12TH ICCRTS
ADAPTING C2 TO THE 21ST CENTURY

Case-Studies of Decision Support Models for Collaboration in Tactical Mobile Environments

Track 7: Network-Centric Experimentation and Applications

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Objective

- Explore the structure of decision making processes observed in result of applying collaborative technology to the selected network-centric tactical scenarios:
  - Collaboration on High-Value Target (HVT) tracking with Light-Reconnaissance Vehicle (LRV) as mobile command center,
  - Collaboration with multiple Unmanned Aerial Vehicles (UAV) Ground Station crews in HVT and Intelligence, Surveillance, and Reconnaissance (ISR) missions
  - Collaboration in Maritime Time Interdiction Operations (MIO),
  - Collaboration in the Emergency Relief Operations.

Major Research Question:

The major question we were trying to address in this study is which of three main decision making cycle models:

-Simon’s problem solving model (Simon, 1979)

-Boyd’s OODA Loop (see Hammond, 2001, Coram, 2002), and

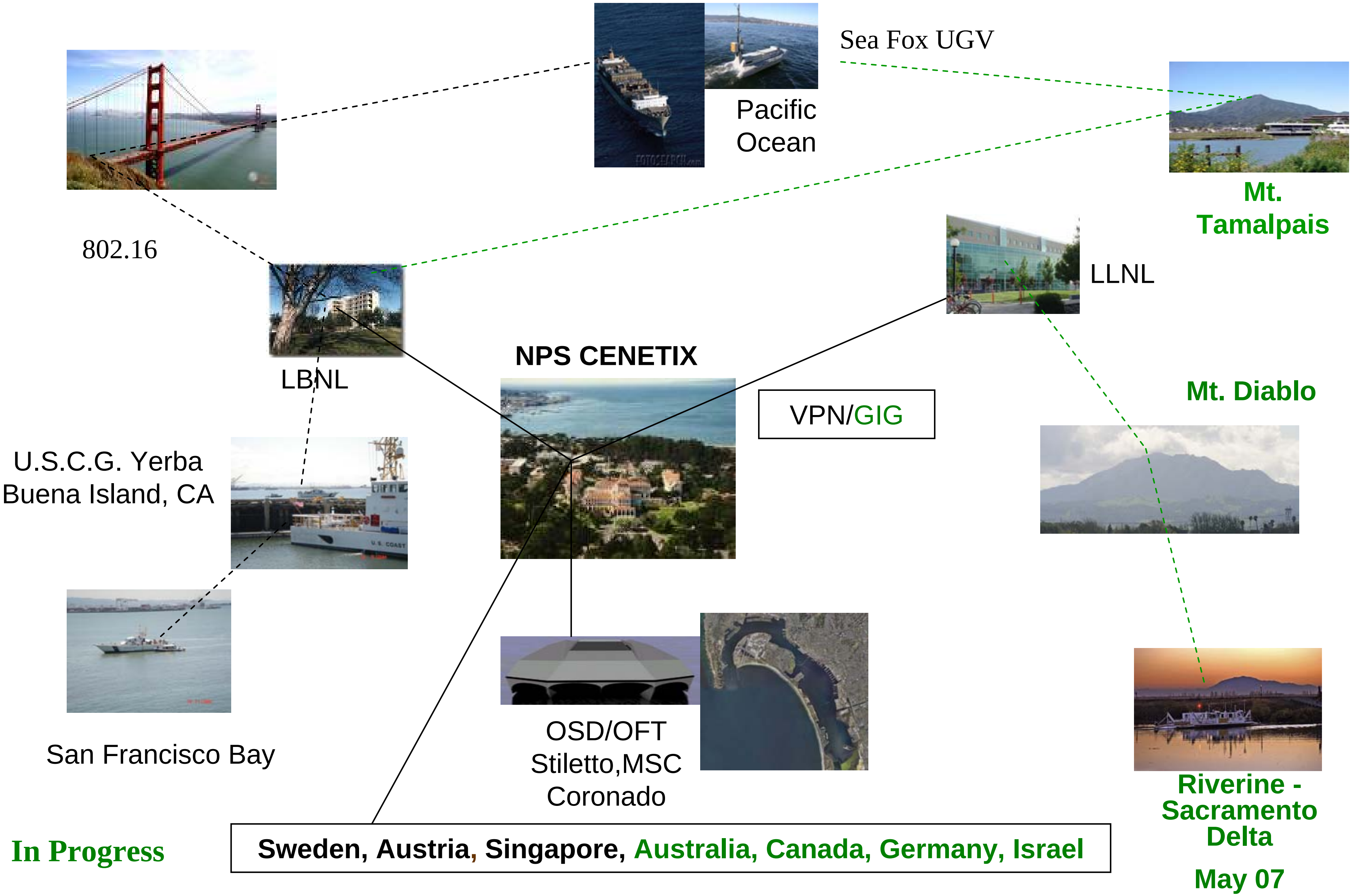
-Albert’s and Hayes’ Collaboration Significant Influences model (Albert and Hayes, 2006),

fits best into the tactical collaboration scenarios

TNT Testbed: Plug-and-Play 24/7 Student Operated Research Tactical Network

- Enables to evaluate the use of networks, advanced sensors, and collaborative technology for conducting rapid ISR, HVT, and Maritime Interdiction Operations
- Provides several layers for integrating models, tools, and experimentation procedures for research teams.
- Users can connect their remote local area net-work, including command and operation centers, via the virtual private network (VPN) and peer-to-peer collaborative environment
- Sensors and unmanned vehicles can be added via the situational awareness environment data channels (CoT, Aware, CAP)

