Design of command and control organizational structures: from years of modeling to empirical validation

Paper 145

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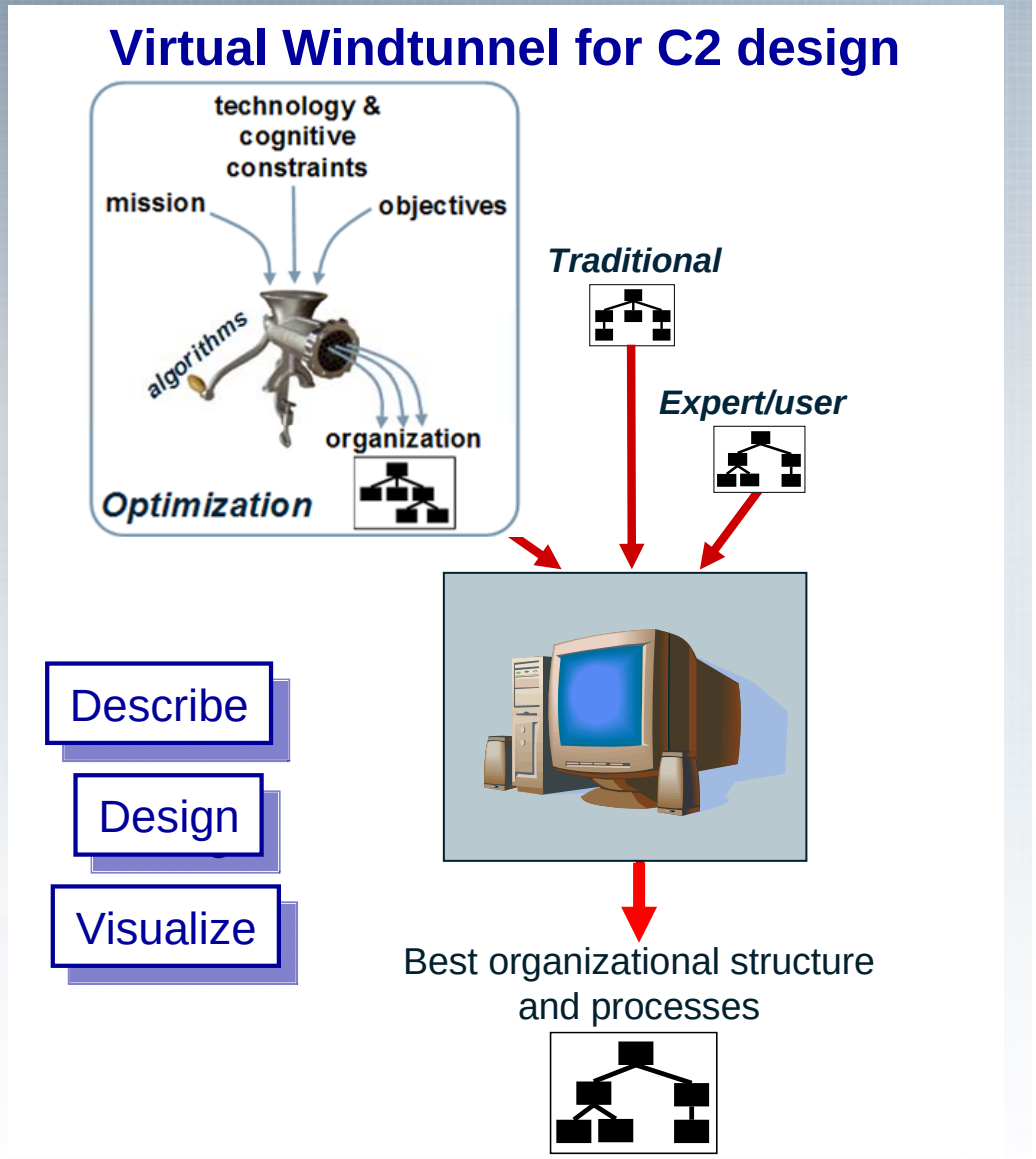
Summary

- Goals
- Research cycle
- Focus of presentation
- Experiment details
- Results
- Conclusions

Goal of research: develop "virtual windtunnel" for design of C2 organizations

- Enable commanders to perform their mission better, "aligned" with the technology and the organization
- Create organizational structures from **modular components** that "fit" the mission, the technology, and the people
- Test new C2 concepts before they are deployed



