ARMY OF CHILE
Military Polytechnic Academy

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

16th ICCRTS, Paper ID 154

Authors:
Col. Hernan Joglar-Espinosa, PhD, Command and Control Program.
Italo Seccatore-Gomez, Eng., Military Polytechnic Academy.
Julio Lamas-Barrientos, Eng., Military Polytechnic Academy.

Quebec, June - 2011

AGENDA

Topics

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

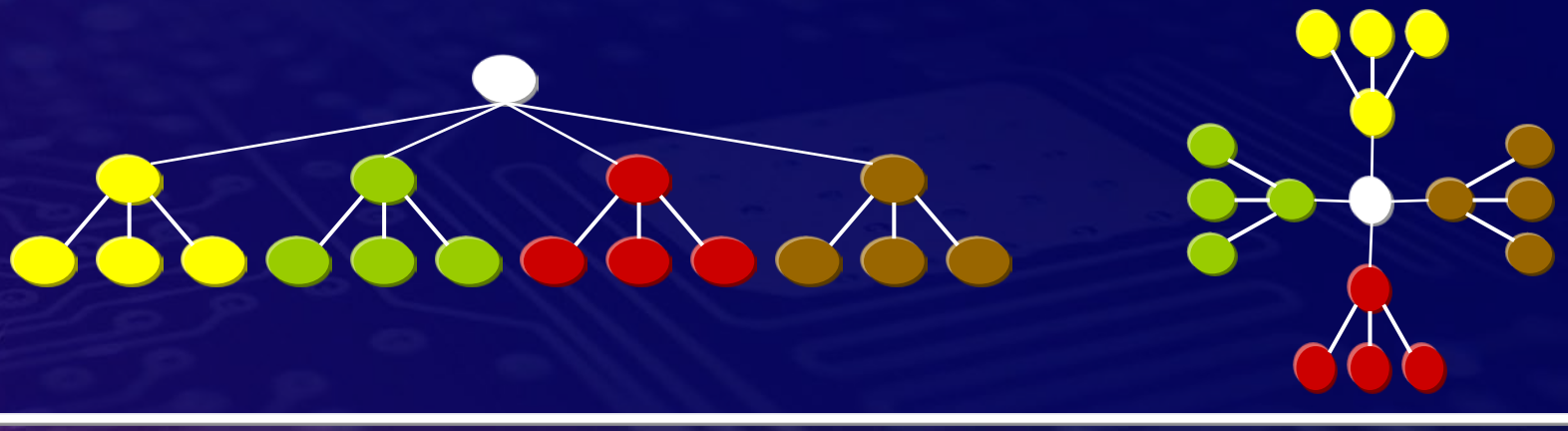
PAPER OBJECTIVE

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.

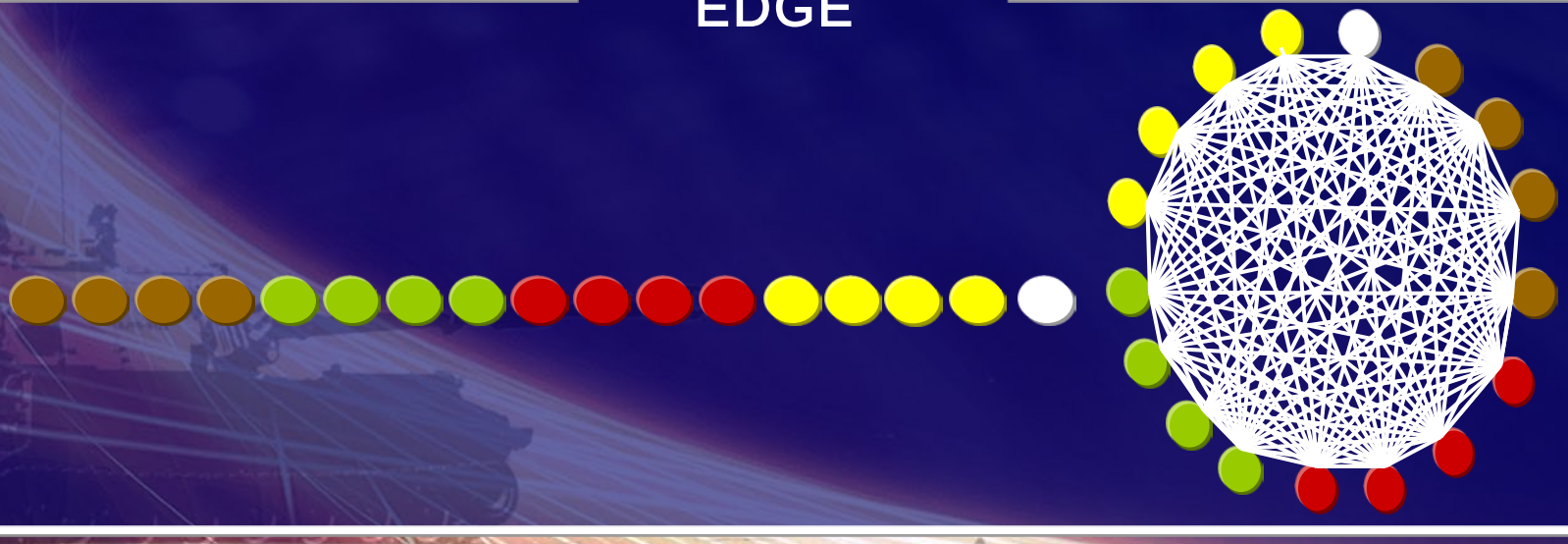
For the latter, we combined ELICIT with a complementary tool we call Common Identification Picture (CIP), which enables participants to share their knowledge of the situation by posting their threat identifications.

