SCENARIO DESIGN FOR THE EMPIRICAL TESTING OF ORGANIZATIONAL CONGRUENCE

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OBJECTIVES

• ESTABLISH EXPERIMENTAL CONDITIONS WITHIN WHICH TO DEMONSTRATE THAT CONGRUENCE SIGNIFICANTLY AFFECTS PERFORMANCE OUTCOMES

• HYPOTHESIS ~ “the better an organization is matched to the overall mission, using a multi-variant set of workload and other congruence metrics, the better will that organization perform”

Congruence ⇒ the interaction of organizational structure and mission/scenario (degree of structural fit between an organization and the mission)

• UNDER A2C2, A METHODOLOGY HAS BEEN DEVELOPED TO DESIGN AN ORGANIZATION THAT IS CONGRUENT WITH A SPECIFIED MISSION
  – who should own what assets, who does what, who sees what, etc.
  – extensive publications in past CCRTS Proceedings, SMC Transactions, …
  – limited empirical testing conducted in previous A2C2 experiments
    (usually via comparison with an ad-hoc organizational structure on one scenario)
• EXPLOIT FINDINGS FROM TWO PREVIOUS EXPERIMENTS CONDUCTED AT NPS
  – N6C (March 2001), C8 (October 2001)

**STEP 1:** SEEK TWO VERY DIFFERENT ORGANIZATIONAL STRUCTURES
  – Functional (F) and Divisional (D)

then

**STEP 2:** DESIGN TWO SCENARIOS TO EXPLOIT THE DIFFERENCES IN F AND D
  – f congruent with F but measurably incongruent with D
  – d congruent with D but measurably incongruent with F

• UTILIZE THE SAME MILITARY CONTEXT AS IN PREVIOUS EXPTS FOR f and d
  – DDD simulator reuse, ease of subject training, etc.

• USE CONGRUENCE THEORIES TO “REVERSE ENGINEER” f and d
EXPERIMENT 8 SCENARIO AOR

- Country A has invaded B
  - remove A’s forces from B

- Prepare for introduction of follow-on forces
  - Clear SAMs North of 325
  - Clear mines: NBE, PORT
  - Dominate air and sea

- Respond rapidly to high-priority unanticipated tasks and (combat) S&R

- Protect D and E from A’s SCUD missile attacks

- Defend Task Force assets
  - vs. enemy air and sea

A course of action (COA) giving a specific sequence for accomplishing mission tasks has been developed by the CJTF.
FUNDAMENTAL TASK GRAPH A2C2 EXPT 8

- **Defend own forces**
  - ACDM
  - Air(AC, PH*)
  - Sea(PB, PH*)
  - Sea(DG)

- **Defend Islands**
  - SML
  - AMIS

- **Obstacles**
  - to strike a/c
  - CLEAR SA3s
  - CLEAR MINES
  - Obstacles to SOF
  - RGF
  - CLEAR MINES
  - CLEAR MINES

- **Defend Islands**
  - SML
  - AMIS

- **Obstacles**
  - to SOF
  - RGF
  - CLEAR MINES
  - Obstacles to SOF
  - RGF

- **M** indicates that these must be distinguished from neutral (or decoy) counterparts.

- **The Mission Is The Highest Priority!!**

- **PREREQUISITE** requirements exist among key mission tasks (establishes mission ordering)

- **OBSTACLES** to own forces that inhibit access to mission tasks may be encountered (need clear enemy defenses)

- **ENEMY THREATS** to friendly nations and your own forces

- **MEDIVAC** may spawn as a result of performing task
TWO ORGANIZATIONAL STRUCTURES: D and F

TEAMS OF SIX PLAYERS EACH: FLAT HIERARCHY, EMPOWERED

• **FUNCTIONAL:** A DM is a warfare area commander and “owns” all appropriate JTF assets
  – a single warfare area that is theater-wide

• **DIVISIONAL:** A DM “owns” a single multi-function capable platform with all its subplatforms
  – multiple warfare areas in a defined geographical region

### Functional

<table>
<thead>
<tr>
<th>DM</th>
<th>Platform</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CVN</td>
<td>2F18S</td>
<td>xxx</td>
<td>1UAV</td>
<td>2F18A, E2C</td>
<td>1FAB, 1MH53</td>
<td>1HH60</td>
</tr>
<tr>
<td>2</td>
<td>DDGA</td>
<td>8TLAM</td>
<td>3ABM, 4TTOM</td>
<td>1UAV</td>
<td>6SM2</td>
<td>1FAB, 2HARP</td>
<td>1HH60, 1SOF</td>
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</table>

* FFGs fixed wing aircraft are located on an island Air Operation Facility (AOF)
SOFs are pre-inserted and located on a Forward Operating Base (FOB)
CONGRUENCE MANIPULATION EXPLOITS ROLES and GEOGRAPHY, PLUS TASK REQUIREMENTS, ASSET CAPABILITIES and LOCATIONS

1) INCREASE DM-DM COORDINATION
   - Introduce tasks that require multi-DM processing
   - Construct many of these tasks to be time-critical and/or unanticipated, with a finite time window within which assets must synchronize
   - Introduce precedence/prerequisite and information-dependence (flow) structure among tasks allocated to different DMs ⇒ create dependence of one DM’s processing upon another DM’s success/activities (e.g., ISR for detection, obstacles to assets, mission task graph, … )

2) CREATE WORKLOAD (TASK LOAD) IMBALANCE AMONG DMS
   - Introduce temporal overload of tasks that must be done by one DM

