



**ARMY OF CHILE**  
**Military Polytechnic Academy**

***Testing Edge versus Hierarchical  
Organizations using ELICIT and Common  
Identification Picture Tool***

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# AGENDA

## Topics

- Objective
- Edge versus Hierarchical Organizations
- ELICIT
- Common Identification Picture Tool
- Hypotheses
- Analysis and Results
- Results Discussion
- Conclusions



# PAPER OBJECTIVE

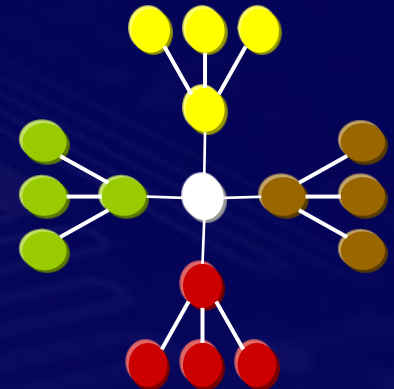
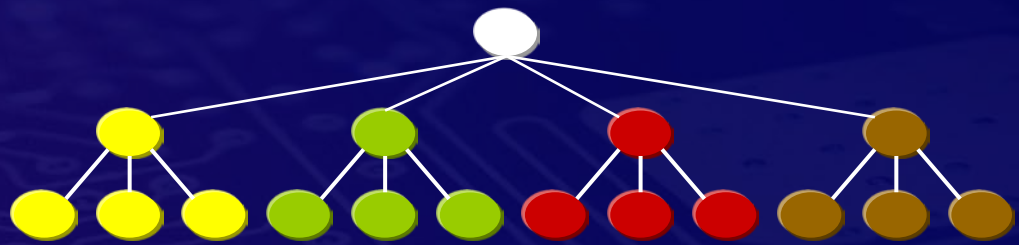
To present experimental research conducted by the Chilean Army, which used the ELICIT platform to contrast the performance of Edge vis-à-vis Hierarchical organizations in both the information and the cognitive domain.

For the latter, we combined ELICIT with a complementary tool we call Common Identification Picture (CIP), which enables participants to share their knowledge of the situation by posting their threat identifications.