USSOCOM - NPS
Field Experimentation Cooperative
Tactical Network Topology Testbed - MIO



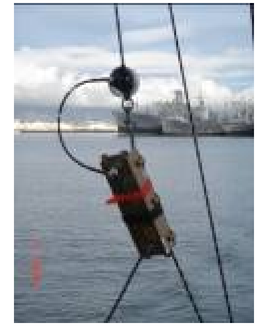
Collaborative Network: HVT and MIO Examples

Collaboration in HVT Scenario: Four UAVs are streaming video, TOC feedback is needed immediately

Maritime Interdiction Operations

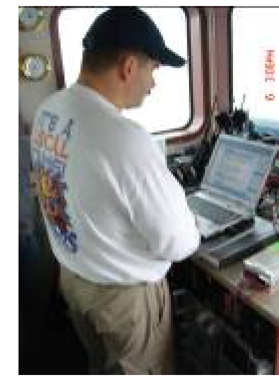
Initial Detection of Potential WMD

Boarding Party Arrival at Target

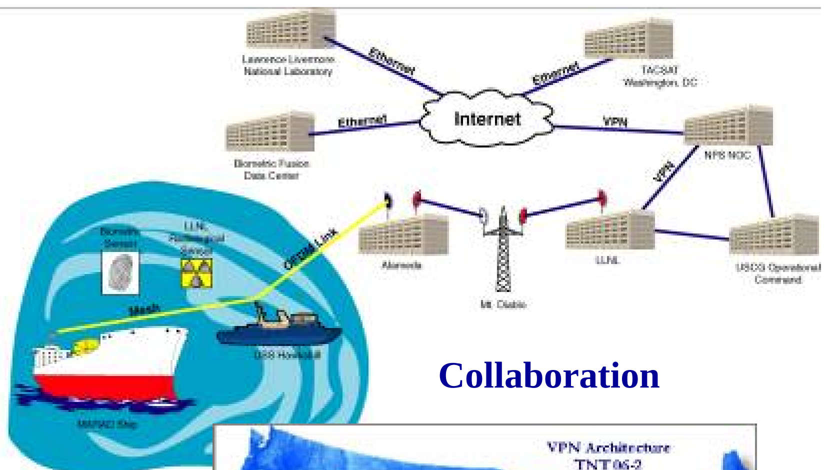


Rapid 802.16 Network Deployment

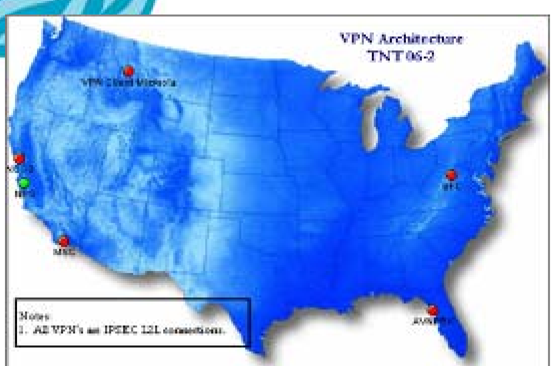
- <u>Wireless Network Technologies</u>
- <u>Agile, Adaptive Networks</u>
- <u>Ship-Ship , Ship-Shore links</u> for exfiltration of data to reach-back centers (802.16, 802.20, VPN-Internet/Satellite, Xtar X-band SATCOM)
- Ship self-forming network based on ITT mesh solution
- <u>Ultra-wide band and/or low-frequency communications from within vessel or structure</u>
- Iridium and Quad-Iridium
- Drive-by radiation detection, networking, and collaboration with boarding and target vessels on the move
- Self-aligning OFDM antennae for ships on the move – robust directional comms

