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Human - Centered Engineering

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Organizational Structure and Dynamic Information Awareness In Command Teams

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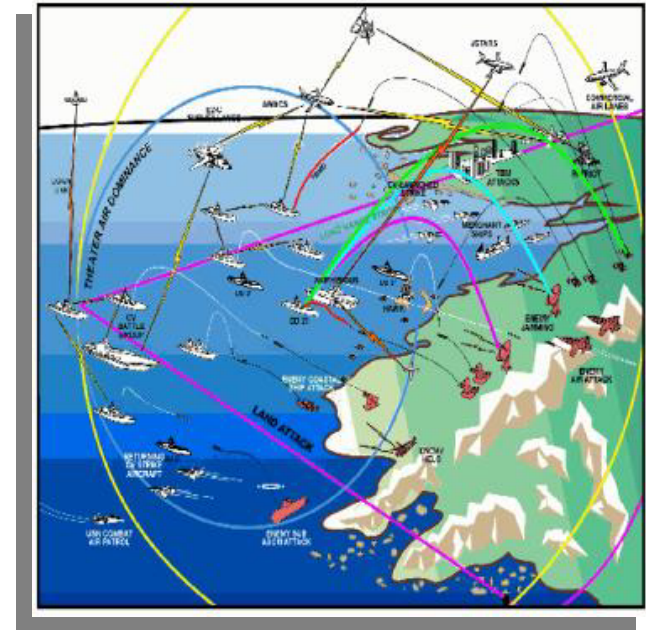
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A UNIQUE FOCUS ON HUMAN-CENTERED ENGINEERING

FORCEnet Principles Hold Promise

- Modeling & simulation effort conducted for SSG-XXI, predict:
 - An increase in shared knowledge in a FORCEnet structure
 - Allow organizations to respond more effectively to new & unexpected situations
 - More adaptable structures
 - Will handle complex tasks that require coordination more effectively than current organization structures
- In FORCEnet collaboration as a way of life



FORCEnet Drives Investigation of New C² Structures

- Modeling examined several structural changes
 - One example - creations of an intelligence, surveillance, and reconnaissance (ISR) coordinator
 - Could increase mission performance by as much as 25%
- A primary goal of this research was to empirically test this model prediction
 - **ISR vs. no ISR organizational structures**



Network Centric Warfare Spawns High Information Loads

- Increased volume of information that commanders must deal with
 - High information load can denigrate situation assessment & decrease mission performance
- Second study goal: investigate effects of high information load on decision making & mission performance
 - Manipulate information load across the two organizational structures (ISR & no ISR)
 - Embedded tactical judgment task to focus on critical aspects of decision making under different information loads



Tactical Judgment Task

- Addresses the process of **sequential revision of belief**
 - Task: estimate probability that the enemy would launch a counter-attack
 - Information necessary for the judgment task embedded in information flow
 - Two orders of information: 3 confirming followed by 3 disconfirming & 3 disconfirming followed by 3 confirming messages
 - Likelihood of attack assessed at middle & end of scenario
- A **contrast-inertia model** (Hogath & Einhorn, 1992) postulated to describe sequential revision process
 - The “**order effect**” – a heuristic error
 - **Sequential order of confirming or disconfirming evidence can have a profound effect on participants’ judgments**
- Not sure how information load will interact with order effect – two speculations