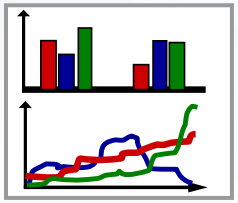
Research cycle in C2 design and analysis

Studies of expert decision making

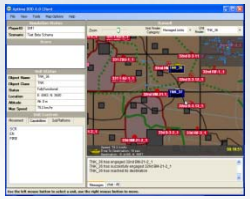
Theory of team formation and decision making

Algorithms to find optimal ("congruent") C2 structures

Detailed simulations to evaluate expected performance and processes



Empirical studies of C2 architectures



Foundational theory

Objectives:

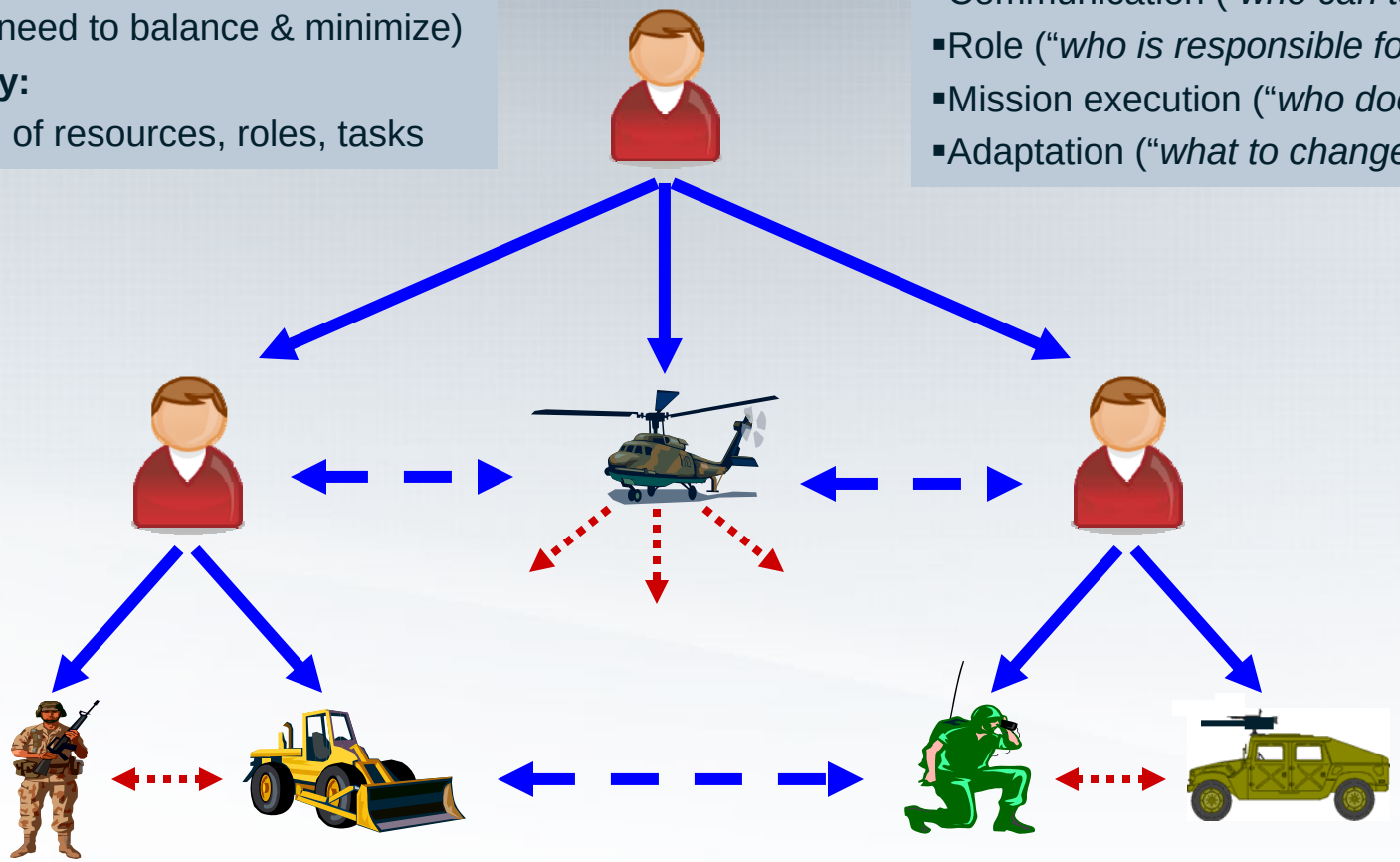
- Fast & efficient execution (resource availability, SA, fast communication, manage task-resource match)
- Workload (need to balance & minimize)

