

Exploring alternative Edge vs. Hierarchy C2 Organizations



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Overview

- Sweden and Singapore have an ongoing C2 development research collaboration.
- The purpose of this study was to explore the effect of different rules of information-sharing, communication, and decision-making on the performance and behavior of three different permutations of Edge versus Hierarchical Organizations.
- Our technical platform was the ELICIT Multiplayer Intelligence Game combined with the use of CHAT.
- Participants from Singapore Command Staff College formed 7 teams and performed 1 training run and 1 experiment run in one of three different permutations of the ELICIT game play.

Disposition

- Problem definition and Introduction
- Description of Experiment Methods
- Presentation of Results
- Discussion of Findings

The Problem

- Current C2 theory advocates the *Edge organization* (e.g. Alberts & Hayes, 2003) as a response to the challenges of current military missions, as well as to the opportunities of the new information technology.

“As part of its network-centric warfare initiative, the Command and Control Research Program (CCRP) is engaged in developing and testing principles of organization that significantly reverses traditional command and control practices, transferring power and decision rights to the edge of the organization.”

“missions designed with superior shared awareness, trust and self-synchronization will perform with greater speed, precision, effectiveness, and agility than missions conducted under traditional hierarchical command structures. This is achieved by placing decision rights at the “edge of the organization,” close to the points of consequence”

- This is theory (and it already has some support from empirical research) but in order to support the development of better military C2 organizational concepts we need to put the theory to test and thus develop a better understanding of the relative advantages of different possible C2 models.

What is the ELICIT Multiplayer Intelligence game ? - I

- ELICIT is an initiative sponsored by the CCRP for C2 research community to research and experiment differences between hierarchical and edge organization concepts.
- ELICIT stands for Experiment Laboratory for Investigating Collaboration, Information-sharing and Trust.
- The present software of ELICIT requires a team of 17 subjects performing the roles of intelligence analysts to collaborate, in a network centric, information processing environment, with the goal to identify a fictitious and stylized terrorist plot.
- In the Elicit Game, the experimental task is for every subject to identify the “who”, “what”, “where” and “when” of an adversary attack, based on simple information facts (called “factoids”) that become known to a team. During the game, all players will eventually receive four factoids each, which can be posted on a website or sent to other players.

What is the ELICIT Multiplayer Intelligence game ? - II

- The original ELICIT Game is designed to compare the edge versus the hierarchy, therefore the independent variable in ELICIT is whether a team is organized using traditional Hierarchical organization or using Edge organization principles.
- Each game requires 17 players and the players are randomly assigned with pseudo-names, and organized in either a Hierarchical or Edge organization, to perform the required tasks.
- Putting the game in real-world context, the organization can be seen as an intelligence organization that has to analyze incoming data and inform its client (or government) about the assessment.

Limitations to ELICIT as a test platform for Edge vs. Hierarchy

- A key consideration in achieving shared awareness among the members of a team, and also being able to trust and collaborate should be the ability to provide inputs by one team member to another and get a response from that member in return. This is not available in ELICIT.
- Another limitation is that ELICIT currently only provide two forms of experiment play and that is, hierarchical and edge. There is no in-between or hybrid, which could be of the more acceptable nature for organizations willing to try edge structures but cannot do away with their current hierarchical structure culture.