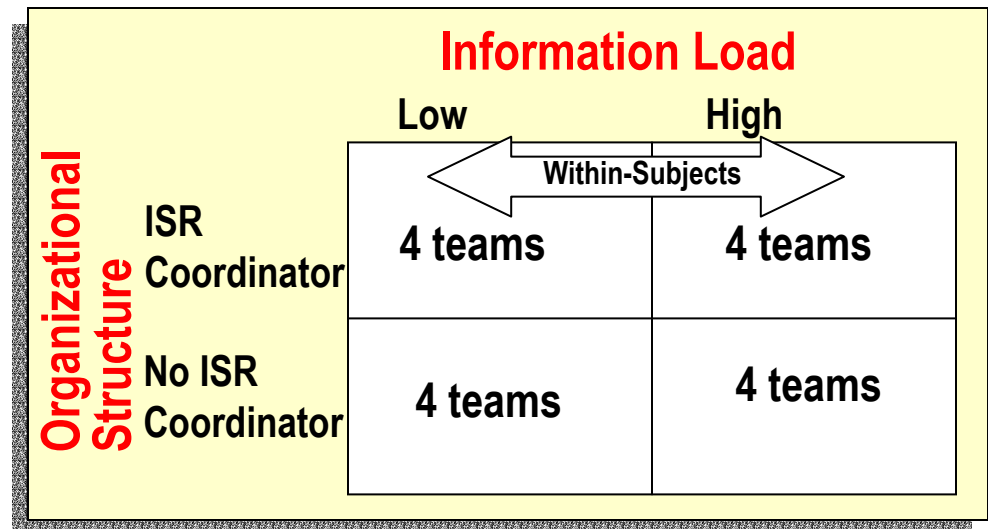


■ Independent variables:

- **Organizational Structures (both functional)**
 - ISR Coordinator vs. No ISR coordinator (Surface Warfare Commander)
- **Information Load**
 - High (9 messages per minute)
 - Low (3.5 messages per minute)
 - Counter-balanced across trials
- **Confirmation order**
 - Confirm-disconfirm
 - Disconfirm-confirm
 - Between Ss - Nested

