Plenary Discussion Notes – Session 7

Visualising Networks

Discussion ranged widely, and the following is a gist of some of the topics mentioned. It is neither exhaustive, nor in order. We have rearranged topics sequentially for the sake of presentation logic.

There are several categories of networks: social, physical, knowledge. A taxonomy is needed to cover the many different networks. Networks seem broadly to fall under three major categories:

- Physical [e.g., railways, roads, gas lines, human circulatory system];
- Logical/electronic/virtual [e.g., social, computer networks, CNS]; and
- Referential [e.g., conceptual, immunities].

Referential networks are relations of concepts or thought, usually in an abstract, diffuse matrix. They relate to knowledge management or cultural & intellectual ideology, among many other possibilities. An immune system, e.g., relates a set of known target pathogens with a set of mechanisms to deal with them.

- The intersections of separate, possible disparate networks form sets that can be of critical importance. Intersections vary by the networks' nature:
    - Intersections may be between or among the same *sort* of network [physical networks, [roads and railways, e.g. or logical--email contacts may correlate with financial transactions significantly.]; and
    - Different sort[s] of network [physical **with** logical, say [emails may indicate a terror cell--where physically are the mailing computers?].
- Interrelations between individual events are frequently of interest:
    - Within a network [as a money transfer that triggers a significant event;
    - Between or among different networks e.g., between roads and railways--constriction on one may cause congestion on the other; and
    - Cyber networks may require geospatial information. Physical actions may impact a logical network's state – e.g. Something has cut an optical cable link. Where is the break located?
- Intercausal events among disparate networks, e.g. transport, communication, social - where an event on one may have an impact on another--e.g., was the break in the optical cable [above] near a rail link, e.g., or a road? Also consider links among several disparate networks for planning logistic operations.

  We can understand the forms of linkage between different physical nets and perhaps among some logical nets, but what about referential nets?
    - Do we know important linkages between forms of network--physical to logical? Is a taxonomy of intersections and interactions needed?
- Automation can be used to reduce clutter, but automation may not solve the problem, esp. in a novel situation. One discussant said, "Unless you can visualize all the threats, it causes stress in the observer

when unexpected things occur. Visualising the unexpected is a major issue; it includes coordination of apparently unrelated views."

- Data needs are task dependent: data needs are different for (e.g.) pursuing a prosecution than for alerting to a potential threat [keeping the event from happening.] Real-time modelling requires different criteria from post-hoc analysis
    - Does the actor know what data he needs?
    - Is the information up to date?

- Can you make a bad thing in one [form of] network look like a bad thing on another?
    - Visualisation of networks: The strong suggestion emerged that NATO proceed to develop or at least consider developing means to create visual presentations of networks taken generically , so that as standardized as possible a picture is done for disparate networks--one sort of picture per one network, or even one sort of network is impractical. This suggests working towards a set of standards for network visualization?, but that raises the problem of standardization v. expediency:
        - A company has a new idea which has commercial appeal and develops its own proprietary "standards" to allow its idea to be implemented. This will inevitably run counter to any standardization process and will eventually either lead to total homogeneity or an inability to incorporate information from other networks into the visualization process. Standardization too early prevents new ideas and paradigms from being addressed.
    - What is inside the network and what is in the environment? It is important, depending on the role and focus of a user, to be able to divide the universal network space into "own network" and the "outside world" (environment). Salient features of the outside world should be visible when needed - e.g. alerting issues but the primary focus will be within "own network". The interface issues between "own network" and "outside world" are matters for significant investigation.
    - Tunnelling (drill down) depends on role the task attempted.
    - Audio is an augmenter of perception [or can be], especially for anomalies in computer network operations.

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- Link modelling: Real-time modelling requires different criteria from post-hoc analysis.