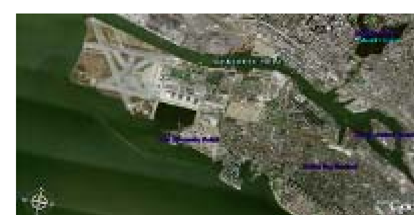


Boarding Party Collaboration with Remote Sites

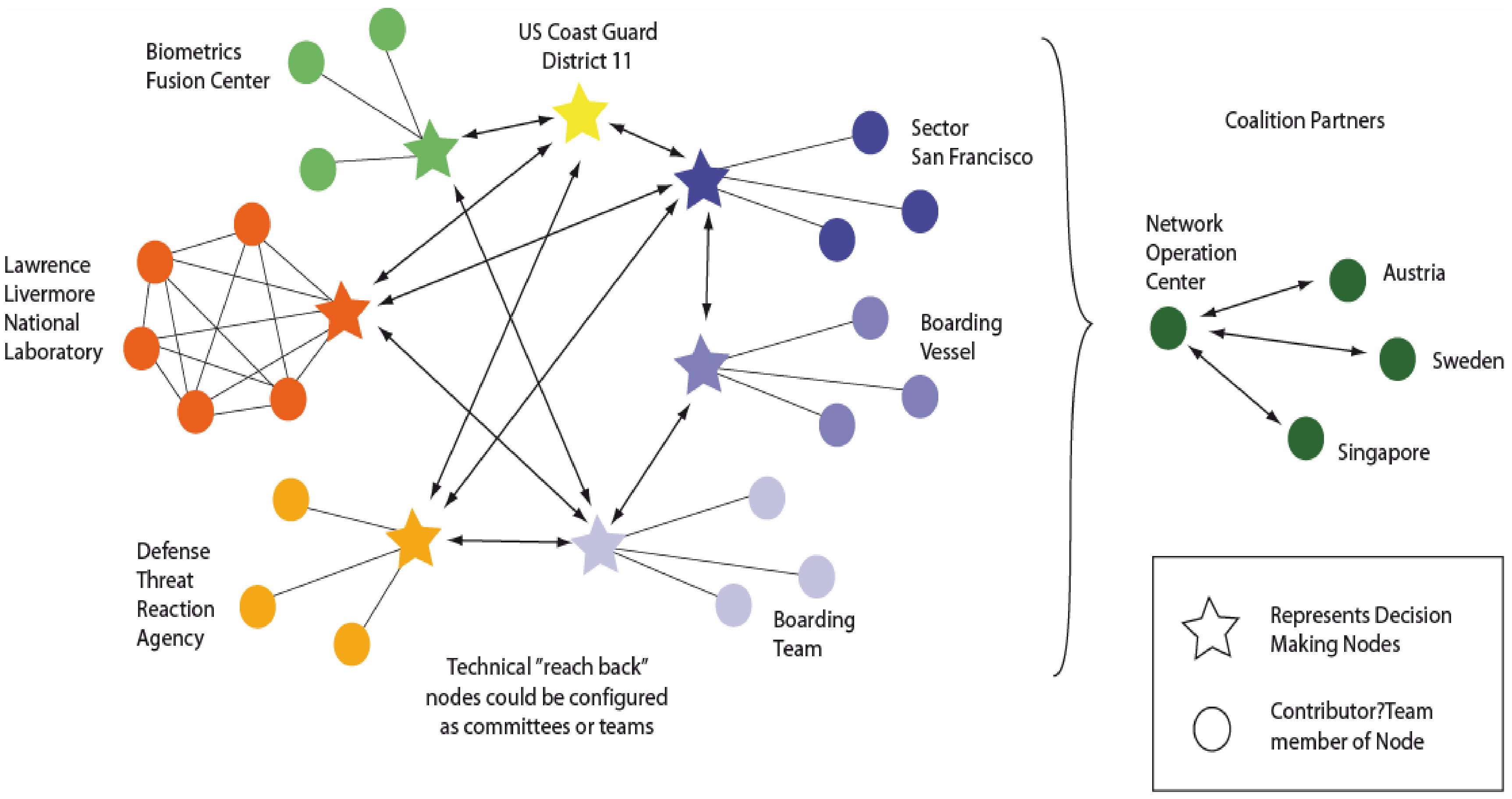


Collaboration

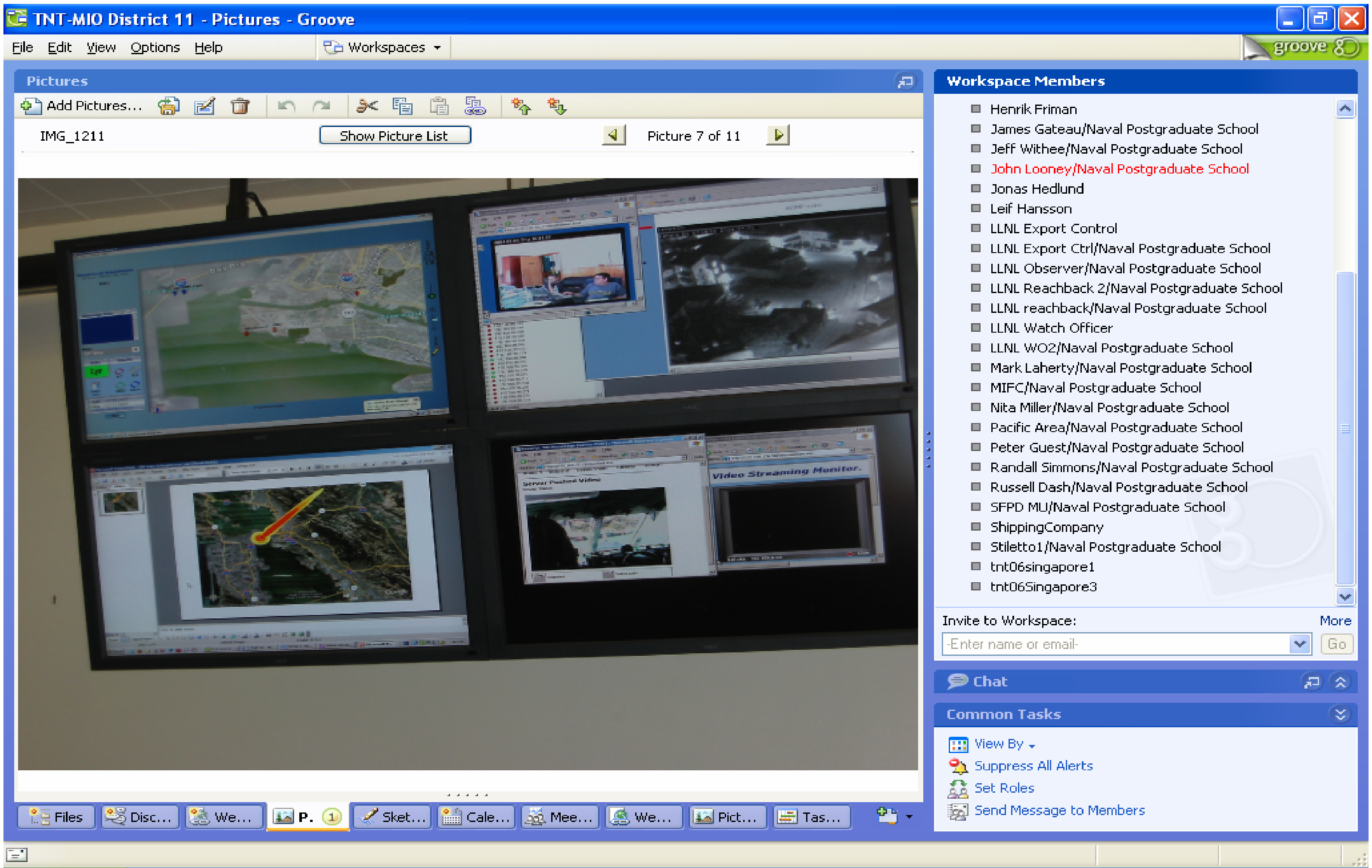




MIO 06-4 Collaborative Network



Boarding Party Situational Understanding Development via Collaboration with Expert and Command Remote Sites



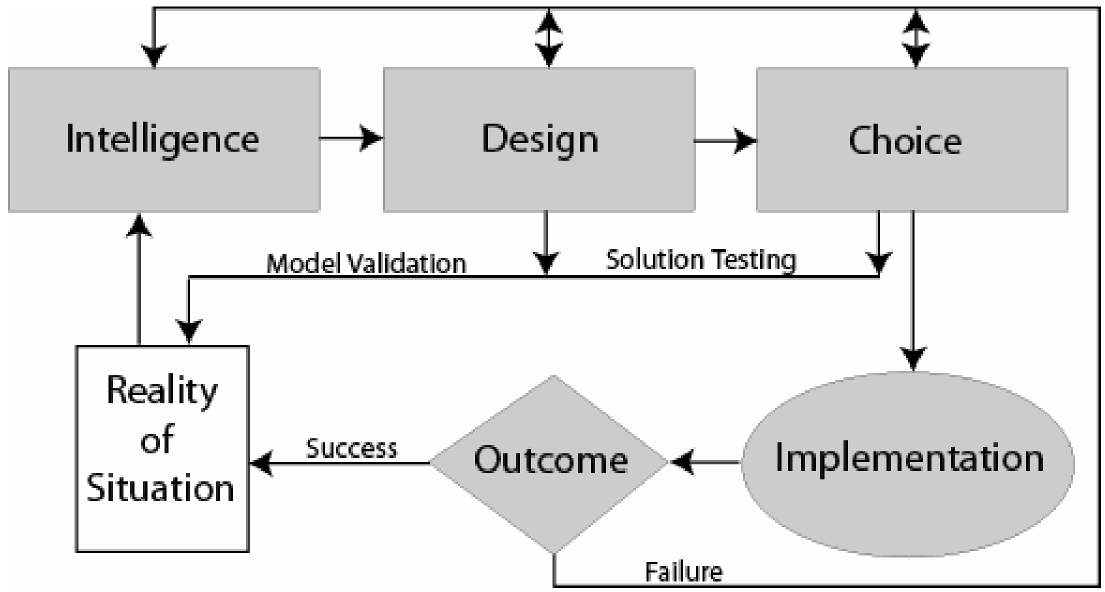
Mapping Collaborative Tasks to Major Decision Support Models

- Using a systematic approach, team of NPS students (Creigh, Dash, and Rideout, 2006; Pena and Withee, 2006) researched the TNT archives of previous CT usage in support of MIO and HVT experiments between multiple agencies and organized pertinent data for qualitative and quantitative analysis.