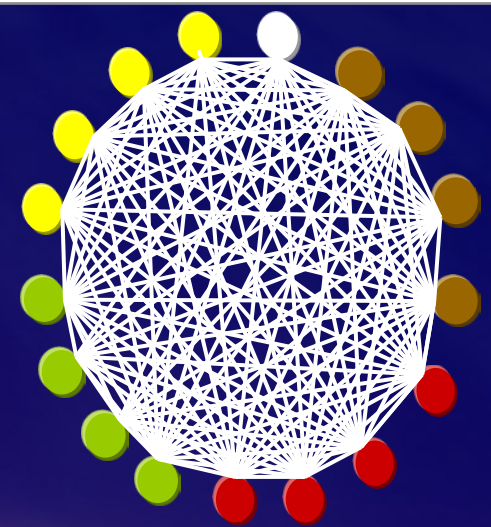


# EDGE VERSUS HIERARCHICAL ORGANIZATIONS

## HIERARCHY

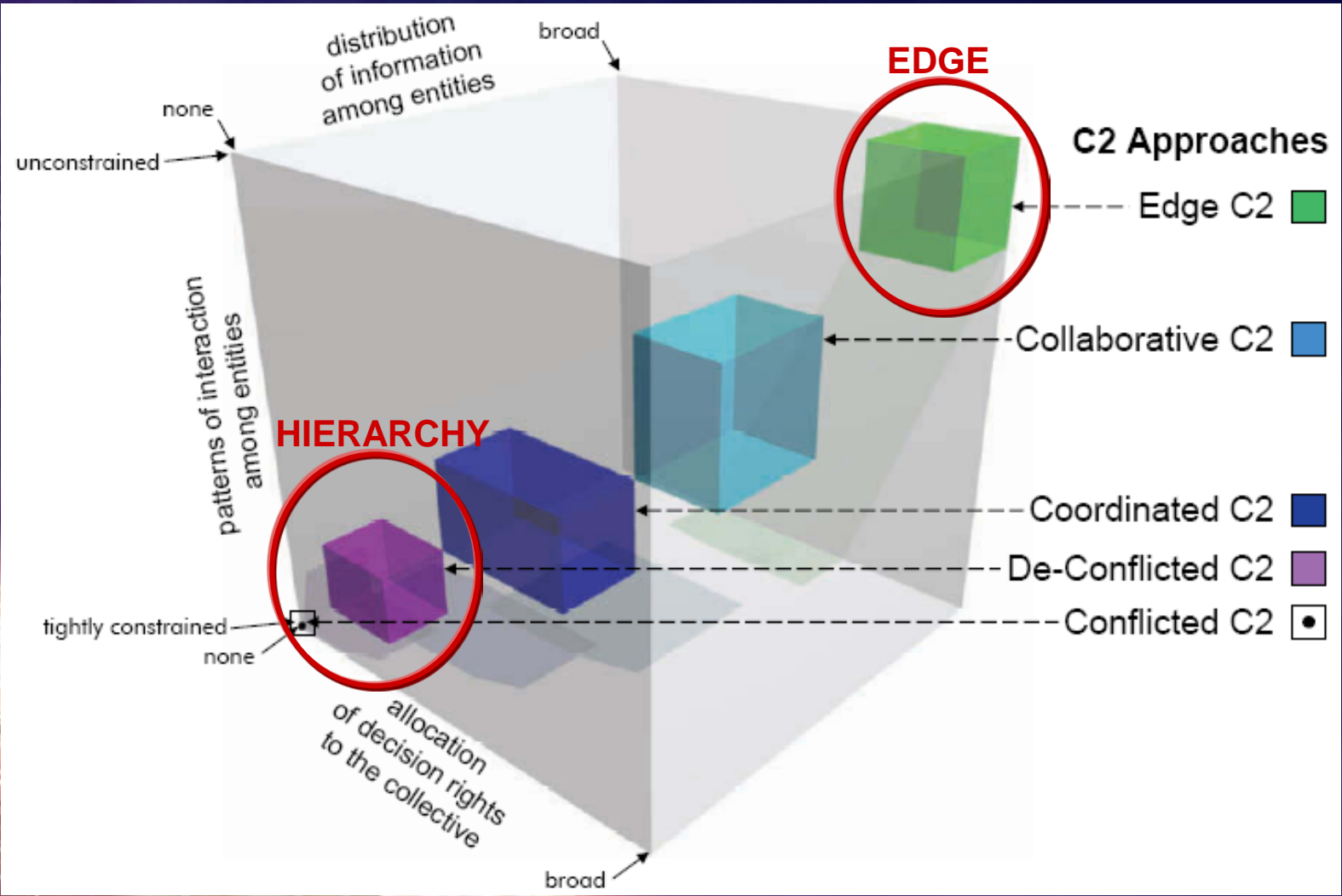


## EDGE





# EDGE VERSUS HIERARCHICAL ORGANIZATIONS



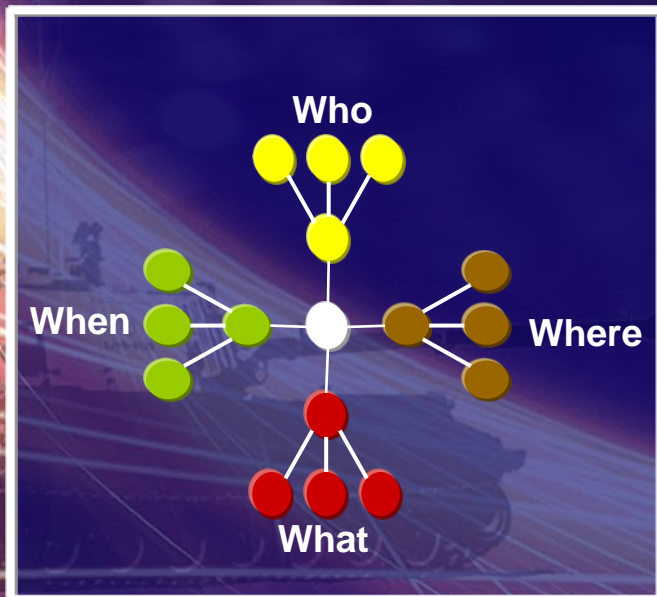
Source: NATO SAS-065 (2010). NATO NEC C2 Maturity Model. Washington DC: CCRP.



