C2 in Complex Urban Terrain: Human Performance Modeling

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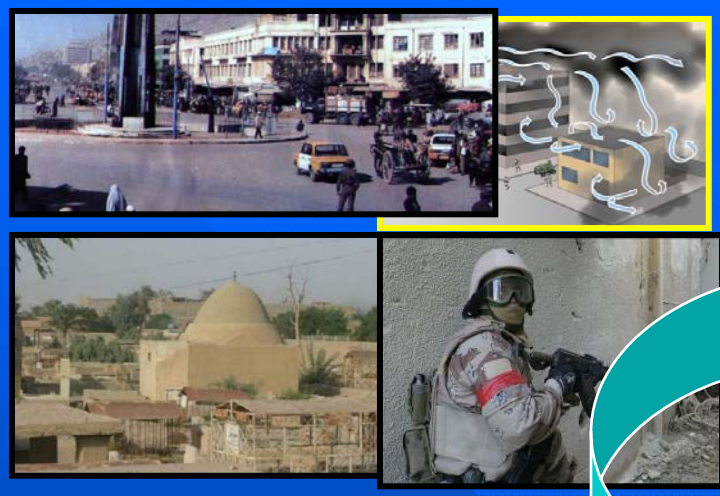
Outline

- Characteristics of complex urban terrain
- New approaches to decision making in uncertain environments
- C3TRACE application and results
- Future research

Decision Uncertainty in Complex and Urban Terrain



Physical terrain

Infrastructure systems: political, economic, social, transportation, utilities

Interactions Create Complexity and Uncertainty

Population density and cultural characteristics

"We cannot simply maneuver through the terrain. We must also "maneuver" through the population, e.g. physically maneuvering along cultural avenues of approach vice physical, or maneuvering through the systems that support the population." USJFCOM Concept for Joint Urban Operations , 1/14/2004.

New Approaches to Decision Making

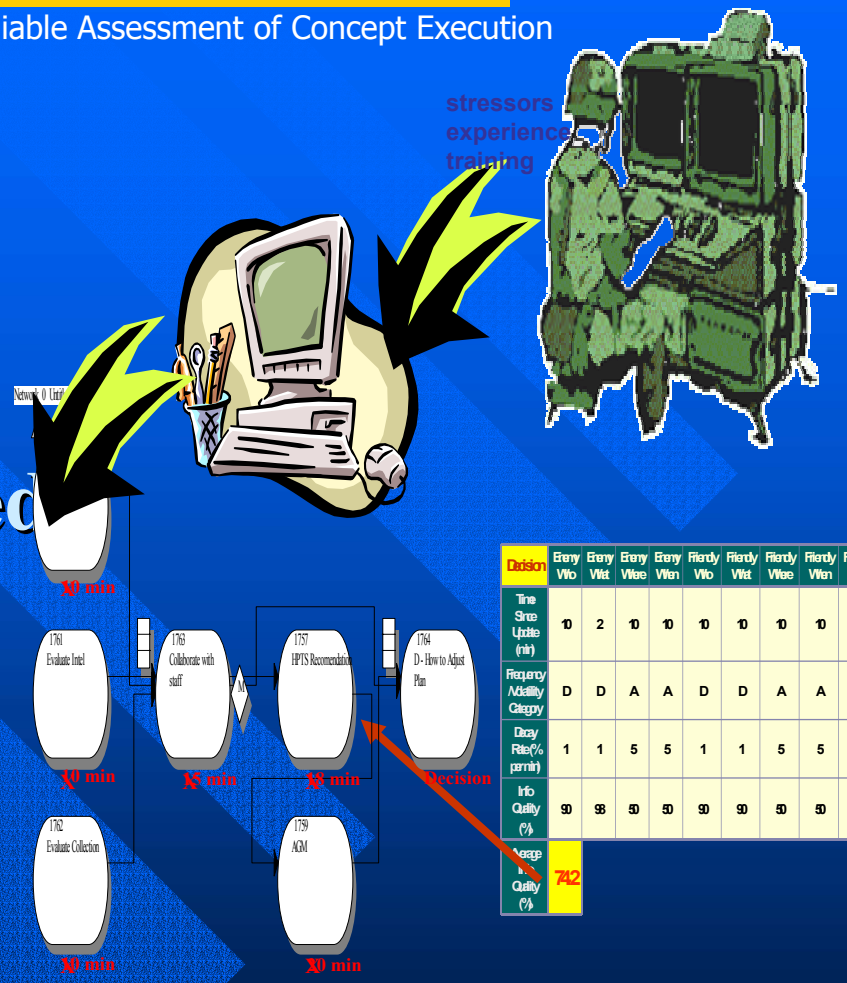
- Net centricity enables distributed collaboration with a ‘reach back’ capability to rear supporting organizations
- Distribution and collaborative networks allow non-military representatives of national power to contribute to decisions
- Effects based planning directs the coordinated (DIME) efforts of a coalition toward shaping others’ behavior