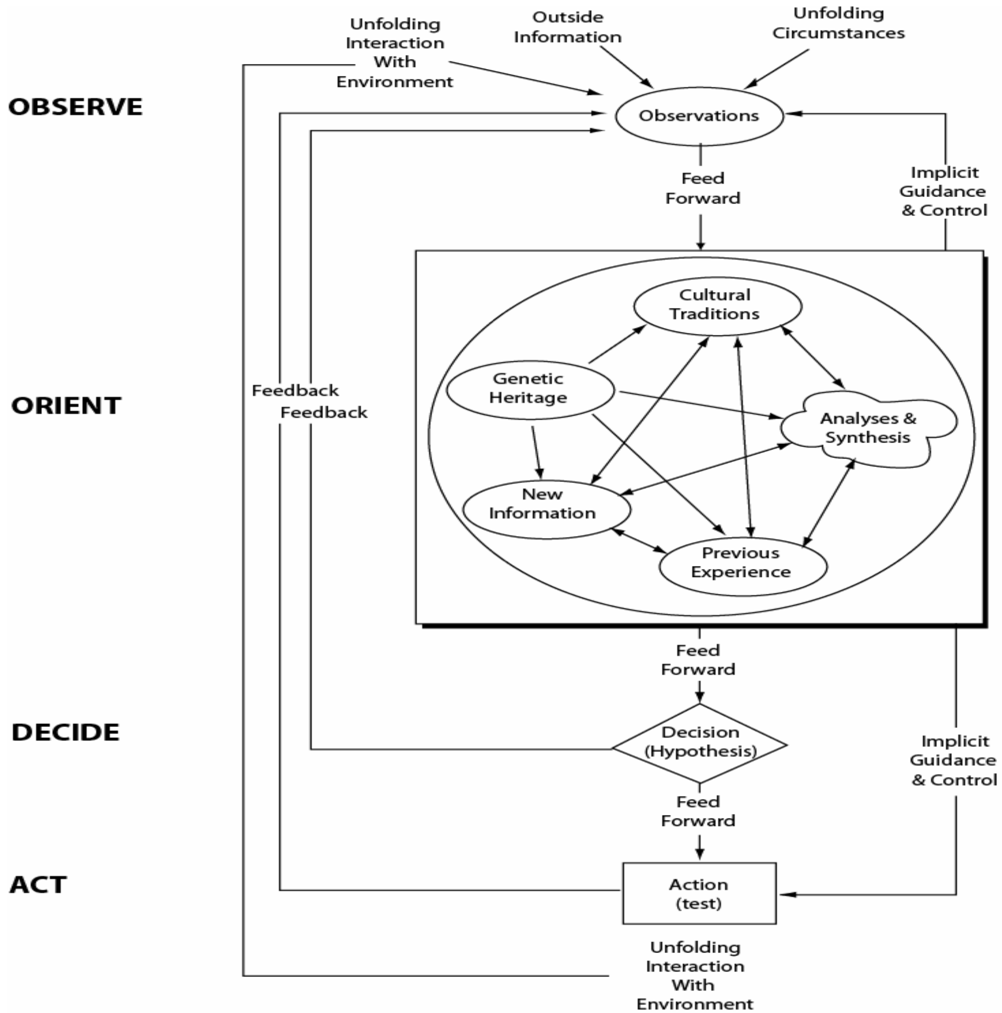
- Files reviewed included: Groove chat/discussion groups, event logs, exercise reports including Executive Summaries, Plans, Team Reports and After-Action Reviews (AAR), as well as interviews with resident experts. Members of the teams consolidated MIO Events, Measures of

- Performance (MOP), and AAR trends to assist in forming a template from which we would position the described collaborative process in the space of three major military decision support models including Simon's problem solving model, Boyd's OODA Loop, and Albert's and Hayes' Collaboration Significant Influences model.