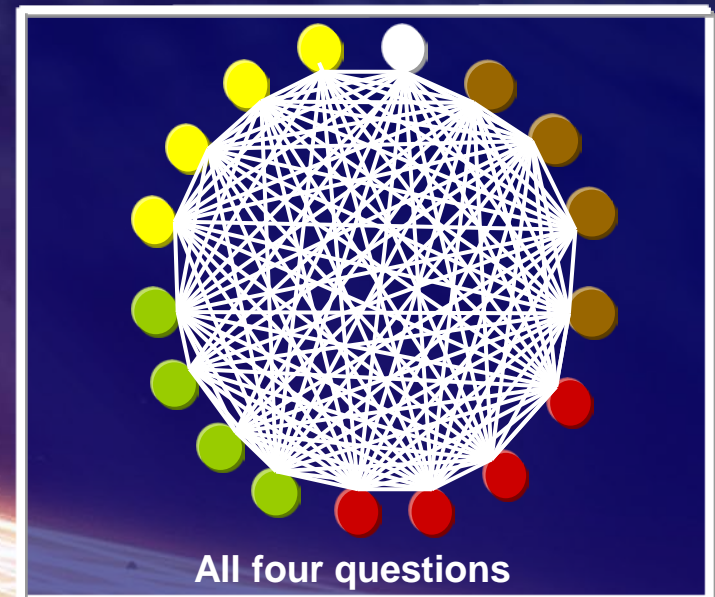
# ELICIT: A PROBLEM SOLVING SIMULATION GAME

- 17 individuals organized either as a Hierarchical or as an Edge structure.
- Players collaborate within a networked environment by sharing information between each other or by posting and pulling from websites.
- The purpose is to complete the threat recognition by identifying *Who*, *What*, *Where* and *When* the attack will occur.

## HIERARCHY



## EDGE





# ELICIT: A PROBLEM SOLVING SIMULATION GAME

- ELICIT provides the players with simple pieces of information (factoids) of varying value for accomplishing the identification goal.
- Each factoid is to be complemented with other pieces of information to build up situational awareness.
- No participant is given sufficient information to solve his/her problem without receiving information from others.
- Players perform the intelligence analysis, select the relevant factoids and share them to improve the collective awareness of the situation.
- Performance is measured in terms of accuracy and timeliness of threat identification.





# COMMON IDENTIFICATION PICTURE TOOL (CIP)



**FROM INFORMATION SHARING**

**TO KNOWLEDGE SHARING**

- Built to complement ELICIT functionalities.
- Represents the common practice of sharing intelligence reports among units.
- Prompts sharing already analyzed and contextualized notions (IDs or solutions).
- Richer *Patterns of Interactions* and incremented *Distribution of Information*.
- Shows the threat perception of participants that are able to make a judgment on the situation.
- Supports complete or partial attack identifications.
- Available for ELICIT community researchers.





# COMMON IDENTIFICATION PICTURE TOOL (CIP)

## CIP ADMINISTRATOR INTERFACE

The screenshot shows a Mozilla Firefox browser window titled "CIP Trial Start - Mozilla Firefox". The address bar displays the URL "http://localhost:8080/CIP/inicioexp.jsp". The browser's menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help". The address bar contains navigation buttons (back, forward, refresh, home) and a search icon. The browser's toolbar shows several icons, including "Comenzar a usar Firefox", "Últimas noticias", "AdminGF", "LOGIN CIP", "Inicio CIP", "Multiseries", and "Banco en Línea - Sa". The browser's tab bar shows two tabs: "Common Tasks" and "CIP Trial Start".