EDGE VERSUS HIERARCHICAL ORGANIZATIONS

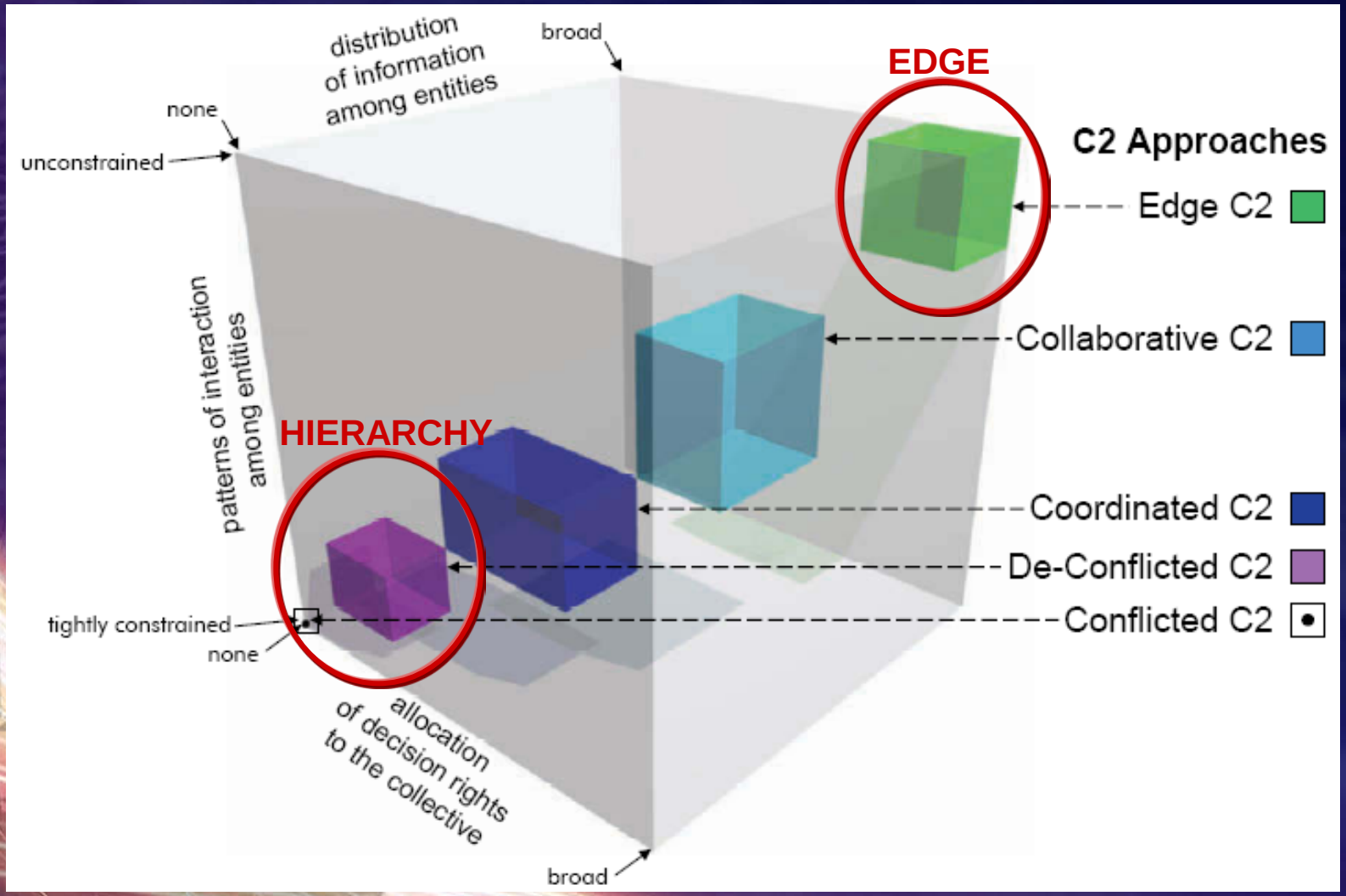
HIERARCHY



EDGE



EDGE VERSUS HIERARCHICAL ORGANIZATIONS

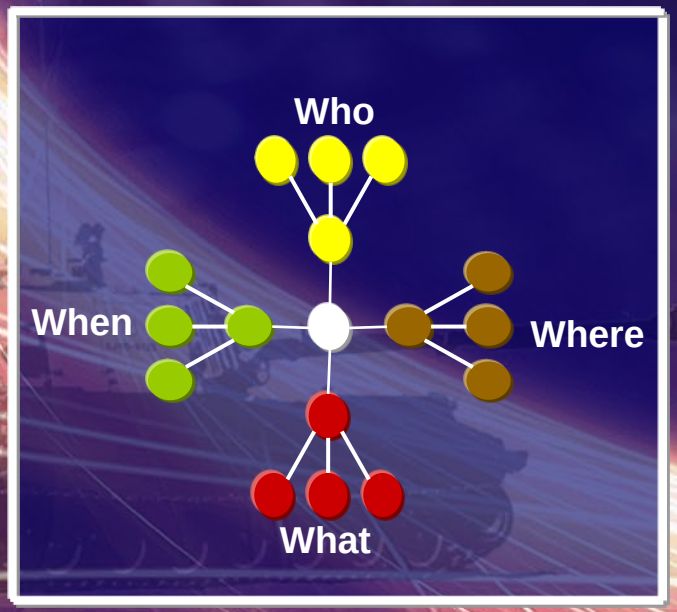