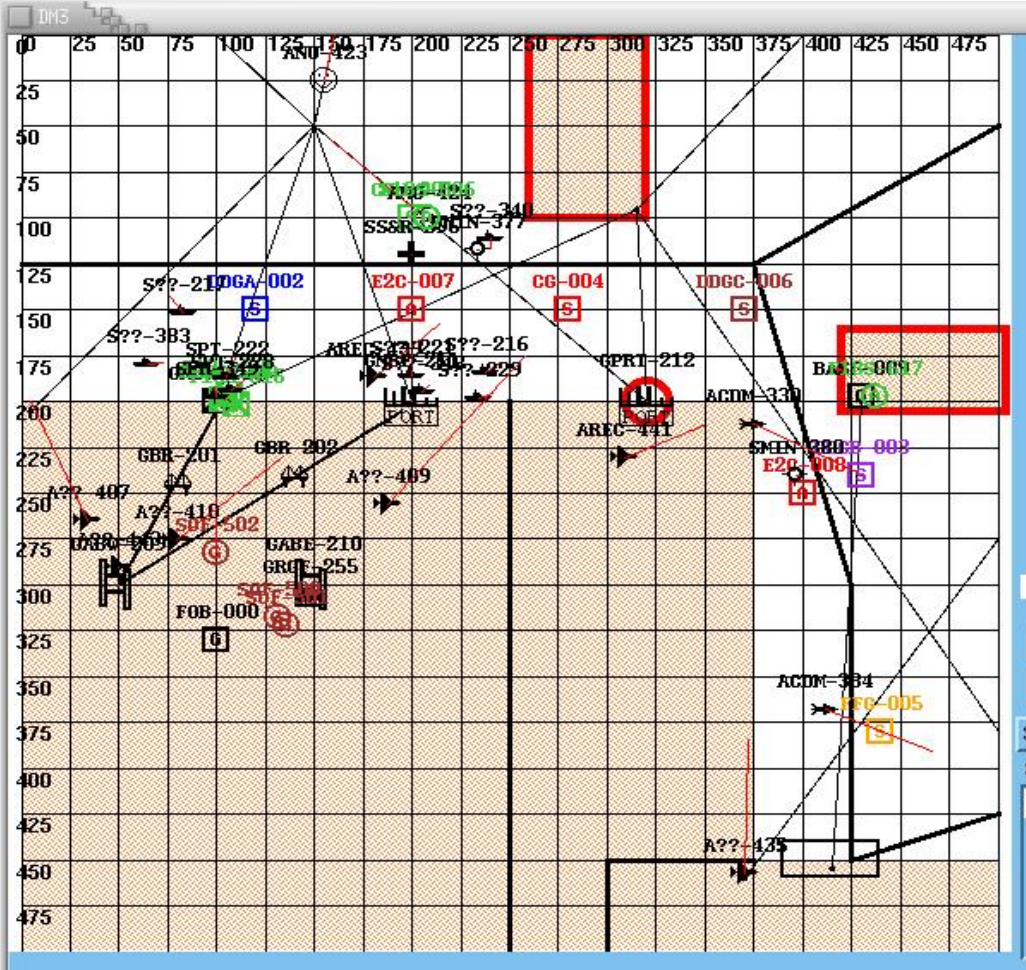
■ Primary performance measure

- **Percentage of task attacked with 100% accuracy**



Simulation Environment

DDD simulation: modified A2C2 Exp 8 Scenarios

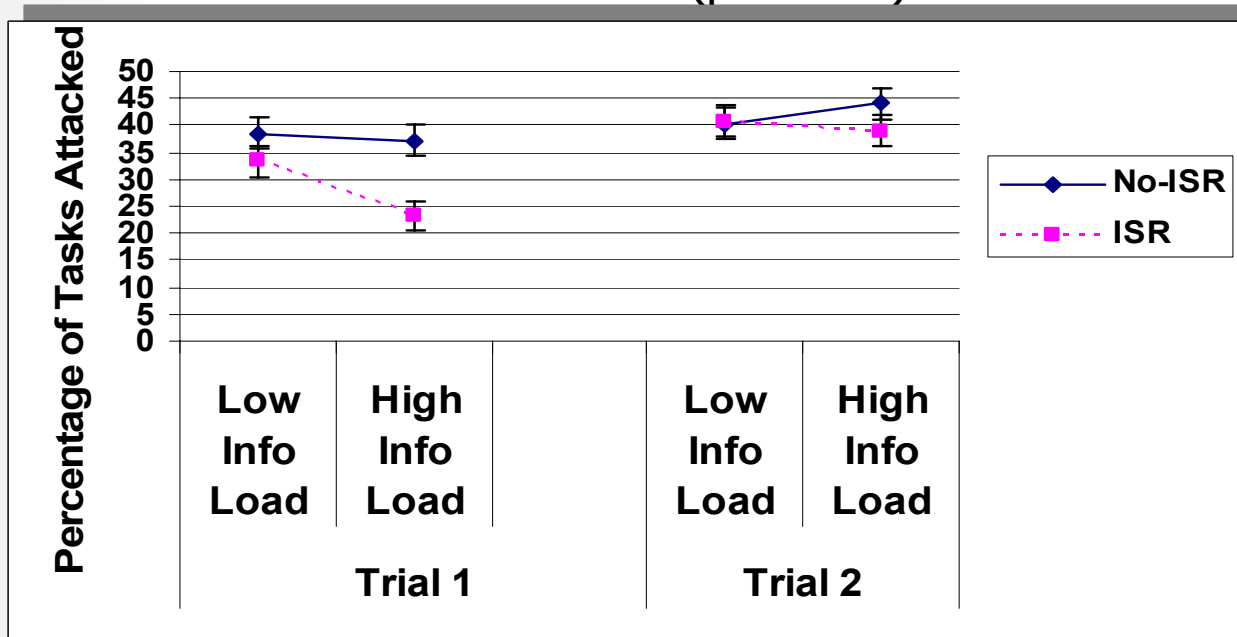


- Scenarios used involved land, sea, & air operations to prepare battle space for insertion of follow on forces
- Primary mission was to engage in information gathering, achieve & maintain good SA, discern if enemy planned launch a counter-attack – monitor Email/Intel traffic
- Secondary task: complete mission tasks



