe + Orient

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This matrix is designed to provide an analytic framework with **core - even checkbox - criteria or variables to consider** into which evaluators can record as holistically as possible - e.g., through mapping - what they observe from, e.g., a selected case/issue/problem, etc.

This approach enables the **comprehensive capturing** of - if not all - at least several different aspects of an event/episode, issue, etc., in its **varying key dimensions**.
## CYBINT ANALYSIS INSIGHTS

### FUSION EXAMPLE: ISIS

**Overall ‘Situational Awareness’ Evaluation (SoSA/G-J2)**

**CONTEXT APPRECIATION - Observe + Orient**

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<tbody>
<tr>
<td>Political (inc. law/legislation)</td>
<td>Sharia law / alternative hierarchies</td>
<td>Unrep. elsewhere/power-play</td>
<td>Strong leadership</td>
<td>Fill governance vacuum</td>
<td>Exploiting Iraq/Syria weaknesses</td>
<td>Ruthless / kill off opposition</td>
<td>Sympathisers</td>
<td>Imposing regime</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>Tight, well-disciplined C2</td>
<td>Got weapons / tactics</td>
<td>e.g. Heavy +automatic weaponry</td>
<td>Succeed vs. weaker/disorg. oppo</td>
<td>Good at capturing; less so at holding?</td>
<td>Agile / flexible / fast-lightfoot</td>
<td>Ex-military personnel</td>
<td>Competent committed adversary</td>
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<tr>
<td>Economic</td>
<td>Profitable/employed</td>
<td>Make profit - e.g. oil</td>
<td>Steady supply funding</td>
<td>Exploit existing/new markets</td>
<td>Exploiting oil-refineries</td>
<td>Able to sell, e.g. oil</td>
<td>Resp to consumer demands</td>
<td>Self-sustaining/autarky?</td>
<td></td>
</tr>
<tr>
<td>Social (inc. sociological + cultural)</td>
<td>Camaraderie/purpose</td>
<td>Romance</td>
<td>Bonding/band-bros/marriage</td>
<td>Links/ties - e.g. friends/passions</td>
<td>Native + Foreign fighters</td>
<td>Quasi-religious/smashing activities</td>
<td>‘Call of the wild’/share adventurism</td>
<td>Soft + not just hard factors</td>
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<tr>
<td>Informational/Intelligence (inc. technological)</td>
<td>Good / social media / BYOD</td>
<td>Able to influence</td>
<td>Social media/propaganda</td>
<td>INFO/PSYOPS = work</td>
<td>Use internet - e.g. Twitter</td>
<td>Access to electronic devices</td>
<td>Acquiescence support thru intimidation</td>
<td>Shifting frames of reference</td>
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<tr>
<td>Infrastructural (inc. environment/all)</td>
<td>Good networks/comms</td>
<td>Can seize/control/trade/ego</td>
<td>Training camps/bases</td>
<td>Using what is there - e.g. roads...</td>
<td>Urban/settled/travel-able areas</td>
<td>Travel on roads / oil refinery use</td>
<td>Unwitting (?) private service prov</td>
<td>Too depend on what have already?</td>
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</tbody>
</table>

**N.B.: main CYBINT concerns not isolated from the other aspects encounter need to consider more widely**
Fusion approach #2

Overall ‘Mission Accomplishment’ Guide (SoSE/G-J3)
SOLUTION FASHIONING - Decide + Act

<table>
<thead>
<tr>
<th>SoSA units (e.g. PMESII) &gt; ‘Levels’ (of interactivity/implementation/engineering):</th>
<th>Political (inc. law/legislation)</th>
<th>Military</th>
<th>Economic</th>
<th>Social (inc. sociological + cultural)</th>
<th>Informational/Intelligence (inc. technological)</th>
<th>Infrastructural (inc. environment[al])</th>
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<td>Ideological (e.g. Ideas/Why realise?)</td>
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<td>Theoretical (e.g. Aspirations/Why do?)</td>
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<td>Strategic (e.g. Directions/How go?)</td>
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<td>Policy (e.g. Aims/Where go?)</td>
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<td>Operational (e.g. How/What realise?)</td>
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<td>Tactical (e.g. How/What do?)</td>
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<tr>
<td>Individual (as ‘professional’) (e.g. What/Which realise?)</td>
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<td>Personal (e.g. Who do?)</td>
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Deliverable work filling/completing this matrix (+ the one given on prev. slide) can be done 'live' - e.g. in a real battlespace/operational context (‘pre-flight’ style); or equally can be done more 'off-line' + in the abstract - e.g. during a simulation/training/exercise in the classroom.

Overall, these matrices form useful analytical frameworks + educational teaching tools, also helping to advance standards + best practices in approaches towards situation evaluations + subsequent transformation.