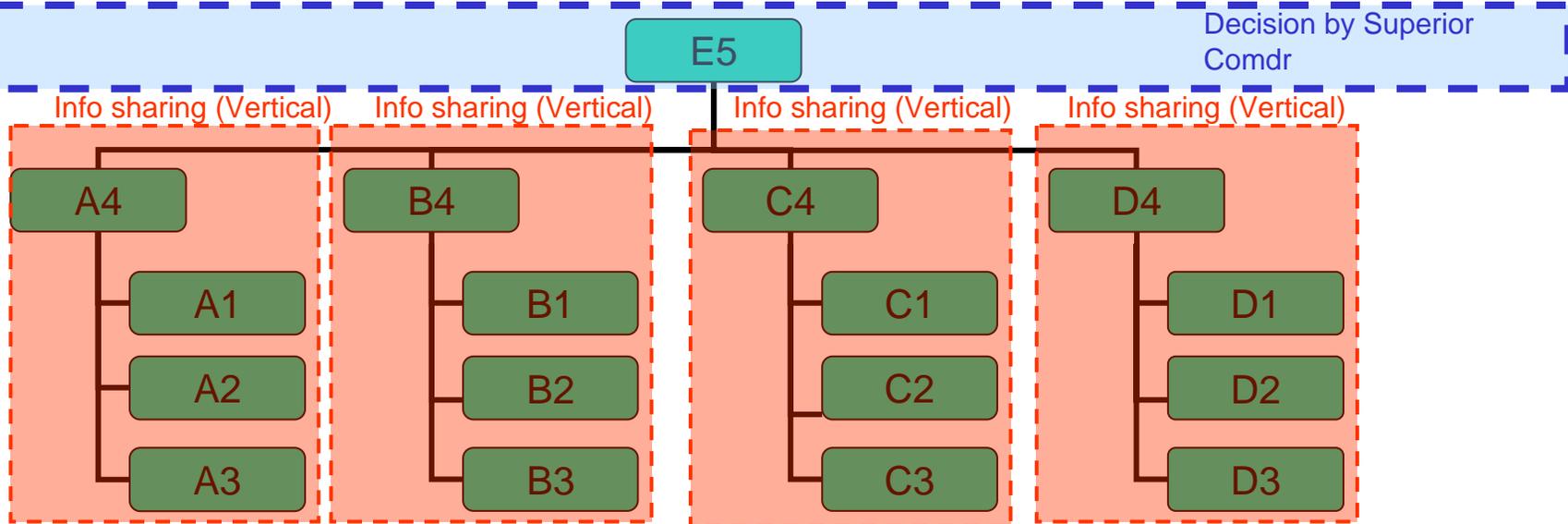
How we addressed the limitations of ELICIT

- The limitation not being able to share mental model between organizational members was solved by adding a chat module. As modern information technology makes its way into current C2 organizations, web-base communication tools such as online-chat becomes a possible way for different roles and groups in an organization to communicate and interact. With CHAT, members can now get immediate response on a topic, fact or an analysis, and at the same time, use group-based CHAT as a means for achieving shared awareness and facilitating reporting structures.
- The limitation of only two testable organizational structures in ELICIT was solved (1) by adding different decision rules to the tested configurations, and (2) by adding different CHAT communication rules to the tested configurations.