Presence of an ISR Coordinator: Performance Results

- Contrary to expectations the traditional org. structure with no ISR coordinator out performed the org. structure with an ISR coordinator – most evident in trial 1 ($p < .055$)



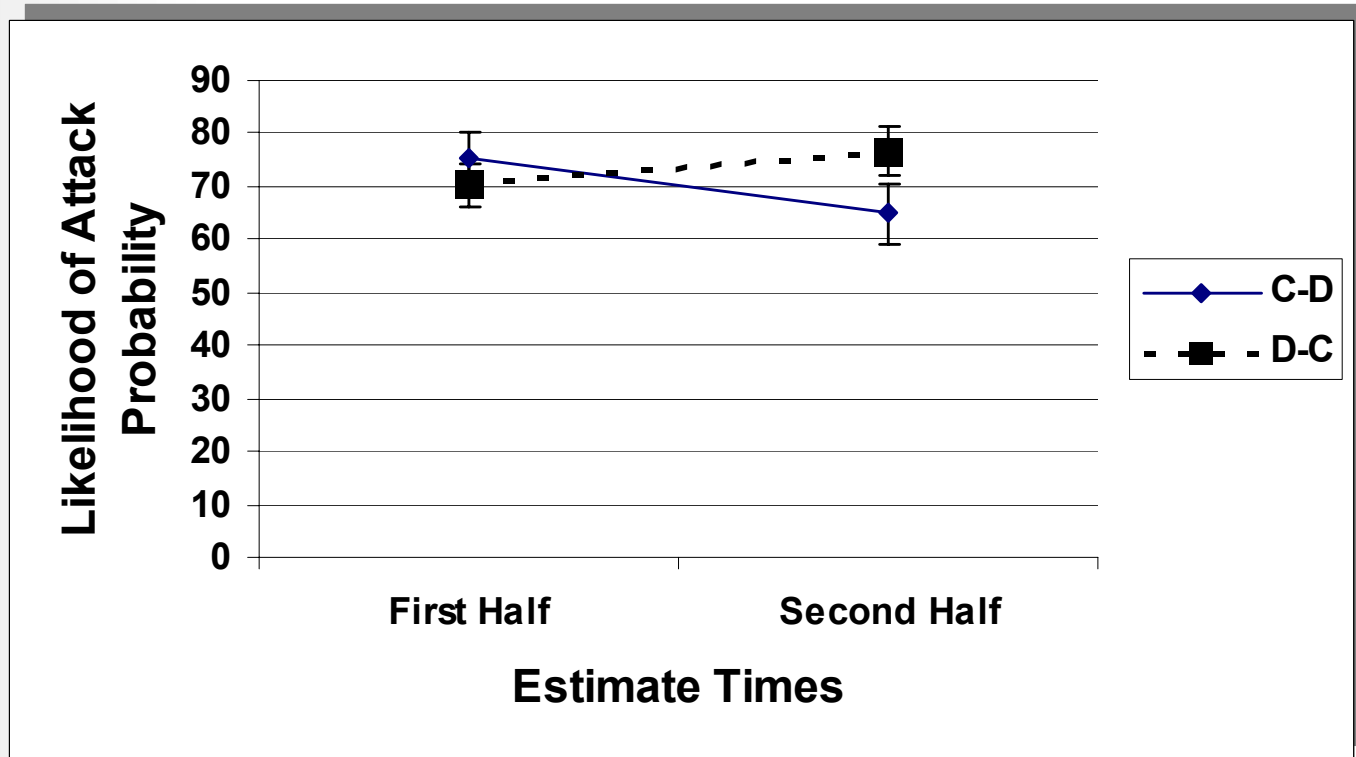
In trial 2, pattern quite different: teams in both organizational structures performed at about the same level in the high & low information load conditions

- Step improvement (38%, $p < .05$) in performance for org. with ISR coord. in high information load condition
- Speculate that with sufficient training & practice org. with ISR coord. might prove superior