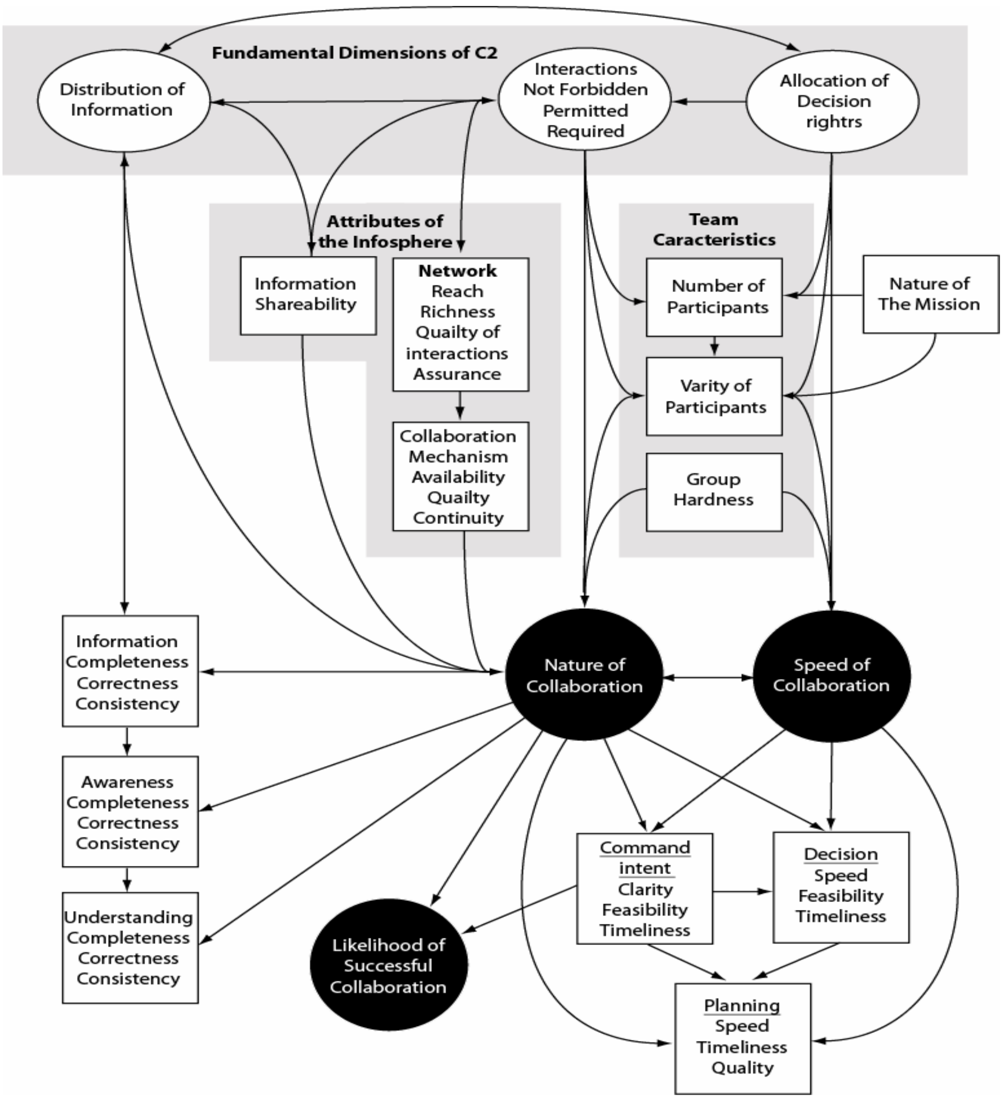
Simon’s Problem Solving Model



OODA Loop Problem Solving Model



Albert’s and Hayes’ Significant Influences model for Collaboration



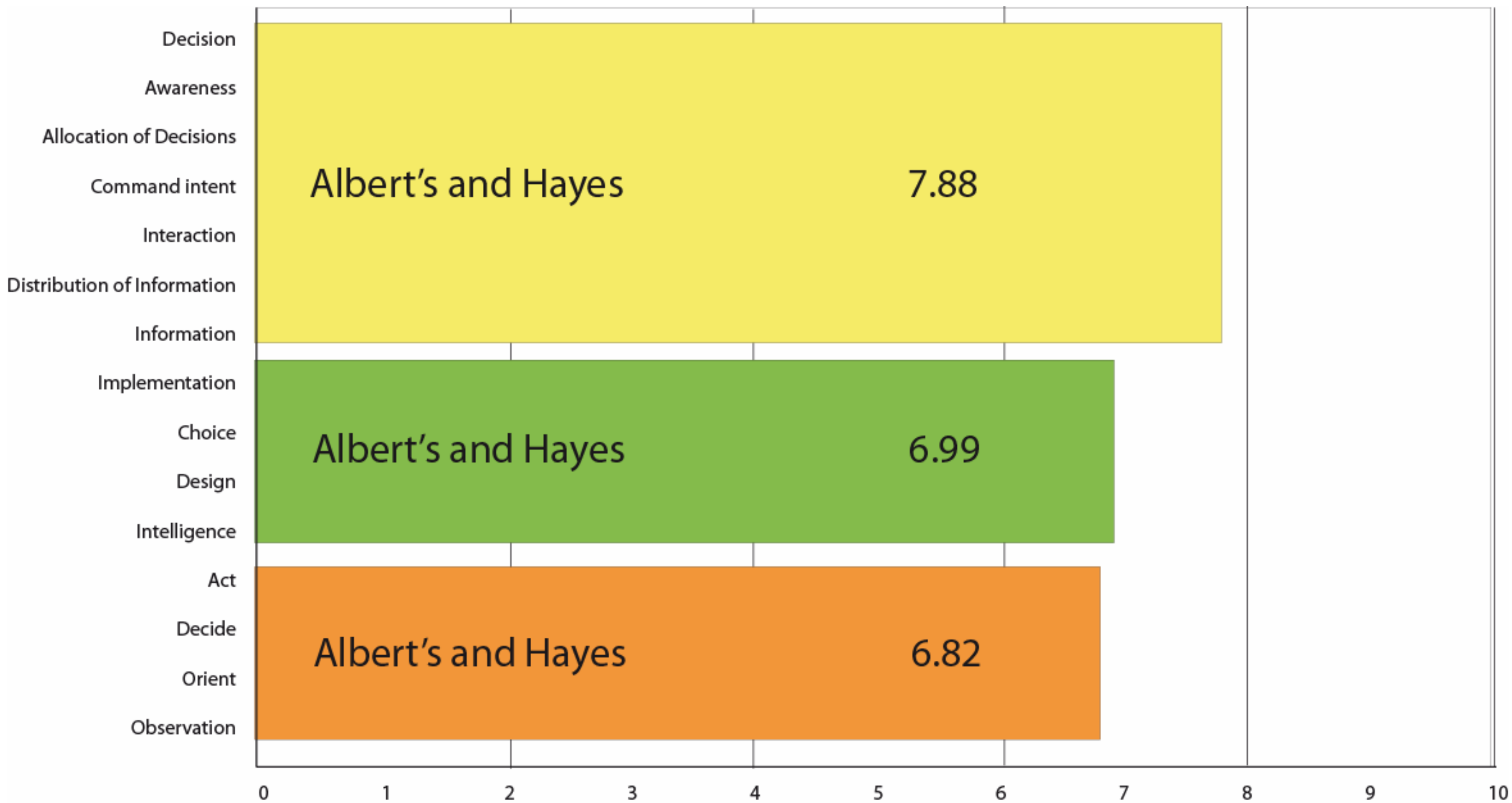
The study team used the following mapping technique:

