

Computational Modeling & Analysis of Coalition Maritime Planning

CCRTS 2006 - C2 Concepts & Organizations
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Research coordinated through the Center for Edge Power.

Motivation

- ✦ Edge organization is fresh approach
- ✦ Question comparative & contingent performance
- ✦ Research problems with methods & ambiguity
- ✦ Computational experimentation as bridge method
- ✦ Center for Edge Power: MY, MD, MU R program
- ✦ This study:
 - Phase 1 – model specification & exp design
 - Phase 2 – field research to model CFMCC process

Prior Research

Archetypal Classification

Classification* of Hierarchy & Edge Organizations

| Design Factor | Hierarchy | Edge |
|--------------------|----------------------------|---|
| Coordination | Work standards | Mutual adjustment (Adhocracy) |
| Specialization – H | High | Low (Simple Structure) |
| Specialization – V | High | Low (Professional Bureaucracy) |
| Training & indoc | High | High (Professional Bureaucracy) |
| Formalization | High | Low (Simple Structure, Professional Bureaucracy, Adhocracy) |
| Grouping | Function | Market & function (Adhocracy & Professional Bureaucracy) |
| Unit size | Large | Small (Adhocracy) |
| Planning & control | Action planning | Limited action planning (Adhocracy) |
| Liaison | Few | Many throughout (Adhocracy) |
| Decentralization | Centralized | Selective decentralization (Adhocracy) |
| Archetype | <i>Machine Bureaucracy</i> | <i>Professional Adhocracy</i> |

* See Mintzberg (1979)