Achieved by:

- Distribution of resources, roles, tasks

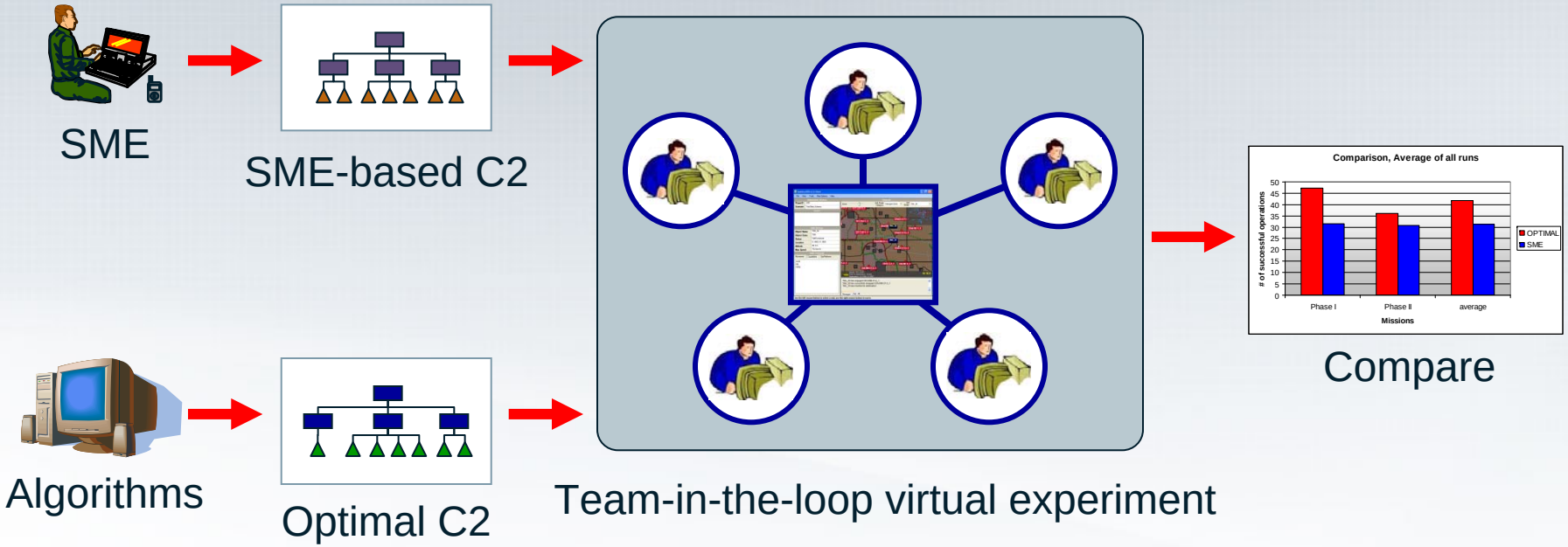
Variables:

- Control (“*who owns what*”)
- Command (“*who commands whom*”)
- Communication (“*who can talk to whom*”)
- Role (“*who is responsible for what*”)
- Mission execution (“*who does what*”)
- Adaptation (“*what to change*”)



Objectives of this paper

- Design “optimal” C2 organizations and compare them to “traditional” ones in team-in-the-loop experiments
- Use two different mission setups