3) OTHER MANIPULATIONS
   - Create a set of tasks where inefficient asset utilization is “costly” (Provide team with limited assets that must be used efficiently)
   - Reduce situational awareness within team and among DMs (Create tasks that cause DMs to adopt “tunnel vision”)
   - Insert tasks that “boundary-split” regions between adjacent DMs
SCENARIO f: (congruent with organization F; incongruent with organization D)

1. INTRODUCE TASKS WITH HIGH RESOURCE REQUIREMENTS OF THE SAME TYPE (REQUIRE DIVISIONAL DMS TO COORDINATE)
   – e.g., task requiring multiple units of STRIKE

2. CREATE TEMPORAL OVERLOADS USING TASKS OF DIFFERENT TYPES IN ONE GEOGRAPHICAL AREA (e.g., simultaneous air + sea + S&R tasks)
   – increase the workload of a selected divisional DM

SCENARIO d: (congruent with organization D; incongruent with organization F)

1. INTRODUCE TASKS WITH RESOURCE REQUIREMENTS OF DIFFERENT TYPES (REQUIRE FUNCTIONAL DMS TO COORDINATE)
   – e.g., task requiring 1 unit each of SOF, STRIKE and AIR

2. CREATE TEMPORAL OVERLOADS USING TASKS THAT NEED ONE RESOURCE TYPE SPREAD OVER A LARGE GEOGRAPHICAL AREA
   – e.g., an enemy air wave simultaneously targeting several platforms
   – increase the workload of a selected functional DM
MAJOR TASKS REQUIRE MULTIPLE RESOURCES OF SAME TYPE

TASK RESOURCE REQMTS

SDG: 2 ASuW
SPT, SPH: 1 ASuW
SGUN: 2 FAB
SSAR: 2 SAR
SMIN: 2 MINES

GEVA: 2 SAR
GCDL, GSML: 1 STRK
GSAM: 2 TLAM (from 2 different platforms)
GSA3: 2 STRK (1 F18S)
GSA6: 2 TLAM (from 2 different platforms)
GRGF: 3 STRK

AAC, APH, ACDM, AXOC: 1 AAW
ACAP: 3 AAW
AMIS: 1 ABM

* indicates that these must be distinguished from neutral (or decoy) counterparts
MAJOR TASKS REQUIRE
MULTIPLE RESOURCES OF
DIFFERENT TYPES

**TASK RESOURCE REQMTS**

- **SDG:** 1 ASuW + 1 AAW
- **SPT, SPH:** 1 ASuW
- **SHOS:** 1 SAR + 1 FAB
- **SSAR:** 1 SAR + 1 FAB
- **SMIN:** 1 MINES + 1 F18A
- **GEVA:** 1 SAR + 1 F18A
- **GCDL, GSML:** 1 STRK
- **GSAM:** 1 TLAM + 1 SOF
- **GSA3:** 2 STRK (1 F18S)
- **GSA6:** 2 TLAM (from 2 different platforms)
- **GRGF:** 2 STRK
- **AAC, APH, ACDM, AXOC:** 1 AAW
- **ACAP:** 2 AAW
- **AMIS:** 1 ABM

* indicates that these must be distinguished from neutral (or decoy) counterparts
Ex: Scenario f, air tasks design

Task types, arrival times, & paths are adjusted to meet design requirements - each DM experiences 2-3 periods of overload within a given scenario

DDD Simulator

IMPLEMENTATION
MODELING CYCLE FOR EXPERIMENT 8

N6 & C8 scenarios and structures

Create two distinct structures – Divisional and Functional

1. Organizations
   • F: Minimize overlap of resource capabilities
   • D: Maximize overlap of resource capabilities

2. Scenario - Coordination
   • f: tasks requiring multiple resources of same type
   • d: tasks requiring multiple resources of different types

3. Scenario - Task load
   • f: load single geographical area over multiple functions and time
   • d: load single functional area over a wide geographical region and time
EXPERIMENT 8 WAS CONDUCTED IN AUGUST AND NOVEMBER 2002

**PLAYER RATINGS** of factors that affected performance

<table>
<thead>
<tr>
<th>Question</th>
<th>D Teams</th>
<th>F Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>“What made playing these scenarios difficult for you?”</td>
<td>d</td>
<td>f</td>
</tr>
<tr>
<td>Need for Coordination</td>
<td>4.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Task Load</td>
<td>4.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Secondary Task Demands</td>
<td>4.6</td>
<td>4.5</td>
</tr>
<tr>
<td>“How proactive vs. reactive did you feel you were when playing each scenario?”</td>
<td>5.1</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Note: Ratings used a 7-point scale

**IN WHICH SCENARIO DID YOU FEEL THAT YOUR TEAM PERFORMED “BETTER”?**
- 96% of Divisional participants reported “better” in congruent (d) scenario
- Only 52% of Functional participants reported “better” in congruent (f) scenario
SUMMARY & CONCLUSION

• MODEL-BASED EXPERIMENTAL AND SCENARIO DESIGN
  – Integrated scenarios, organizational structures, and congruence metrics
  – “Reverse engineered” f and d using congruence theories

• SO, DO CONGRUENT ORGANIZATIONS PERFORM BETTER?
  – Model-based performance and process measures of congruence effects exist
  – Can associate nature of incongruence with asymmetric performance decrements e.g., F ⇔ d and D ⇔ f.

• YES! – EXTENSIVE RESULTS ARE FOUND IN COMPANION PAPERS
  Example: Accrued Task Gain metric (gain = value*processing accuracy)
  AREA UNDER CURVE IS A MEASURE OF OVERALL PERFORMANCE

On average the CONGRUENT teams significantly outperformed the NON-congruent teams
- better time-accuracy tradeoff
- but . . .