C3TRACE Architecture

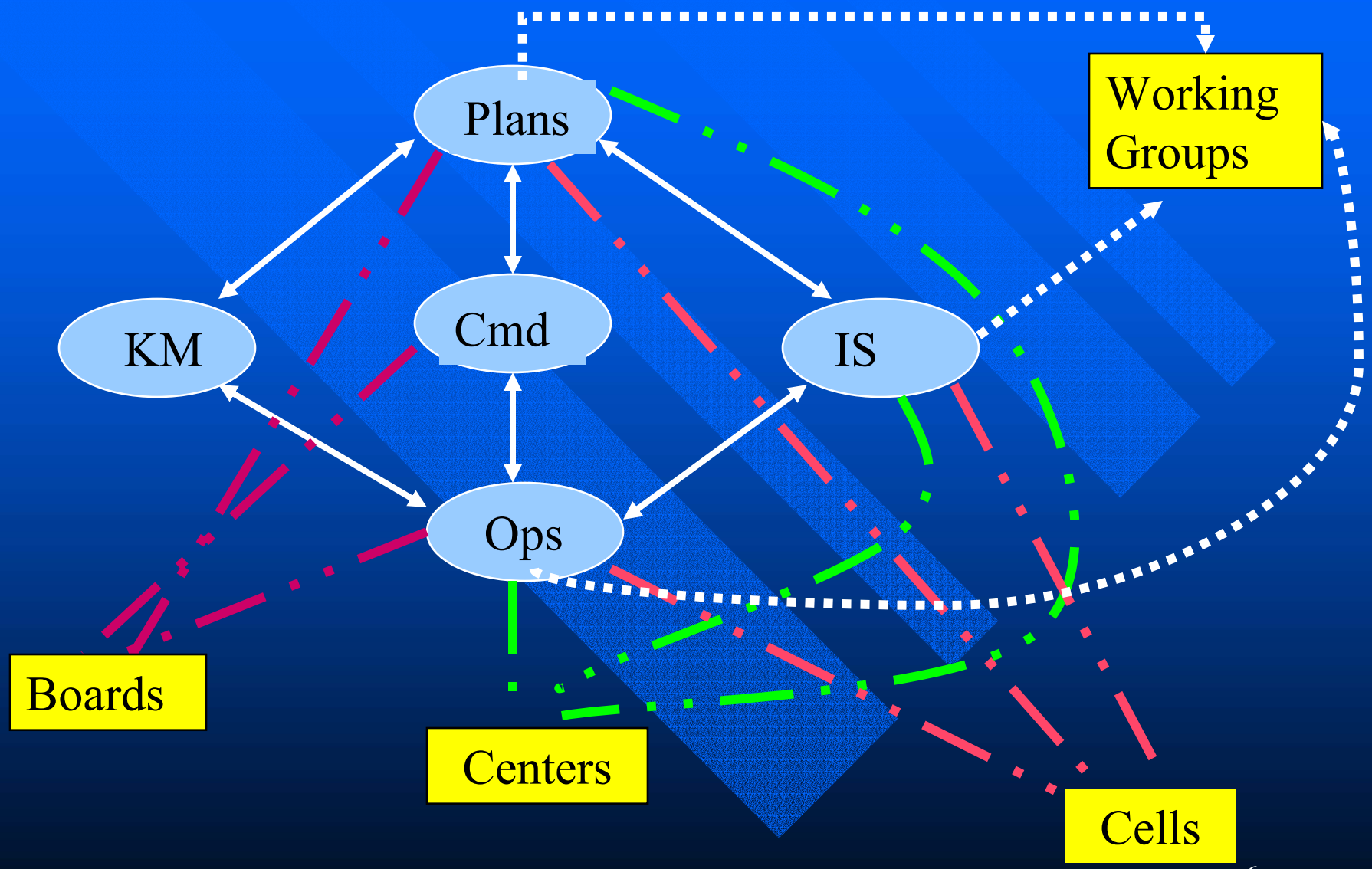
Command, Control, & Communications: Technically Reliable Assessment of Concept Execution

