PERSUADE*: Modeling Framework for the Design of Modular Army Organizations

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*PERSUADE: PERSonnel-based Unit of Action Design Environment

CCRTS, 2006

The research reported in this paper was performed in connection with contract/instrument W911QX-06-C-0045 with the U.S. Army Research Laboratory. The views and conclusions contained in this document/presentation are those of the authors and should not be interpreted as presenting the official policies or position, either expressed or implied, of the U.S. Army Research Laboratory or the U.S. Government unless so designated by other authorized documents. Citation of manufacturer’s or trade names does not constitute an official endorsement or approval of the use thereof. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation hereon.
Outline

- Trends in current Army operations & PERSUADE challenge
- PERSUADE method and tool concept
- PERSUADE conceptual model
- PERSUADE example of analysis
- Conclusions
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Past
- Slow-time large-scale conflict
- Numbered engagements
- *Enemy is well known*

Current
- Asymmetric threats and changing missions
- Moderate to small-size forces
- *Enemy may take different forms*

Future: **Increased # & change in type of Ops**
- Fast-paced engagements
- Larger number of and higher time criticality
- *Enemy is adapting*

**US Army Response: Force Transformation**

**Major variables to consider**
- Speed of deployment/attack/response
- Accuracy/precision/firepower
- Action effects
- Understanding/predicting the situation; proactive COAs

**Transformation focus on**
- **Novel C2 organizational forms** tailored for new & diverse environments/missions and technologies
  - Modular force units
- **Novel processes/TTPs**
  - Rules of engagements
  - Adaptation (reactive and proactive)

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*Heavy Brigade Combat Team Field Manual FM-I 3-90.61, Fig. 2.1.*
Addressable Problems

Army’s Force Tailoring Problem:
- Find the right mix and sequence of units to accomplish a mission:
  - Force Allocation – *select main force unit*
  - Force Augmentation – *add-on force components*
  - Force Refinement
    - METT-TC adjustments
    - Force deployment sequencing
    - Staff tailoring & Task organizing

PERSUADE’s questions:
- **Question 1:** How to *compose* the forces mix?
  - Select the units, resources & staff
- **Question 2:** How to *organize* units?
  - Define command, control, and communication relationships/structures/roles
- **Question 3:** How to *employ* the force?
  - Design mission execution strategy and courses of action
  - Reconfigure/adapt the force dynamically based on mission changes

UE = Unit of Employment
PERSUADE Challenge

PERSUADE Design Space
Technologies enable new C2 organization forms

Technologies
• FCS
• UxVs
• Network Centric C2

Organization
• C2 Structure
• Responsibilities
• Work Process/TTPs

Can have leaner, faster forces
Save cost + improve performance

Human Element
• Capabilities
• Competencies

New mission rehearsal capabilities allow attaining broader skills

Missions
• Environment
• Tasks
• Threat

Environment is changing
Current organizations are stove-piped
How do we **optimize** the *modularity* afforded by Future Combat Systems (FCS) and the Future Brigade Combat Team (FBCT) to adapt to mission changes?
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PERSUADE Tool Objectives

What:
- Develop model-based decision support system focused on design and evaluation of organizational structures and processes for Army teams

How:
- Interactive environment
- User in full control
- Develop and compare design alternatives
- Present the reasoning behind each alternative developed using optimization engine

Allow the user to
- Visualize the environment
- Develop mission plans
- Design organizations
  - Unit and staff selection
  - Command, control, communication structures
  - Roles definition
  - Mission execution strategy
  - Adaptive reconfiguration of the organization
- Simulate the organization in virtual environment
- Assess and compare performance

In PERSUADE, C2 organization can be designed
- Manually
- Using optimization for whole C2 structure
- Using optimization for parts of C2 structure
3rd Generation
- Integration of
  - Human
  - Organization
  - Task/work
  - Technology
- System Optimization

2nd Generation
- System Simulation

1st Generation
- Component Models
  - Control Theory Models
    - (OCM, DDM, etc,...)
  - Cognitive Models
    - (ACT-R, SOAR, COGNET)
  - Event-based Models
    - (PetriNets, Disc.-event Sims,...)
  - OR & System Models
    - (SDN, ... etc,...)
  - Physiological Models
    - (workload, vision, motor,...)

Simulation tools:
- IMPRINT
- MIDAS
- C3TRACE

Virtual Windtunnel for C2 design

Best C2 Structure

Optimization

Traditional

Expert/user
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PERSUADE Conceptual Model

Integrated Dynamic Management of Physical, Communication, and Human Resources

Org Structures:
- Command
- Resource ownership/control
- Communication
- Information flow

Human Operators, Commanders, and Staff Modeling

- Monitoring
- Decision-making
- Communication
- Command
- Synchronization

Challenges:
- Time constraints
- Expertise/skills/load constraints
- Coordination overhead
- Situation awareness
- Switching costs & task complexity
- Learning, fatigue

PERSUADE benefits:
- A-priori optimized C2 organization design
- Dynamic re-organization
- Integrated man-machine dynamic re-tasking
- Delays
- Quality of decisions
- Quality of actions

Example: TCT

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Phase 1: Unit-Task Assignment

Optimal Mission Schedule: who does what and when

Phase 2: Intra-Unit Dependence

Define Coordination among Units: what is needed to coordinate units

Phase 3: Unit Control Assignment

Find Allocation of Units to Commanders: who controls what

Phase 4: Command Structure

Find Command Hierarchy: who commands whom

Phase 5: Communication Network

Find Communication Network: who can talk to whom
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Supported by our partners from L-3COM, we developed mission scenario for brigade-size forces
- Test PERSUADE concepts
- Understand uses and users of the tool
Baseline organization: traditional HBCT

Created alternatives and compared using several different scenario classes
  – Varying Engineer, fire, civilians, attacks

Alternative organizations
  – Add resources
    ▪ HBCT + 6 Rec Co
    ▪ HBCT + 6 Rec Co + 4 MP + 3 Engr Co
    ▪ HBCT + 6 Rec Co + 4 MP + 2 Fire Co
  – Change C2 structure
    ▪ Alternative-1 with control of engineers, infantry, tanks, and reconnaissance by single commander
    ▪ Alternative-2 with TUAV and attack Helicopters distributed among commanders

Comparison of Forces Configuration

Mission Scenario Classes
- Baseline ENGR FIRE-ATTACK DTNS DTNS-ATTACK DTNS-ENGR

Mission Time, hrs
- HBCT-RECON
- HBCT-MP-FIRE
- HBCT-MP-ENGR

Comparison of Taskload per Unit Class

Average Number of Tasks
- Recon Co
- Inf Co
- Fires Co
- Tank Co
- MED
- HCT
- MP
- Attack Helo
- Air Evac
- Mech Eng
- Eng Co
- TUAV
- Q-36 Radar

Δ = 6.4%
Δ = 5.7%
Δ = 12.3%
Δ = 15.8%
Δ = 6.5%
Δ = 21.5%
Δ = 24%
Δ = 29%
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- Mission performance is influenced by number and types of tasks and dependencies (structure) between them

- Different trade-offs can be achieved by changing organizational resources composition and C2 structure

- The design of mission-tailed C2 organizations can be extended for robust design (over multiple mission classes) and adaptive design (adaptive proactive/reactive reorganization)

- PERSUADE tool is currently in the planning and early development stage