Different methods of decision making

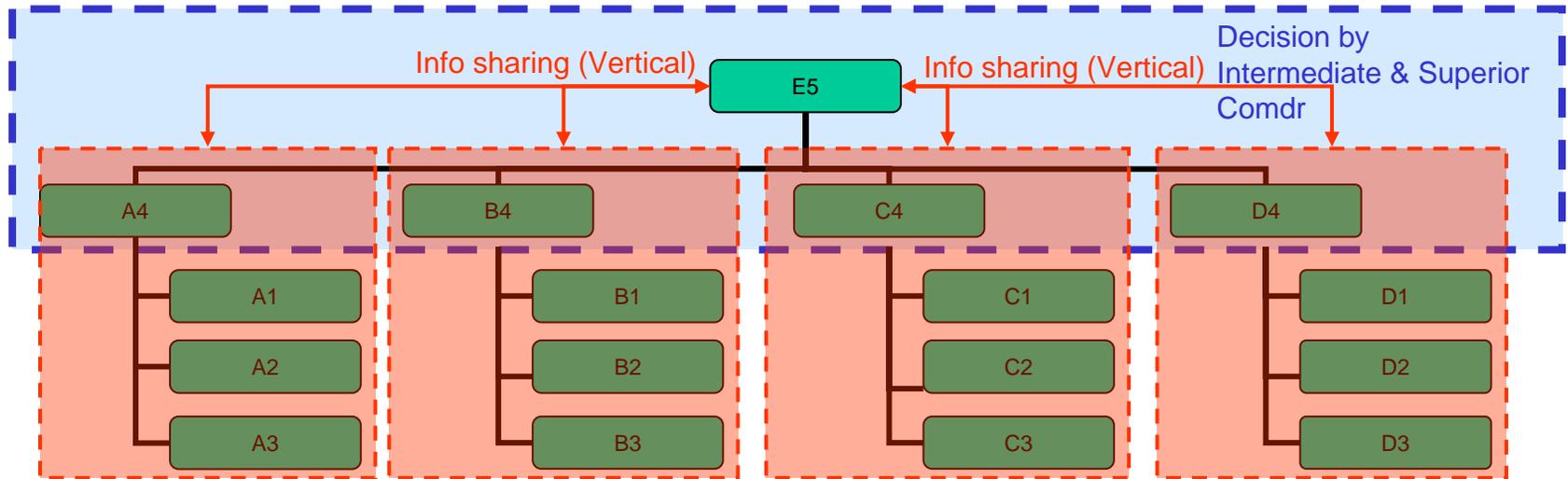
- Another aspect that we wanted to include in our investigation was organizational decision making.
- A traditional hierarchy normally makes decisions at the top, by the commander.
- In the edge organization it is not so clear how the organization as such makes decisions, but the general idea seems to be that in the edge, everyone has the right to decide how to act for them selves (Alberts & Hayes, 2003).
- There are also other ways for an organization to make a decision. For example, making decision in a committee or coalition, where the decision makers all represent different areas of responsibility or expertise and they are forced to make a decision in consensus, or at least, by majority.
- Another example is if an edge organization has to come up with a (common) decision. Then such a decision could be made by majority or plurality or some other decision rule.
- We combined both different configurations of CHAT and different decision rules with the basic ELICIT game in order to explore and compare three different kinds of organizations.

Organizational structures – Traditional Hierarchy (TH)



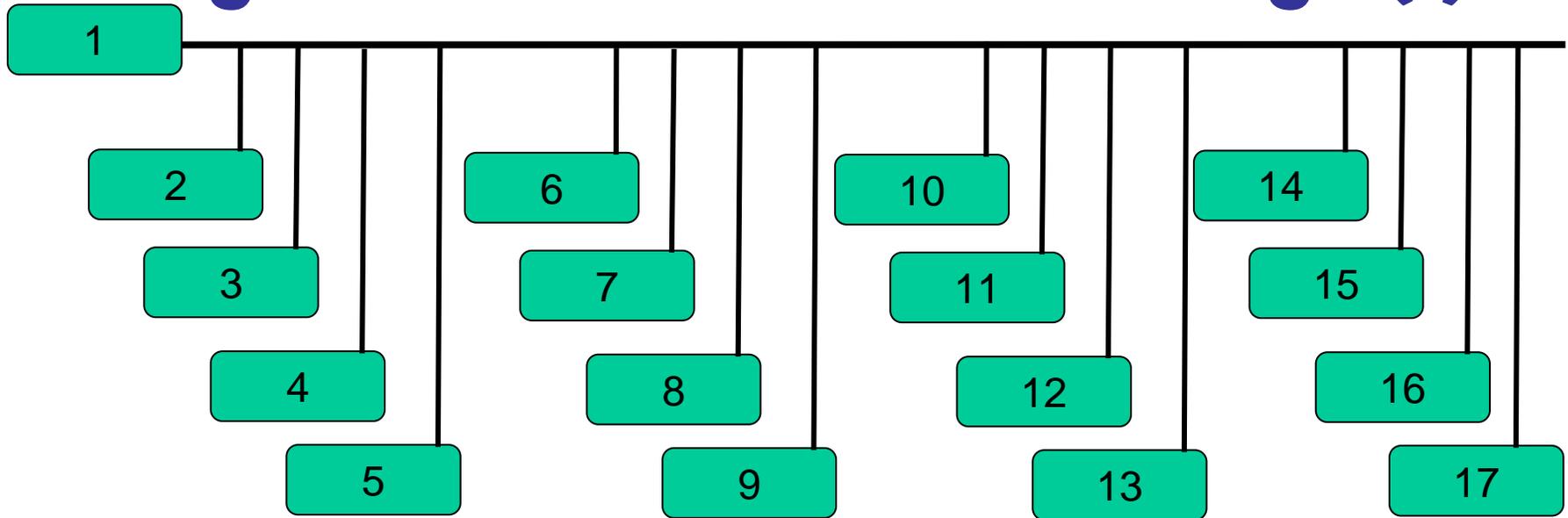
No. of Layers	Three: Cross Team Leader, Team Leader, Team Member
Grouping	Organised in Functional Groups: Who, What, Where, When
Information Access	Access to websites of OWN functional group
Communication Channels through CHAT	Members can CHAT with Members. Members can CHAT with their own Team Leader. Team Leaders can CHAT with other Team Leaders and Cross Team Leader. Members cannot CHAT with Cross Team Leader.
Decision Making	Only by Cross Team Leader

