Unintended Consequences of the Network-Centric Decision Making Model: Considering the Human Operator

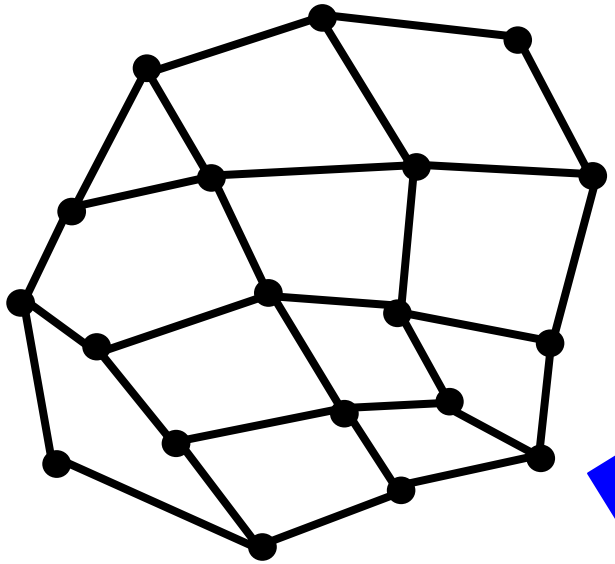
Robert S. Bolia
Michael A. Vidulich
W. Todd Nelson
Air Force Research Laboratory
Wright-Patterson AFB, OH

The Wisdom of History

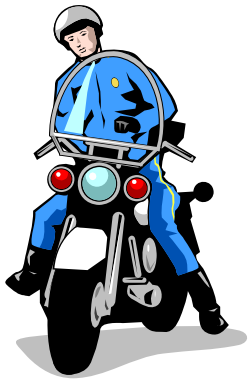
All in war is very simple, but the simplest is difficult.

- Carl von Clausewitz, *On War*

Promises of NCW



Shared SA



Speed of Command

Self-Synchronization

Challenges to NCW Thesis

- Lack of novelty
- Questionable foundations
  - Mathematics
  - Business model
  - Epistemology
- Technological immaturity
- Countermeasures (inattention to military history)
- Subversion of defense acquisition paradigm
- Human factors issues…

Human Factors Laundry List

- Interpretation of the Common Operational Picture
- Information, Uncertainty, and their Display
- Automation and its Accidental Consequences
- Perturbing the Levels of War
- Obfuscation of Authority and Responsibility
- Teamwork and Distributed Collaboration
- Training and Selection

Interpretation of the COP

- COP → shared SA → self-synchronization
  - 21st century version of *Auftragstaktik*
  - Moltke's commanders at Königgrätz
  - Nelson's captains at the Nile
  - Shared SA requires a shared mental model

Interpretation of the COP

- **What is the shared mental model?**
  - ***Is it the COP?*** **No!**
    - **The COP is theoretically a picture of the *current* situation**
    - **The COP must be interpreted in the context of the shared mental model**
  - ***Then what is it?***
    - **Doctrine**
    - **Intelligence**
    - **Commander's Intent**

Interpretation of the COP

- **Indoctrination of the shared mental model**
  - **For Moltke, a shared mental model meant that commanders at every level of the command chain shared *his* mental model**
  - **Inculcated by exposure:**
    - **Training**
    - **Staff tours**
  - **Problems with this**
    - **Little joint training**
    - **Even less coalition training**
    - ***Ad hoc* nature of modern coalitions**

Interpretation of the COP

- **More questions**
  - **Does a shared mental model imply shared SA?**
  - **Does shared SA imply a shared mental model?**
- **Answers by illustration**
  - **Two commanders may arrive at the same interpretation of the COP without having a shared mental model**
  - **Two commanders may decide to attack the same target based on different (and even contrary) interpretations of the COP, which will look superficially like self-synchronization**
- **False assumptions**
  - **A shared mental model will lead to a shared interpretation of the COP**
  - **A shared interpretation of the COP will lead to a shared interpretation of *the* correct course of action**

A Word on the Philosophy of SA

- **Philosophical dispute**
  - **Team SA: all team members have the SA they need to perform their individual tasks (Endsley, 1995)**
  - **Shared SA: some component of the SA must be shared among one or more subsets of team members**
- **Practical implications**
  - **Measurement:** $SA_{Team} = \sum_i a_i SA_i$

    vs

    $$SA_{Team} = \prod_i \left(SA_i + a_i \right)$$

    vs

    $$SA_{Shared} = \bigcap_i SA_i$$
  - **Design: the technology by which we display and share the COP must be designed to support the appropriate flavor of SA**

Information, Uncertainty, and their Display

"*Power to the edge* is the result of technological advances that will … eliminate the constraint of bandwidth, free us from the need to know a lot in order to share a lot, unfetter us from the requirement to be synchronous in time and space, and remove the last remaining technical barriers to information sharing and collaboration."