Questions we asked:

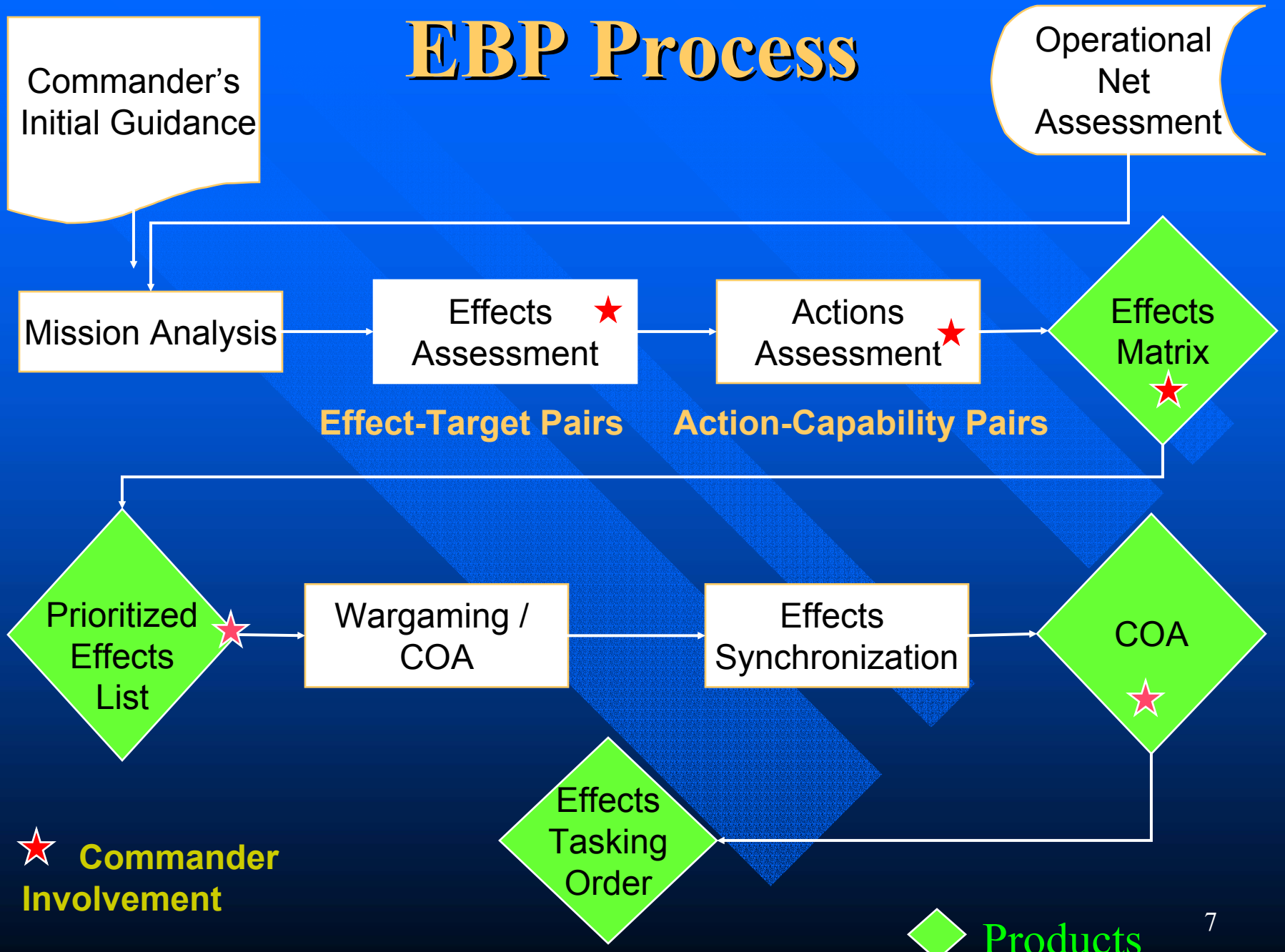
- Does the staff structure facilitate EBP?
- How are tasks distributed across staff groups?
- What communication events drive the process?
- Is the Commander adequately represented?