The main content area of the browser displays the following information:

- User : admin**
- Date : 2011-01-24 23:33:12**
- Elicit trial configuration**

The configuration section includes three dropdown menus and two text input fields:

- Exp. Nº 1 17 Subjects (dropdown)
- 30 minutes (dropdown)
- Edge (dropdown)
- Trial description (text input)
- Edge trial, Polytechnic Academy, Engineering Students (text input)

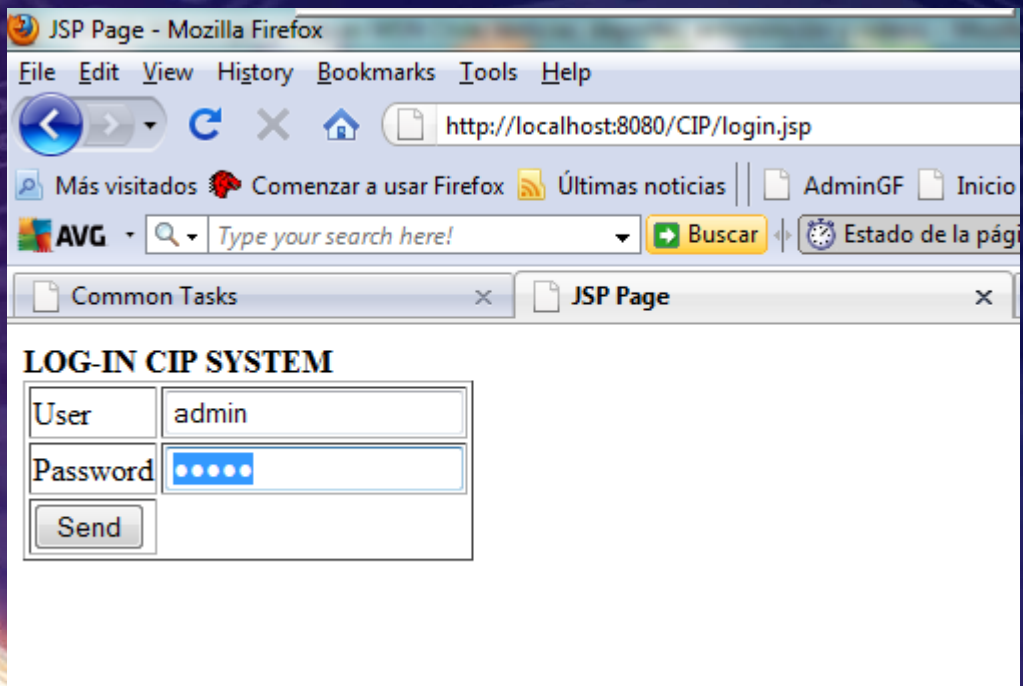
Below the configuration fields are two buttons: "Send" and "Clear".

At the bottom of the interface, there is a section titled "End of Elicit trial" with a "Trial end" dropdown menu and a "Finish" button.



# COMMON IDENTIFICATION PICTURE TOOL (CIP)

## CIP USER INTERFACE





# COMMON IDENTIFICATION PICTURE TOOL (CIP)

## CIP USER INTERFACE

CHART SECTION

IDENTIFICATION SECTION

The screenshot shows the CIP user interface in a browser window. The browser address bar shows `http://localhost:8080/CIP/graf2.jsp`. The page title is "Common Information Picture (CIP)". The main content area is titled "COMMON IDENTIFICATION PICTURE".

The "CHART SECTION" contains six 3D bar charts arranged in a 2x3 grid. The top row shows "Who", "What", and "Where". The bottom row shows "When (month)", "When (day)", and "When (time of day)".

Category	Value
Who (brown)	3
Who (blue)	14
Who (NR)	0
What	17
Where	17
When (month)	17
When (day)	17
When (time of day)	17

Legend for "Who": brown, blue, NR. Legend for others: Restricted Information.