Also suggests where ‘to draw the line’ in relation to issues, e.g. privacy, etc.

Privacy buffer
**Fusion approach #3**

Fusion grid = mapping System Attributes/Variables + Levels for each specified SoS unit of analysis* - e.g. using PMESII model: Political; Military; Economic; Social; Informational/Intelligence; Infrastructural (*show which is selected for focus)

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This third chart (table) for mapping allows for ‘triangulation’ to be undertaken, e.g. with the results from the other two previous charts, during overall ‘fusion’ activities.
## Fusion approach #4

### OVERVIEW SNAPSHOT SUMMARY

At a minimum for context consider + fuse:

<table>
<thead>
<tr>
<th>(A) ‘Key Actors’ - e.g. who?</th>
<th>(A1) Events - e.g. what? when? where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. OC groups, individuals, other ‘targets’, etc.)</td>
<td>(A2) Patterns - e.g. how?</td>
</tr>
<tr>
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<td>(A3) Drivers - e.g. why?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(B) ‘forces/factors of change’ - e.g. what activity?</th>
<th>(B1) Events - e.g. what? when? where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. SOC areas, etc.)</td>
<td>(B2) Patterns - e.g. how?</td>
</tr>
<tr>
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<td>(B3) Drivers - e.g. why?</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>(C) ‘possible change over time’ - e.g. when? / where?</th>
<th>(C1) Events - e.g. what? when? where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. environment, PESTLE/PMESII [SoSD] indicators, SWOT, etc.)</td>
<td>(C2) Patterns - e.g. how?</td>
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<td>(C3) Drivers - e.g. why?</td>
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</tbody>
</table>

Aim = capture: (i) the **players**; (ii) their **relationships**; (iii) their **drivers** (e.g. their **means, motives & opportunities**).
Fusion approach #5

Generation of ‘Signifier Node(s)’ for positioning on triage-related/colour-coded ‘indicator board(s)’ = for context appreciation + situation awareness generation >>> help for making where next + response decisions
Conclusions #1

• Arguably ‘SoSA+SoSE’ (i.e SoSD) approach advanced here in CYBINT domain >>> better:

  (i) captures enterprise-relevant ‘intelligence dynamics’ - e.g. info flows, cybernetic ‘feedback-loop’, networked dimensions, etc. - found in CYBINT work; +

  (ii) joins up the many different ‘systems’ involved +
    encountered during MFOs (+ not just in cyber domain) in overall virtual + physical GSR and CCP environments.

  (iii) ‘fills the/any gaps’ + offers greater contextualisation of CYBINT-related full-spectrum-ranging issues, problems, hazards, risks + threats.
Conclusions #2

- Integrated/joined-up/comprehensive CYBINT ‘SoSA+SoSE’ (SoSD) approach =
  - Helps meet ‘mission accomplishment’ ends - e.g., transform developments + better keep ‘ahead curve of events’ proactively.
  - Can be readily overlaid with other (perhaps more familiar) approaches - e.g. OODA Loop, etc.
  - Encourages greater ‘thinking outside of the box’ in CYBINT-related enterprises.
  - Assists in/with both collection + analysis in overall enterprises - e.g. better refines gathering platforms/sensors focus, tasking + targeting, etc.

Key Takeaway:

1. Basic SoSA units of (e.g.) PMESII (etc.) = good starting place
2. ‘situational awareness’
3. ‘mission accomplishment’/meeting/achieving ‘goals’
4. Constant feedback loop process (1-2-3-1-...)
Conclusions #3

- Generally, grander strategic + architectural + shaping approaches - inc. greater structural + cultural efforts = esp. pressing:

  (i) during our contemporary ‘Big Data’ + ‘Cyber’ (writ large) age +

  (ii) when experiencing much ‘sensory’ + other conditions of ‘information/data overload’ +

  (iii) as do more ‘Collective Intelligence’ (COLINT) while scrutinised more by more involved public +

  (iv) while continually subjected to, e.g., ‘Snowden-related’ allegations (or so-called ‘revelations’) + assoc. mis-/distrust; +

  (v) as related challenging ‘legalisation’/‘legalism’ trends extend >>> ‘Smart-Law’ to instead needing advancement = better weighing Soft/Hard Law dimensions.
Next steps & learn more:


‘The Intelligence-domain System of Systems Dynamics Reference Content (SoSD)’ research project - an innovative partnership between the Global University Alliance (www.globaluniversityalliance.net) + the Copenhagen Institute for Futures Studies (www.cifs.dk) = focuses on System of Systems Dynamics (SoSD) in CYBIN + other INT domains: www.cifs.dk/en/gua.asp / Reuters ResearcherID: www.researcherid.com/rid/D-9577-2015