Organizational structures – Hierarchical Hybrid (HY)



No. of Layers	Two - Three: Cross Team Leader, Team Leader, Team Member
Grouping	Organised in Functional Groups: Who, What, Where, When
Information Access	Access to ALL FOUR functional websites
Communication Channels through CHAT	Everyone can CHAT with everyone else.
Decision Making	Simple majority among Cross Team Leader and Team Leaders

Organizational structures – Edge (E)



No. of Layers	One layer for all
Grouping	Nil
Information Access	Access to ALL FOUR functional websites
Communication Channels through CHAT	Everyone can CHAT with everyone else.
Decision Making	Simple majority (9 of 17)

Method – Design

- The study employed an experimental design. Independent variable was the *type of organization* in three different levels: (I) the Traditional Hierarchy (TH), (II) the Hybrid between a traditional hierarchy and the edge (HY) and (III) the Edge (E).
- Study design included:
 - Formal training (0.5 day) on ELICIT and CHAT
 - 1 training run on 1 of the 3 different organizational types, but not the same as in the test run, followed by a short AAR.
 - 1 experiment run on 1 of the 3 different organizational types.
 - The experiment run included a slightly more difficult scenario than the training run and all teams used the same scenario.

C2 Concept	Number of Teams
Level I – Traditional Hierarchy (TH)	2
Level II – Hybrid (HY)	2
Level III – Edge (E)	3

Method – Dependent variables

Dependent Variable	Experimented C2 Concept		
	Traditional Hierarchy	Hybrid	Edge
Decision Speed	Time taken for Cross Team Leader to decide	Time taken for 3 or more among the leader group to agree on solution	Time taken for 9 or more in the whole organization to agree on solution
Organizational Decision Accuracy	Solution posed by Cross Team Leader	Solution arrived by majority (3 or more agree) between leaders	Solution arrived by majority (9 or more agree)
Level of Correct Shared Awareness	Proportion of Org with 100% correct answers	Proportion of Org with 100% correct answers	Proportion of Org with 100% correct answers
Team working process	A qualitative assessment on (1) how the information is accessed and shared, and (2) pattern of communication and decision making within the organization.		