The "IDENTIFICATION SECTION" contains a form with the following fields:

- User: alex
- Area: Who
- Experiment Date: 2011-01-25 01:28:17
- Enter your attack identification
- Who... (text input)
- What... (text input)
- Where... (text input)
- When... (Day, Month, Hour dropdowns)
- Send and Clear buttons

The "HISTORY SECTION" contains a table titled "My Identifications" with the following data:

Nº	Hour	Who	What	Where	When
01	01:03:55	blue	gammaland	Power Plant	10 May 06:00 PM

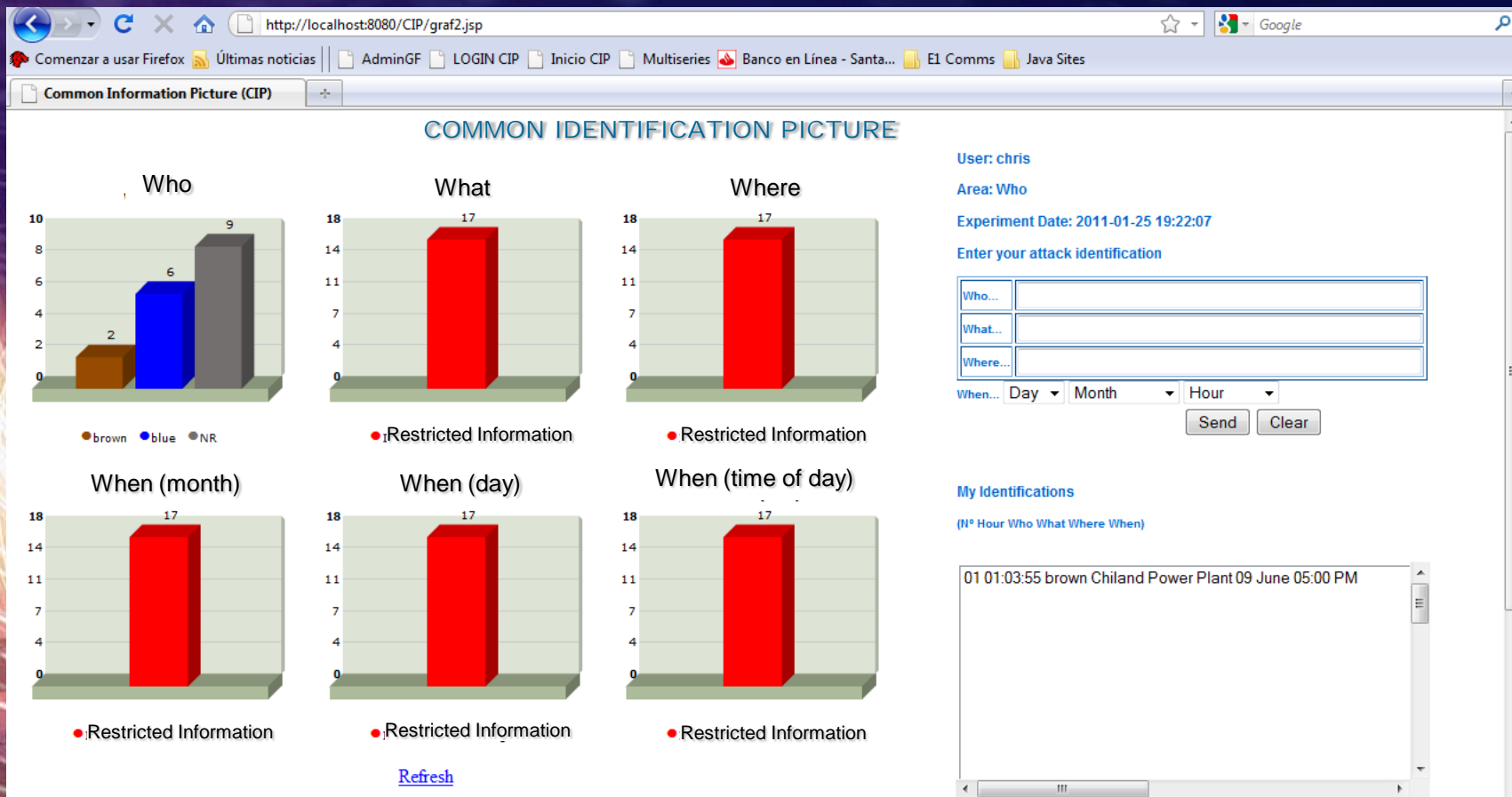
A "Refresh" link is located below the charts.