Elements of C2 organization

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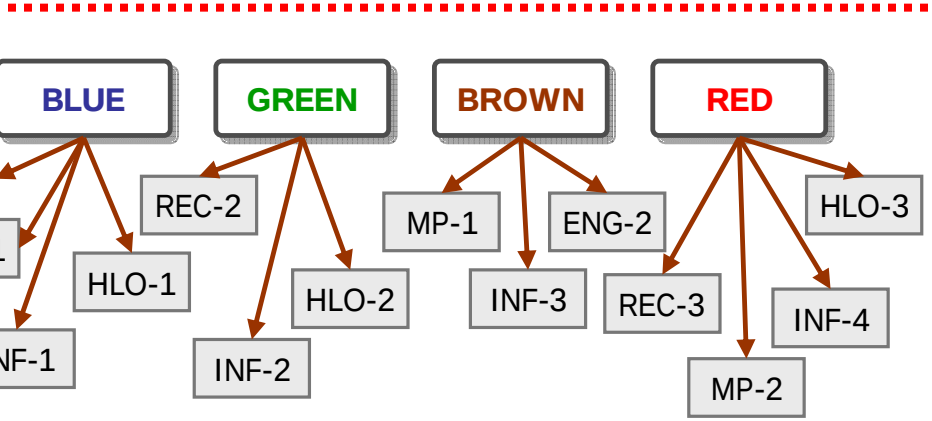
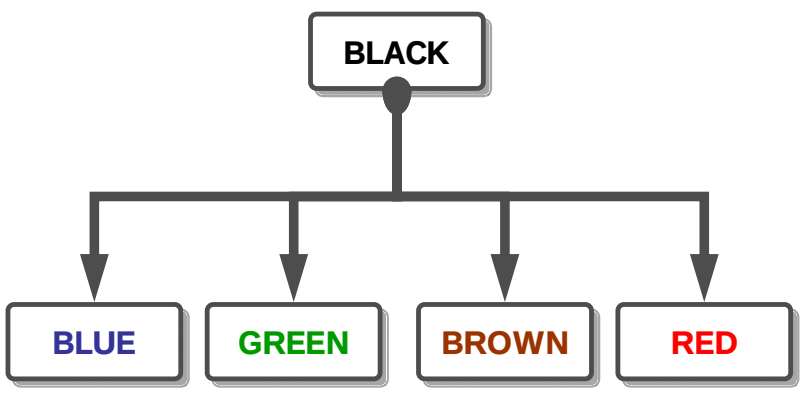
e	#	Description	FIRE	REC	ENR	MP
	3	Reconnaissance Team	0	2	0	0
	2	Engineering Team	0	0	1	0
	4	Mechanized Infantry	1	0	0	0
	2	Military Police Team	0	1	0	1
	3	Helicopter Section	2	0	0	0

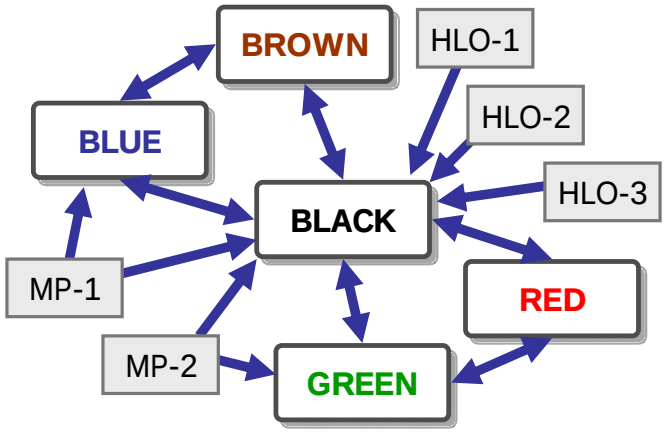
(a) Resources composition



(b) Control Structure



(c) Command Nodes & Structure



(d) Communication Structure

Domain of the study

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my modular division consisting of
gade-level combat teams

Team Players (represent commanders)

MI (1st BCT):
- PIR BN (2)
  - *RFL CO (3)*
  - *WPN CO*
- CAV SQDR
  - *MTD TRP (2)*
  - *DSM TRP*
- FA BN
  - *HOW BTRY (2)*
- AR (MBT)
  - *RFL CO (2)*
  - *TNK CO (2)*
  - *CMBT ENGR CO*
- AR (IFV)
  - *RFL CO (3)*
  - *CMBT ENGR CO*