Results – Dependent variables

C2 Concept	Organizational Decision Accuracy (Correct = 2 / Incorrect = 1)	Decision Speed Minutes, (SD)	Shared Awareness (Proportion of Org with 100% correct answers out of 17)
Hierarchy	1.5 ^a	42.5 (2.12) ^{a, c}	20.5% ^a
Edge	2.0 ^{a, b}	30.5 (6.73) ^{a, b}	91% ^{a, b}
Hybrid	1.5 ^b	38.5 (3.53) ^{b, c}	23.5% ^b

a, b, c = comparison indicates a large effect size (Cohen's *d*)

- The teams in the edge condition had higher organizational decision accuracy than did teams in TH and HY.
- The fastest organization to make a decision was the edge, followed by the hybrid and the slowest was the traditional hierarchy.
- The teams in the edge had a higher level of shared *correct* awareness of the threat situation than did teams in both of the other conditions.

Discussion

Main Finding:

- On this task, when an intelligence organization have to analyze incoming data and decide on an interpretation of these data, the edge organization outperformed both the traditional three-level hierarchy and the hybrid edge/hierarchy organization on decision speed, decision accuracy and level of shared, correct, awareness of the threat situation.
- The hybrid organization made decisions faster than the traditional hierarchy, but performed equally well on decision accuracy and shared awareness among the members of the organization.

Discussion

Main reason:

- The main reason behind the difference between the edge and both of the hierarchies is probably that in the hierarchy the processing of information takes place at two different levels subsequent to each other in time, but in the edge there is only one processing level.
- In the hierarchy there is first some processing within the functional team (e.g. the who-team). This processing involves the team members and their team leader. Next, there is a second sequence of processing, involving the team leaders for all four teams and the cross team coordinator, (i.e. the commander).
- This processing takes time and we saw examples how the team-leaders did not share the threat evaluation made by their team members and thus did not report the team evaluation to the cross team coordinator but only their individual assessment, resulting in the command team getting it wrong while the functional team had the correct assessment.

Discussion

Limitations:

- Firstly, as the number of observations is small, at only two data points per condition, this makes it difficult to establish how stable these results will be if the study was to be replicated.
- Secondly, as has been shown from the qualitative analysis of the information dissemination traffic, a key factor for success in ELICIT, regardless of organizational structure, is that all (critical) information received by a player gets posted on a website so that more people can take account of it. This depends on the individual player's behavior during the experiment and may not be attributed to any particular C2 structure. Having insufficient runs to average out this uncontrollable variance may have distorted the total results.

Discussion

Validity?

- We showed that in at least some circumstances consensus decision making in a flat organization does not have to take longer time than hierarchical decision making, at least not in a situation where a true, or objectively correct, decision can be found. On the contrary, it can be faster.
- We also showed that filtering of information through hierarchical “filters” is risky and sensitive to distortion in some cases. Some mid-level managers can suppress the opinion of their subordinate team members and present only their own personal view, and there is normally little incentive for a superior commander to surpass his subordinate commander and go directly to the team in order to get their view.
- We also showed that understanding of the intent is not enough. It is equally important for success that the individual entities of an organization (a) understands its own role (here to disseminate incoming information) and (b) that there is a functional working procedure in the organization so that all team members can contribute effectively.
- Although may not be statistically robust, **these findings do possess a fair amount of face validity.**

Discussion

Validity?

- Another issue is of course if an edge C2 organization generally would outperform a hierarchical C2 organization regarding decision speed, decision accuracy and level of shared (correct) situation awareness? This can not be concluded from our results, partly because of the limitations, but mainly because the differences between the ELICIT and a real C2 organization are substantial.
- First, an organization normally have to take some action and not only perform a decision as in ELICIT. In real C2 situations this need for action often requires some prioritizing of resources as well as determine the order that the actions are taken. This might be quite difficult and time consuming in a flat organization.
- Second, in real C2 situations no objectively correct “truth” can ever be found, as in ELICIT. It is always a matter of opinion among the members of the organization how a specific task and situation should be interpreted and real values are at stake, which make people more prone to fight for their beliefs. This is also a complicating factor for a flat organization.
- Third, in real C2 situations, the participants tend to have different level of experience and background, which makes them less able to act as equals in a flat organization.

Questions?