HISTORY SECTION



# COMMON IDENTIFICATION PICTURE TOOL (CIP)

## CIP USER INTERFACE



Hierarchical Organization, "Who" group participant, 8 IDs already made



# COMMON IDENTIFICATION PICTURE TOOL (CIP)

## CIP USER INTERFACE

Common Information Picture (CIP)

### COMMON IDENTIFICATION PICTURE

User: whitley  
 Area: Transversal  
 Experiment Date: 2011-01-25 19:17:47  
 Enter your attack identification

Who...	
What...	
Where...	

When... Day Month Hour  
 Send Clear

#### Who

Category	Count
brown	2
blue	6
NR	9

#### What

Category	Count
Pipeline Terminal	2
Power Plant	6
NR	9

#### Where

Category	Count
Gammaland	7
Chiland	1
NR	9

#### When (month)

Category	Count
09	2
10	6
NR	9

#### When (day)

Category	Count
June	1
May	7
NR	9

#### When (time of day)

Category	Count
06:00 PM	7
05:00 PM	1
NR	9

[Refresh](#)

#### My Identifications

(N° Hour Who What Where When)

```
01 01:03:55 brown Chiland Power Plant 10 May 06:00 PM
```

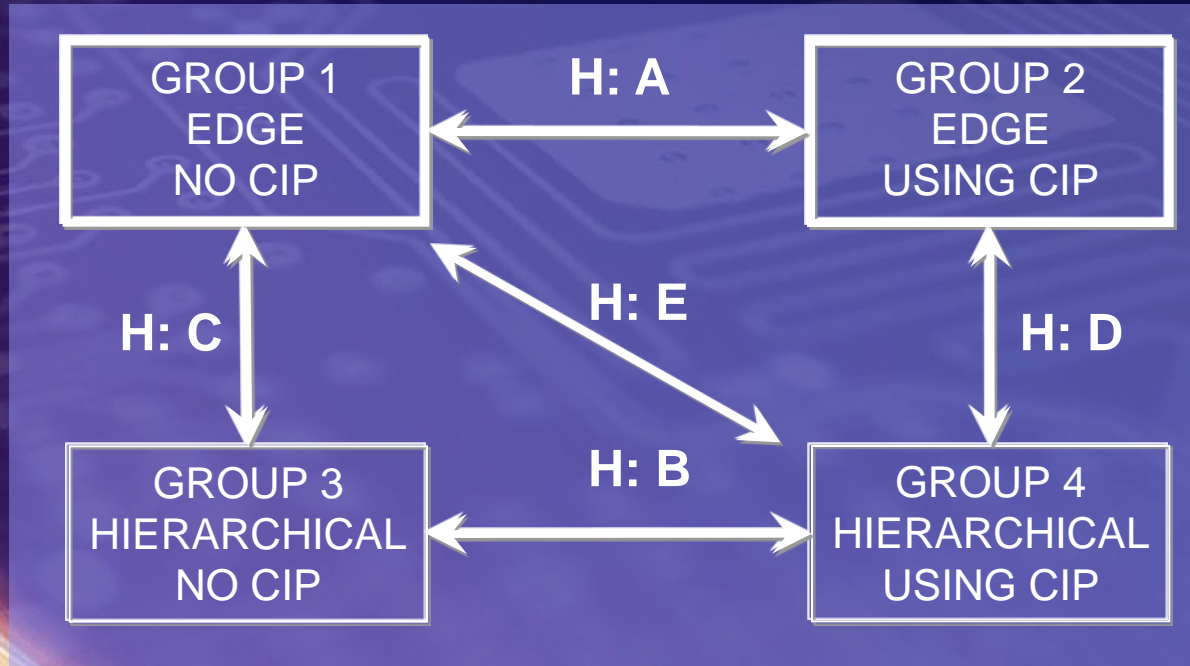
Edge Organization, 8 IDs already made



# HYPOTHESES

**Dependent Variable:** Group Performance.

**Independent Variables:** CIP Usage, Organizational Configuration.



- Whenever structure is kept constant, CIP usage will result in better performance.
- Edge organization will outperform Hierarchies, both using and without using CIP.
- The performance difference between a Hierarchical organization using CIP and an Edge organization without using CIP will be meager.