EBP Organization



EBP Process


Commander's Initial Guidance
Operational Net Assessment
Mission Analysis
Effects Assessment
Actions Assessment
Effects Matrix
Effect-Target Pairs
Action-Capability Pairs
Prioritized Effects List
Wargaming / COA
Effects Synchronization
COA
Effects Tasking Order
Commander Involvement
Products

Participants

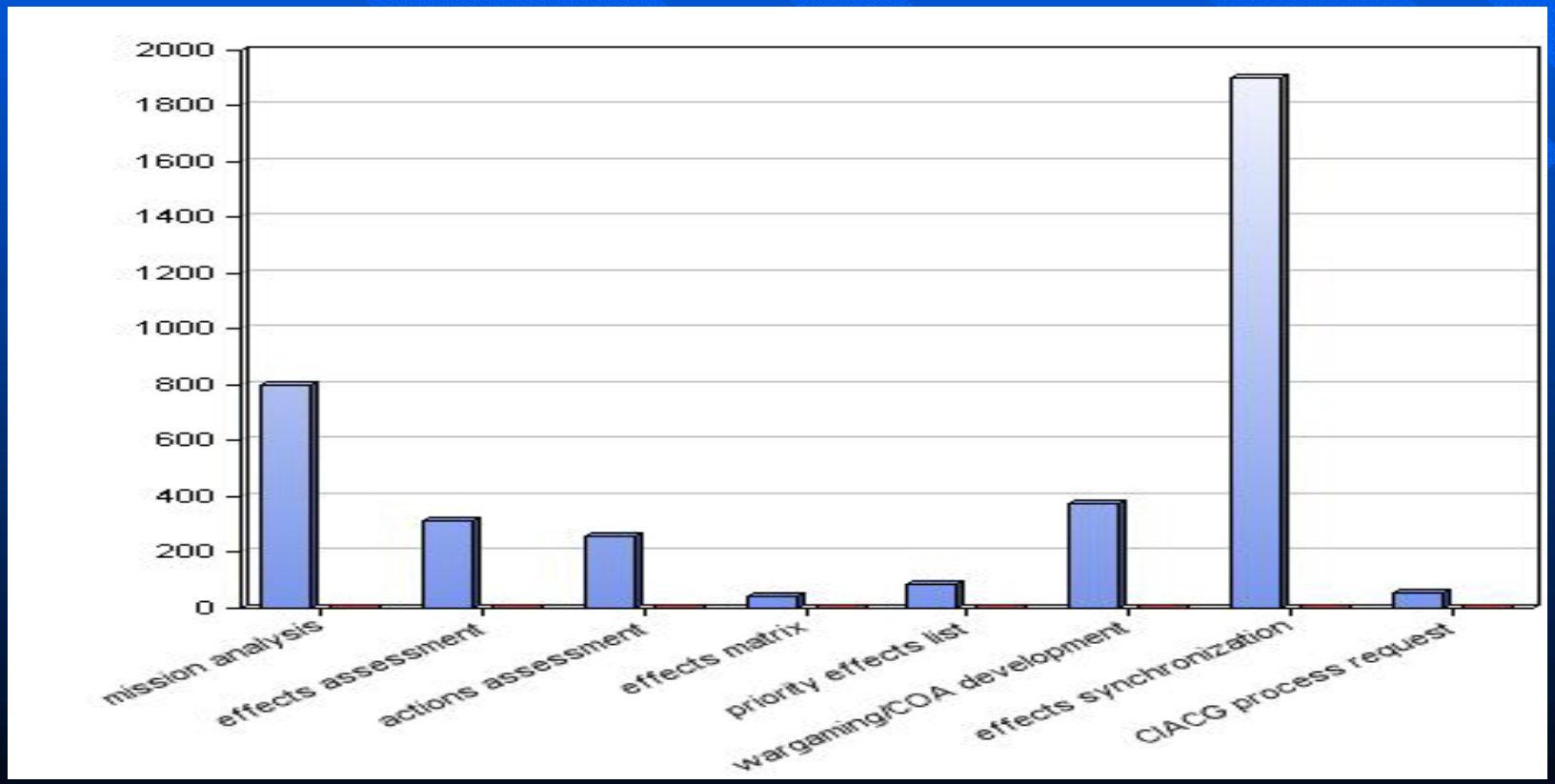
- CTF = 117, NRF = 34
- AU (6%), CA (12%), FR (13%), GE (18%), UK (18%), US (36%)
- Army (27%), AF (16%), Navy (18%), Marines (1%), Civilian (11%), Defense Contractor (24%), other (3%)
- Prior military experience = 90%
- No Experience with EBP = 77%
- No Experience in Dist Collab Envir. = 70%