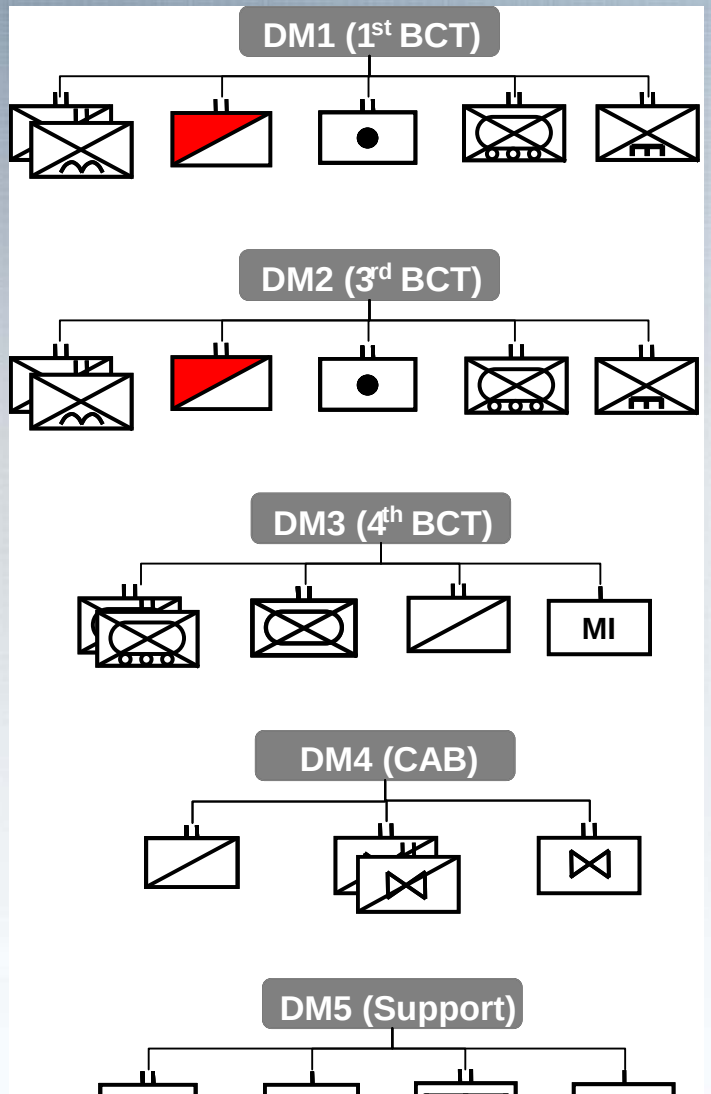
"Assets" (units)

DM2 (3rd BCT):
- PIR BN (2)
- CAV SQDN
- FA BN
- AR (MBT)
- AR (IFV)

DM3 (4th BCT):
- AR (2)
- IN (M)
- CAV
- MI

DM4 (CAB):
- CAV
- Atk Av Bn (2)
- Gen Sprt Av Bn

DM5 (Support):
- FA BN
- MP BN
- ENGR



Experimental scenario

LUE force elements:

Rifle & Weapons Co; Motorized, Dismounted, and Recon Troops; Howitzer & Towed Field Artillery; Tank Co; Mech and Combat Engr; Military Police and Intel Co; Helicopters (OH58D, AH64, UH60, CH47); Civil Affairs

ssion Phase I (*combat*): 82d AIRBORNE DIVISION clears the city AZ to destroy RED 3d Infantry Division

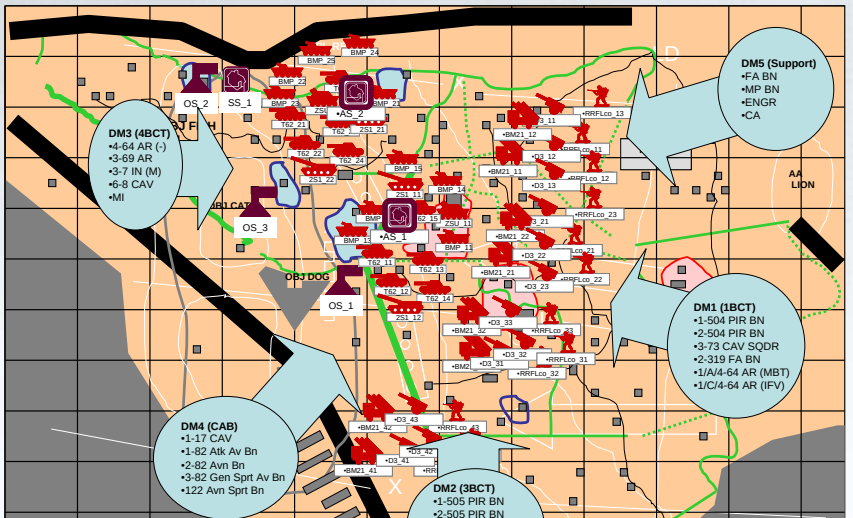
RED targets: Infantry, Tanks, Fighting vehicles, Howitzers (towed and self-propelled), Mortar artillery, Anti-aircraft guns

BLUE ops: site and area security, enemy forces, force-on-force engagement, seize/occupy objective

ssion Phase II (*stability*): reinforced by ts of 2d CAF Division, conducts stability erations to ensure security of city & ablishment of vital infrastructure functions