# DATA ANALYSIS

## GROUP PERFORMANCE COMPARISON

Performance:  $P = K * (A/T)$  ; where:

- K is 100,000 (constant for figure readability)
- A is Accuracy (correctness of IDs)
- T is Time (time to submit IDs)

### Data Analysis was made in two steps:

1. Obtain a comparative boxplot in order to examine and contrast the main parameters of the data distributions.
2. Run an ANOVA hypothesis test using 95% of confidence ( $\alpha = 0.05$ ):
  - Check for normality through Kolmogorov-Smirnov and Shapiro-Wilk tests.
  - Verify homogeneity of variances through the Levene test.

Perform a mean comparison through ANOVA and –whenever possible– rejected the corresponding null hypothesis.

If ANOVA was not applicable, we applied the non parametric Kruskal-Wallis Test for mean comparison.



# RESULTS

<b>ID</b>	<b>HIPOTHESES</b>	<b>p (<math>\alpha = 0.05</math>)</b>	<b>RESULT</b>	<b>KEY FACTOR*</b>
A	Group 2 “Edge Using CIP” outperforms Group 1 “Edge No CIP”	0.044	Validated	Accuracy
B	Group 4 “Hierarchical Using CIP” outperforms Group 3 “Hierarchical No CIP”	0.003	Validated	Accuracy
C	Group 1 “Edge No CIP” outperforms Group 3 “Hierarchical No CIP”	0.051	Rejected	None
D	Group 2 “Edge Using CIP” outperforms Group 4 “Hierarchical Using CIP”	0.006	Validated	Accuracy, Time
E	Group 1 “Edge No CIP” and Group 4 “Hierarchical Using CIP” perform similarly.	0.513	Validated	Accuracy, Time

\* KEY FACTOR: is the factor that influences the most in the result of Performance variable “P”, which is computed through the equation:  $P = K * (A/T)$





# RESULT DISCUSSION

- ELICIT+CIP improved performance of both types of organizations.
  - CIP added realistic conditions to the experimental setting.
  - CIP enhances abilities in two of the C2 maturity dimensions: *Patterns of Interactions* and *Distribution of Information*.
- CIP moderately slows down decision making. However, it considerably increases accuracy, as it provides access to notions that have the potential to influence action.
- Performance difference between Edge and Hierarchies was scarce without CIP, but discrepancy was significant when using CIP.
  - Incremented interactions and enhanced cognitive teamwork benefits more the less constrained organization.
  - Enrichment of interaction space is better exploited by the entity featuring a more complete pattern of interactions and freedom to collaborate.
  - The organization type that is better able to exploit the new functionalities reaped more benefits out of CIP.
- By improving interaction means and raising the cognitive level of collaboration, Hierarchies can mitigate their communicational limitations, matching the performance of Edge entities.



# CONCLUSIONS

- The CIP tool allows the players to share their understanding of the situation after analyzing the pieces of information provided by ELICIT.
- When units make efforts to communicate their understanding of the situation, it becomes easier for the collective to form “correct” shared awareness.
- The practice of performing information analyses, and diffusing intelligence at all levels should be stressed and deeply embedded in doctrinal practices.
- Less restricted organizations are better able to exploit knowledge sharing functionalities. Only when these features are implemented, the noticeable difference emerges.
- This research supports “*NNC2MM*” theory as Edge organizations do outperform Hierarchies. It is correct to adopt Edge whenever the situation allows it.
- To materialize Edge superior performance, all the potential of NCW must be available, specifically, rich communication channels; information diffusion, knowledge sharing, among others.
- the architectural communication restrictions of Hierarchies can be reduced by implementing technology and procedures that encourage intelligence sharing.