Predicted Measures

- Task Times
- Staff Utilization
- Information Quality
- Situation Understanding

Task Times

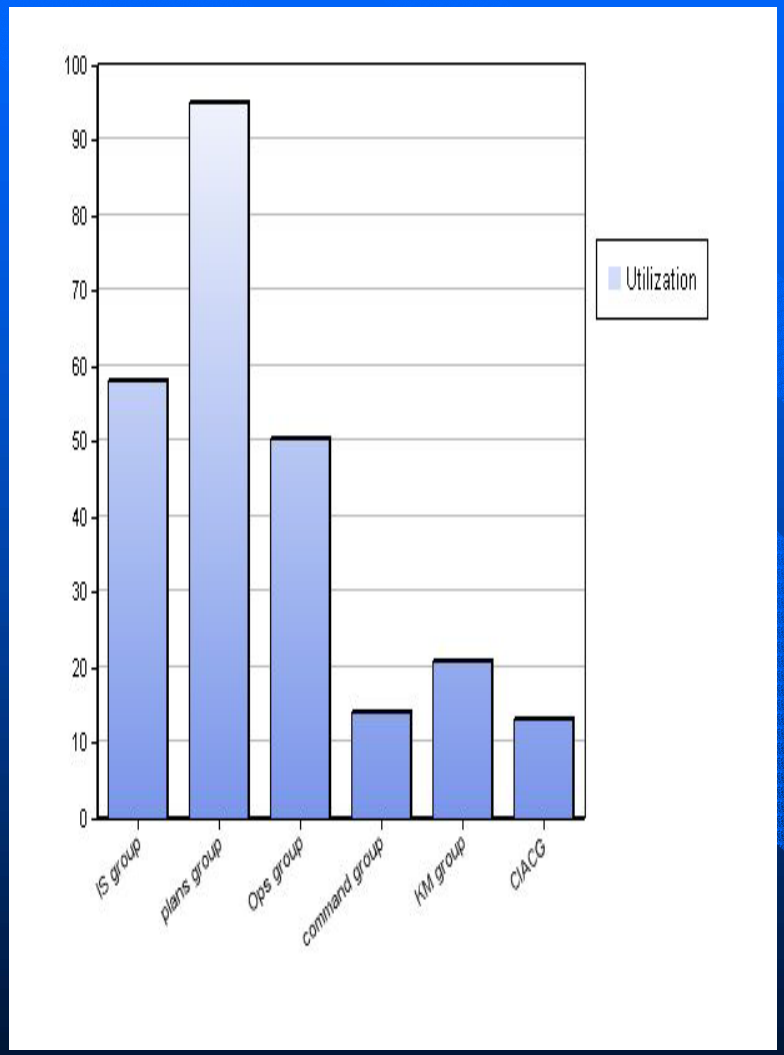
Mission Analysis and Effects Synchronization had highest task times due to collaboration requirements and difficulties



Collaborative Challenges

- Language (Terminology, acronyms, pace of conversation)
- Difficult to evaluate communications in a virtual environment.
- Confusion arising from doctrinal differences.
- Confusion over process.
- Confusion with organization

Staff Utilization



Plans (98%),

Ops (50%)

IS (58%),

KM (20%)

Cmd (14%),

CIACG (13%)

Overall judgment of information quality

Variable	Mean (7 point scale)	SD
Precision	3.45	1.49
Content	3.55	1.35
Sufficient	3.44	1.29
Accurate	3.57	1.32
Clarity	3.27	1.32
Timely	3.35	1.38
Current	3.56	1.30

Situation Understanding

- Ratings of SA and Information Flow were taken in each process step
- MANOVA between national groups showed no significant differences in the first three EBP stages
- In Effects Synchronization, significant differences were noted for 2 nations $F(6, 73)=2.967$, $p=.012$
- 2 nations reported a significantly lower abililty to predict how events would develop in the Effects Synchronization stage.

Conclusions

- The Effects Synchronization stage was highly problematic, indicating the complex tasks involved
- The structure and functions in a cross-functional operational staff need refinement
- Modeling is a valuable tool to investigate the consequences of various structures and contributions of technologies
- New patterns of command involvement should be explored in a decentralized, virtual C2 structure to ensure appropriate levels of oversight