RED ops: IED & VBIED, Small-arms attacks, mortar attacks, snipers, riots, criminals

BLUE ops: site and area security, facility reconstruction, crowd control, patrolling, searches, civilian ops, hostage situation, aid delivery, police



Metrics

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Process/efficiency (drivers of performance)

- External coordination (dependency on others vs unity of command)
- Internal coordination (balance of work among commanders)

Performance/effectiveness:

- Operations Completed Successfully
- Response Time

Sample results:

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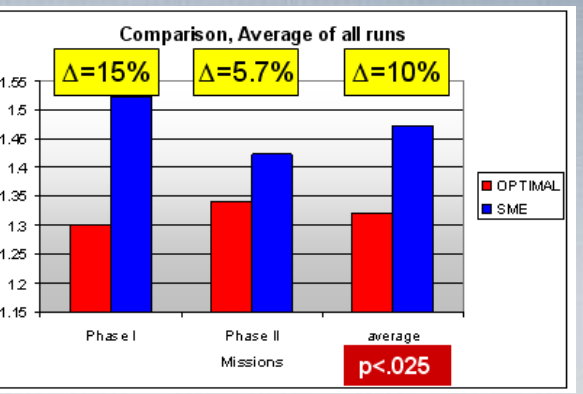
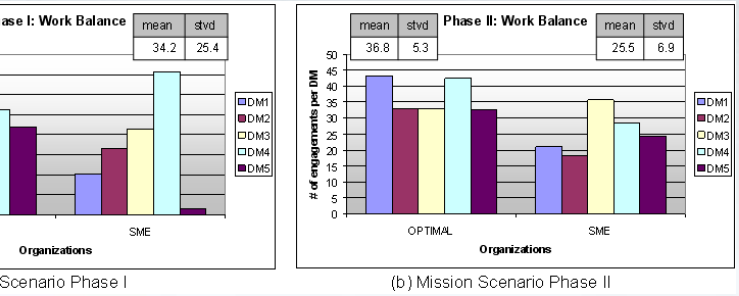
Processes



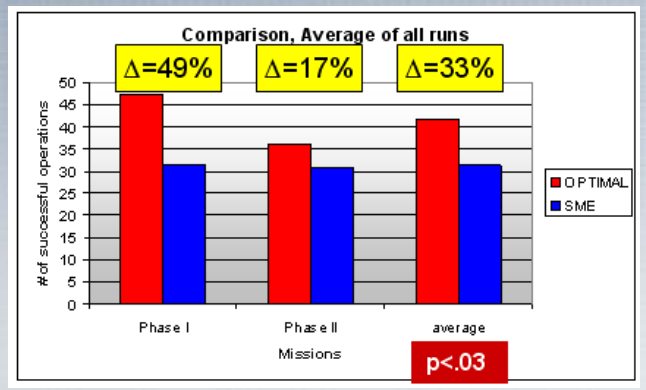
External coordination load



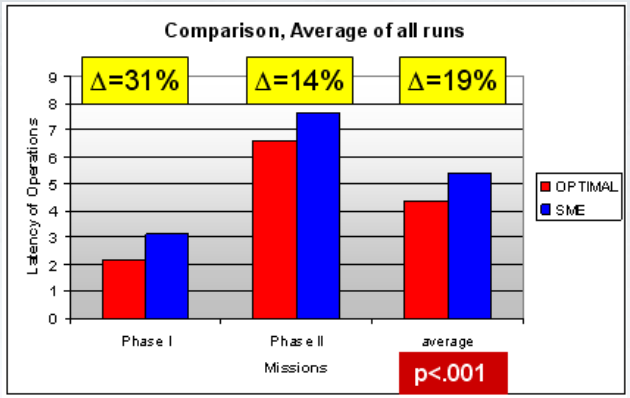
Scenario Phase I (b) Mission Scenario Phase II

Internal coordination load

Performance



Operations completed successfully



Operation response time

Conclusions

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High coordination is detrimental to performance

- **External coordination:** commanders spend time on requests and synchronization activities and less time on executing operations
- **Internal coordination:** managing different resources results in planning and monitoring overload

Optimization model has detailed knowledge of expected tasks, allowing for a more optimal distribution of resources to balance coordination and work

- Smaller number of commanders per operation results in decreased external coordination and in turn frees commanders to manage their assets and conduct engagements
- Better workload distribution removes bottlenecks and improves response time

Future research efforts must be focused on analysis of command and communication structures

- Hard to manipulate in empirical studies

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