– John Stenbit, ASD (NII)

"War is the territory of chance. No other human activity gives this stranger so much room to maneuver, because no other has on all sides such constant contact with him. Chance multiplies the uncertainty of all circumstances and interferes with the course of events."

– Carl von Clausewitz

"I believe that the computer revolution … presents us with a unique opportunity to "lift the fog of war" and transform the US military."

– Admiral Bill Owens, USN (Ret.)

Information, Uncertainty, and their Display

- NCW theorists suggest that historically commanders have been hampered in their ability to make good decisions by lack of information
- Assumption 1: More Information is Better
  - Information Overload
  - Historical counterexamples demonstrate that even with sufficient information human decision makers are liable to misinterpretation based on inappropriate mental models
    - Battle of the Bulge: preparations for a German attack revealed by Enigma decrypts but not believed
    - Yom Kippur War: all intelligence suggested attacks by Egypt and Syria but did not fit model held by Israeli commanders

Information, Uncertainty, and their Display

- **Assumption 2: Quantity over Quality**
  - **Clausewitz again: "A greater part of intelligence reports that one receives in war are contradictory; a still greater part are false, and nearly all are subject to uncertainty."**
    - **Deception: filling the network with illusory tracks**
    - **Compromised data due to faulty sensors or imperfect processing**
    - **The illusion of completeness leads to the inevitable epistemological question: *How do we know what we don't know?***

Automation and its Accidental Consequences

- **Automation as a means of reducing the workload of the human decision maker**
  - **Data fusion**
  - **Entity tracking**
  - **Decision support**
- **Human performance effects of automation have been investigated extensively**
  - **Changes the perceptual and cognitive demands of the operator**
  - **Leads to skill degredation**
  - **"Trust" as an issue in human interaction with automated systems**
    - **Undertrust in Automation: Operators used to working with manual systems will not always trust automation, leading to excessive drill-down and hence *longer* decision times**
    - **Overtrust in Automation: Operators will fail to detect errors in highly reliable systems**

Perturbing the Levels of War

- Military theorists distinguish three "levels of war"
  - Strategic
  - Operational
  - Tactical
- Consequences of decisions at each level vary in magnitude
- Decision authority is conferred based on rank and, implicitly, expertise
- Different model of decision making at each level
  - Strategic ≈ Rational evaluation of COAs
  - Tactical ≈ Recognition-primed decisions
  - Operational ≈ Mixed-model

Perturbing the Levels of War

- The concept of *Power to the Edge* implies at least a compression of the traditional hierarchical command chain, at most a subversion of it
- The network-centric emphasis on speed of command suggests a collapse toward the tactical level
- Implications
  - Expertise
    - Burnsides, 1862
    - Hooker, 1863

  - Automated decision support is predicated on the existence of a validated model of decision making

Blurred Authority and Responsibility

- **NCW allows decisions to be made at inappropriate levels**
  - **Operational level commanders will have the information they need to make tactical decisions (micromanagement or "decision up-creep")**
    - **Circumvents normal command chain**
    - **Contrary to the doctrine of *Auftragstaktik***
  - **Tactical level commanders will have the information (if not the authority) they need to make decisions that have operational or strategic consequences**
- **Distribution of decision making allows distribution of responsibility ("Pervasive Buck Passing")**

Teamwork and Distributed Collaboration

- **NCW calls for distributed teams**
  - **More difficult to build trust**
  - **Leadership issues**
  - **Development of shared mental model / comprehension**
- **NCW enables but also *requires* better communications and collaboration**
  - **Sharing of knowledge**
  - **Sharing of intent**
  - **Clarification**

Selection and Training

- Training
  - How do we train shared mental models?
  - How do we train junior officers to make tactical decisions with strategic consequences?
  - How do we train operators to trust their distributed colleagues?
- Selection
  - “Strategic Corporal” has arguably less education but more responsibility
  - Little or no research into personnel selection in this area

Conclusion

- **NCW theorists have provided a vision that is *network*-centric, but warfare is *human*-centric**
- **Human operator needs to be accounted for before NCW can reach fruition**

"Warfare is not 'network centric.' It is either 'people centric' or it has no centre at all."

—Lt Gen William Wallace, USA

Questions