Tactical Judgment

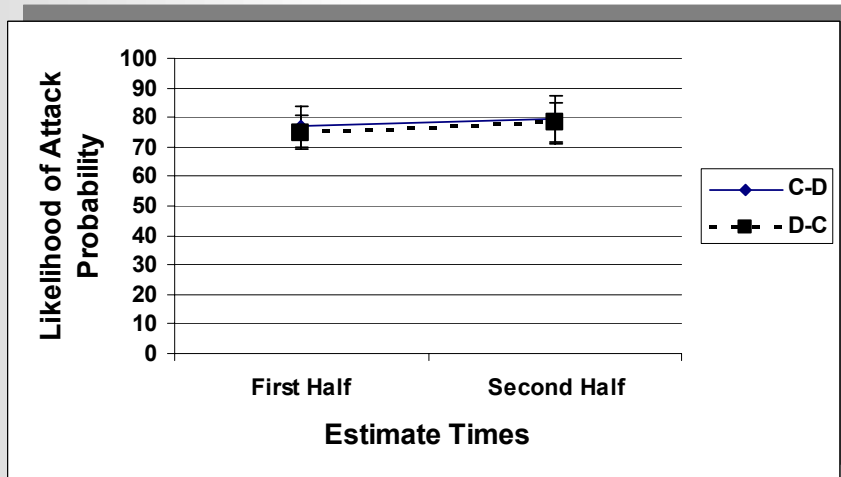
As predicted the confirming-disconfirming & disconfirming confirmation orders elicited different strengths of belief for an enemy attack ($p < .06$)



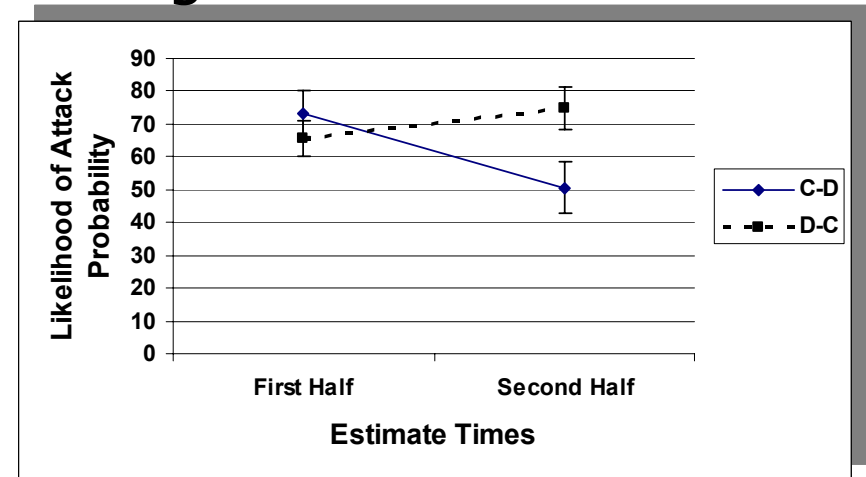
Tactical Judgment and Information Load

- No evidence of an order effect when information load is low
- Significant contrast (order effect) when information load is high

Low Information Load



High Information Load



- The results demonstrated an order effect despite the fact:
 - Participants had to glean the information from the Email/Intel traffic of over 75 messages
 - Participants received the same information only in a different order



Conclusions

- Performance results did not support the prediction that an org. with an ISR coord. would out perform an org. without an ISR coord.
 - However, org. with an ISR coord. Caught up to the org. without an ISR coord. in trial 2 in both low & high information load conditions
 - Steep improvement may indicate presence of an ISR coord. does facilitate performance once sufficient training & practice have occurred
- Participants exhibited an order effect (a heuristic error) even though the confirmatory and disconfirmatory evidence was embedded in Email/Intel traffic
 - Order effect heuristic error strengthen by high information load
 - Suggest a problem related to network centric warfare that will have to be address