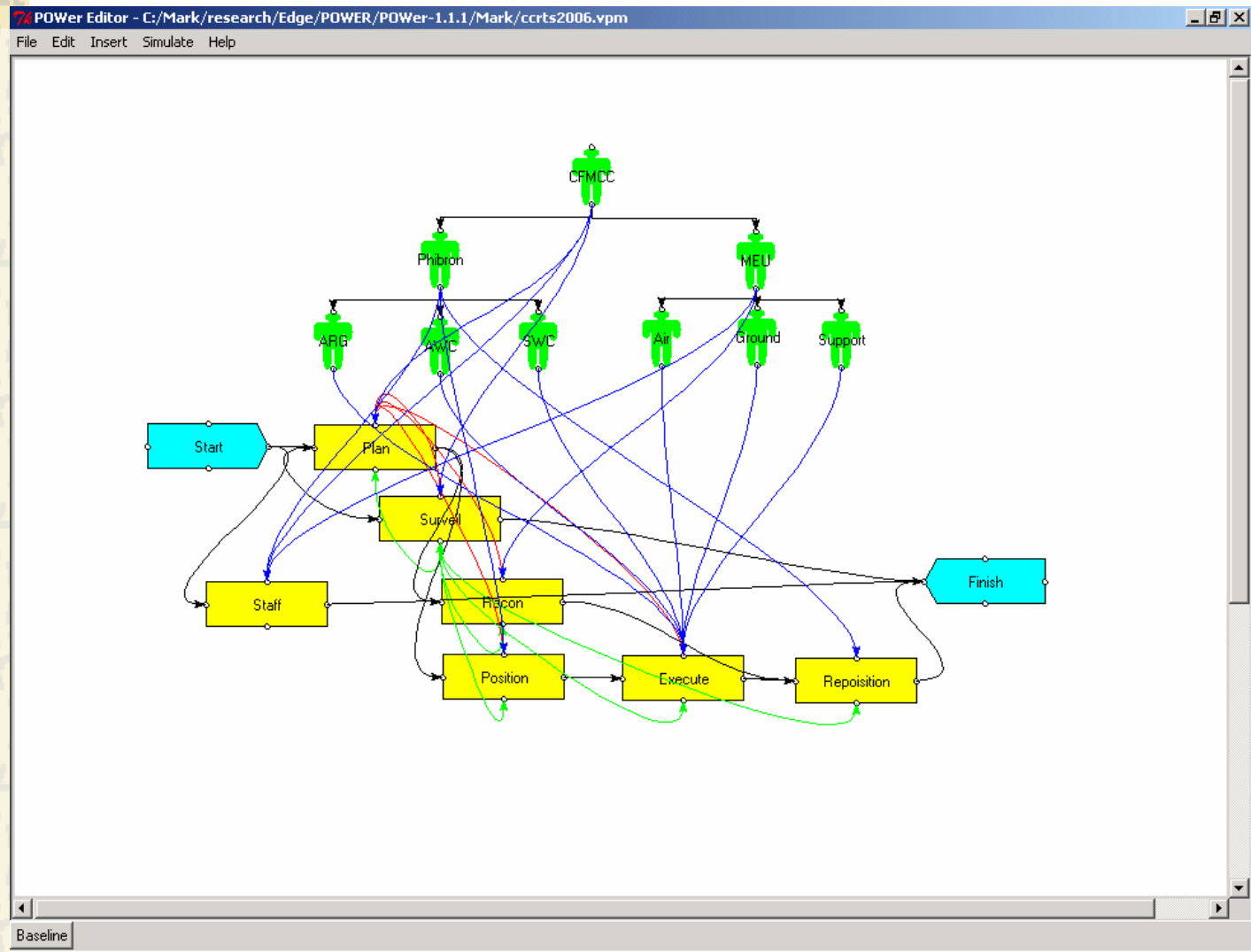
Research Design

- ✦ Computational tools – POWer
- ✦ CFMCC field research
- ✦ Integration, synthesis & CFMCC analysis

Field Research Results

- ✦ Observations confirmed CFMCC as a Hierarchy
 - High degree of work standards, horizontal and vertical specialization, formal information flow information, action planning and control, and centralization
 - Functional grouping, unit size and liaison are not clearly hierarchical
- ✦ Observations used to:
 - Refine the C2 model's baseline parameters
 - Validate and calibrate model performance – "Observed" column

CFMCC Computational Model "Observed"



Alternative CFMCC Models

- ✦ Communications – same structure and skill levels
 - Common planning network, improved information processing
- ✦ Knowledge Network – same structure and network
 - Better educated, experienced, and trained planners
- ✦ Power Flow – same skill levels
 - 1-level meritocracy with interdependent tasks
- ✦ Combined – best aspects from each of the three models

Computational Results

| Measure | Observed | Communications | Knowledge-Net | Power Flow | Combined |
|-----------------------------|-------------|------------------|-----------------|-------------------|-------------------|
| Simulation Duration | 9.5 days | 8.8 days | 6.9 days | 8.6 days | 5.3 days |
| Joint Planning Duration | 3.5 days | 3.3 days | 1.5 days | 3.4 days | 1.6 days |
| Coalition Planning Duration | 4.5 days | 3.6 days | 1.6 days | 3.6 days | 1.5 days |
| Mission Go | 6 days | 5 days | 4 days | 4 days | 4 days |
| Direct work | 2694 P-days | 2694 P-days | 2694 P-days | 2726 P-days | 2726 P-days |
| Rework | 126 P-days | 96 P-days | 52 P-days | 411 P-days | 60 P-days |
| Coordination | 136 P-days | 48 P-days | 114 P-days | 668 P-days | 407 P-days |
| Wait time | 16 P-days | 19 P-days | 8 P-days | 0 P-days | 0 P-days |
| Meetings | 42 | 0 | 31 | 0 | 0 |
| Functional Risk Indicator | 0.23 | 0.27 | 0.26 | 0.38 | 0.42 |
| Project Risk Indicator | 0.26 | 0.35 | 0.20 | 0.32 | 0.32 |
| Maximum Backlog | 2.0 days | 1.4 days | 1.6 days | 1.8 days | 1.3 days |

Contributions

- ✦ Calibration of POWer C2 model provides confidence in computational experimentation outputs
 - Highlights advantage & disadvantages of alternate organizational forms, process changes, and technological improvements
- ✦ Topologies of knowledge networks vary per task
 - Make K-net explicit, incentivize its use, and monitor the balance between exploration (creation tasks) and exploitation (work tasks)

Limitations & Future Research

✦ Limitations

- Bridge research method, interpretation & judgment
- C2 is relatively new domain for VDT; POWER in development
- CFMCC studied in experimental vs. operational mode

✦ Future research

- Campaign of experiments – compare CFMCC to other forms
- Complementary studies ongoing & planned
- Center for Edge Power welcomes input