- Use Lickert Scale with common “score” descriptions ranging from 1-10
- Apply this 1-10 scale across the pre-selected components from the three models for all 25 MIO events
- Look at the event (example 1 – for Boyd, we say it applied to the Observe section, Simon’s: Intelligence and Al/Hayes: Information)
- Open the Excel doc and read the 1-10 scale (best way to think of this is 10 = 100%, 5 = 50%, etc)
- Assign a value under your particular name (1-10) for each event –and for each model (example 1 –I give Boyd a 7/10 for Event 1 matching the Observe portion of the model, a 8/10 for Event 1 matching Simon’s model and a 9/10 for Event 1 matching the Information portion of the Albert-Hayes model)
- The averages will automatically calculate and populate the graphs

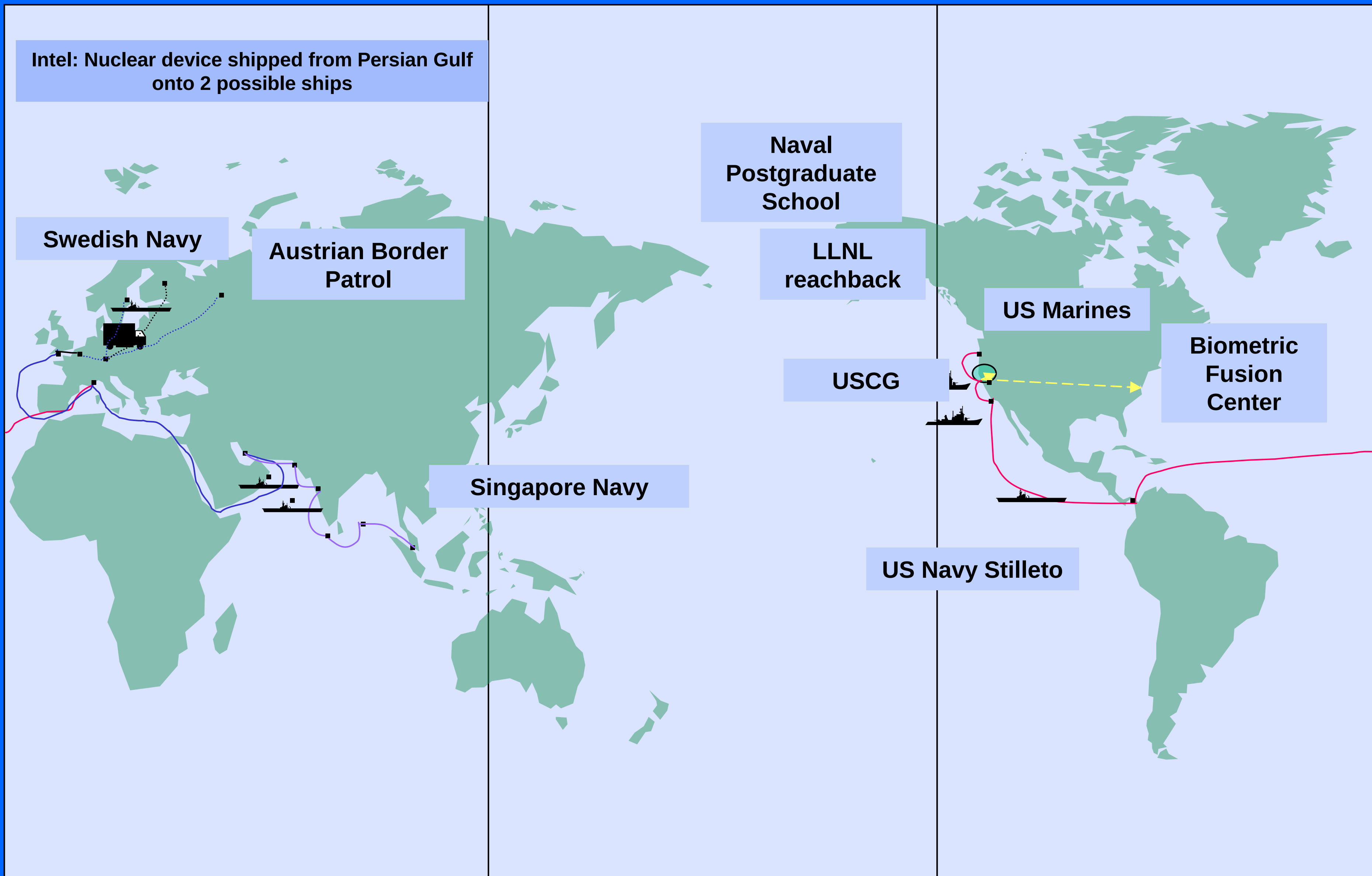
Additional Questions Related to the Decision Cycle Mapping

- **Characterization of observed collaborative network topology in terms of: degrees of separation and clustering, as well as multi participant Decision Support topology (group, team, and committee**
- **Characterization of collaborative technology usage pattern in terms of frequency and timeline for using major Collaborative Technology (CT) building blocks: file sharing, white board, application sharing, chat, audio/video communications etc.**
- **Characterization of communication mode for collaboration (client-server, peer-to-peer, etc) and networking capabilities that were set up to execute Collaborative Technology applications**
- **Characterization of decision support roles distribution in terms of *keepers, communicators, and coordinators***

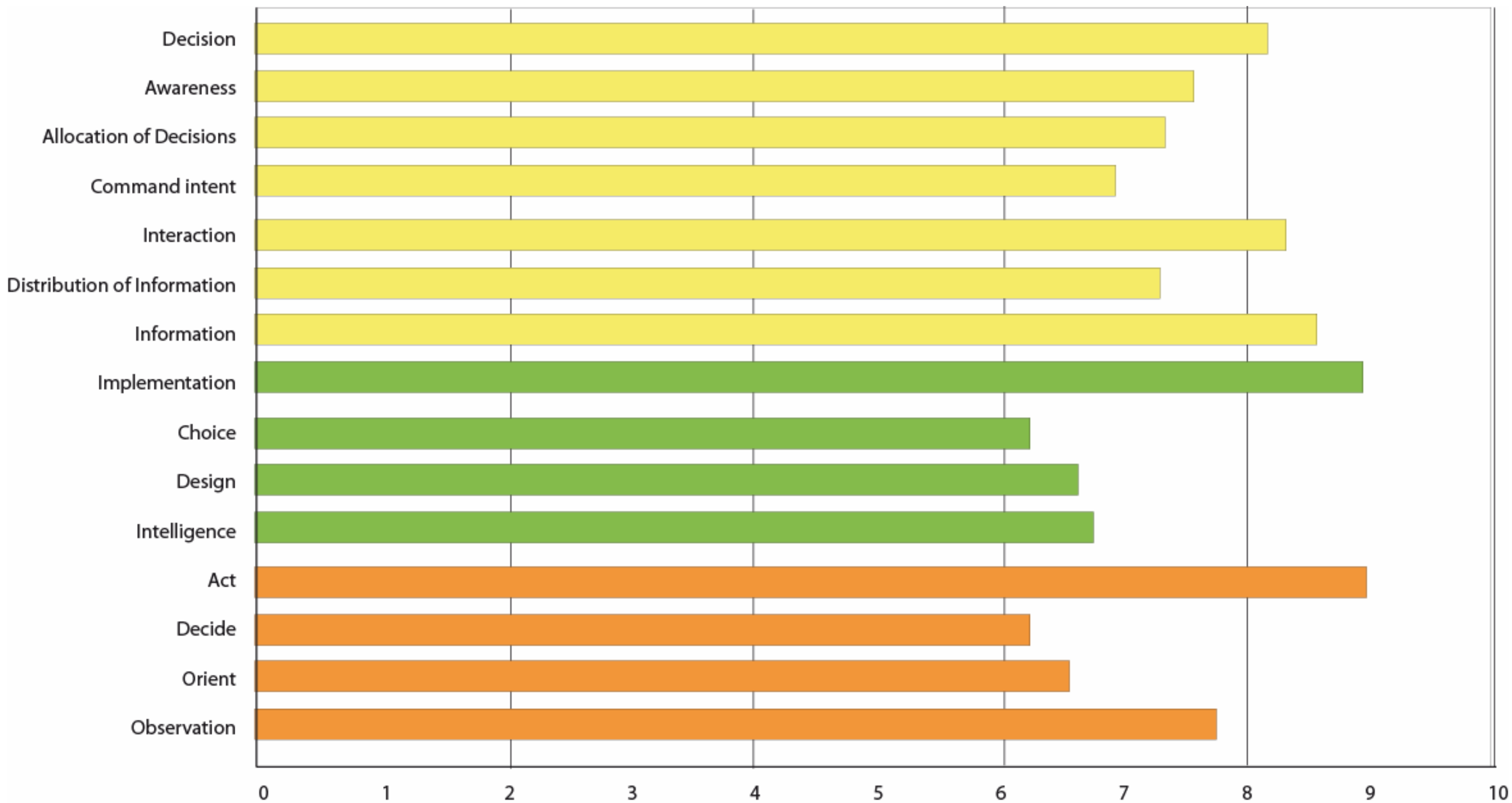
Overall “Fit” of Models to Scenario Tasks



Collaboration in MIO Experiments



MIO: ”Fit” of Model Dimensions to Related Scenario Tasks (yellow - Albert-Hayes / green - Simon / orange - Boyd)



Conclusions: HVT Collaboration

- Although the entire process of detection and identification of HVT can be easily mapped with the **Simon's model,** but the actual use of collaborative process required in the entire decision making cycle is only implicit and needs to be visualized.
- **Boyd's model** misses out the Orientation Phase that is extremely important towards the final Action Phase in which the entire organization towards speeding up the loop in the next iteration.
- **Albert's and Hayes model** more explicitly defines the entire process of decision making. This model breaks the cyclical or hierarchical aspects of the previous two models and highlights the strength of the organization as a whole working towards a common decision

Conclusions: MIO Collaboration

- The MIO team concluded that none of the models accurately represent the collaborative decision making environment that exists for MIO
- They proposed a new model, which combines the elements of the three decision support models team analyzed

Final Points

- Both teams came up with the conclusion that none of the three decision support models themselves are adequate to deal with the HVT and MIO scenarios
- However, Albert’s and Hayes model provides a better fit to the observed collaborative processes
- The main characteristic missed in all three models is the reflection on networking nature of the observed collaborative processes
- From the networking stand point transition from the decision makers network of “Who” to “Which Workspaces” network, and “What Content” sharing network is critical for defining collaborative process