Source: NATO SAS-065 (2010). NATO NEC C2 Maturity Model. Washington DC: CCRP.

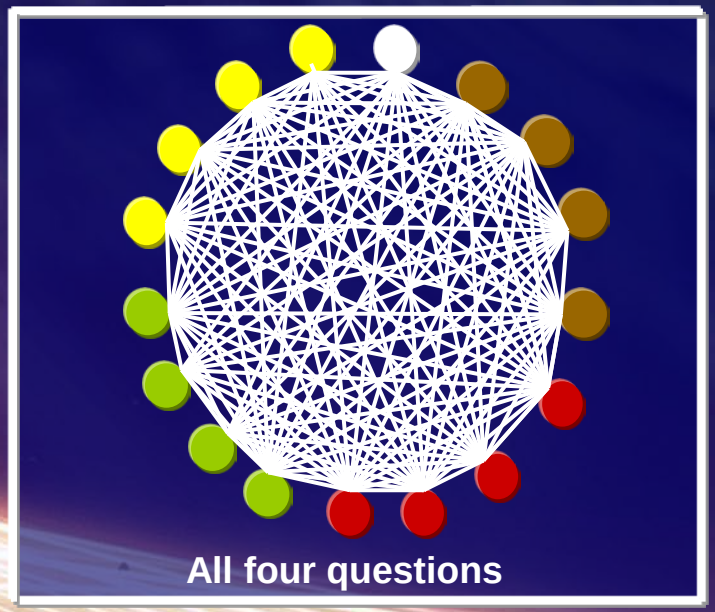
ELICIT: A PROBLEM SOLVING SIMULATION GAME

- 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)

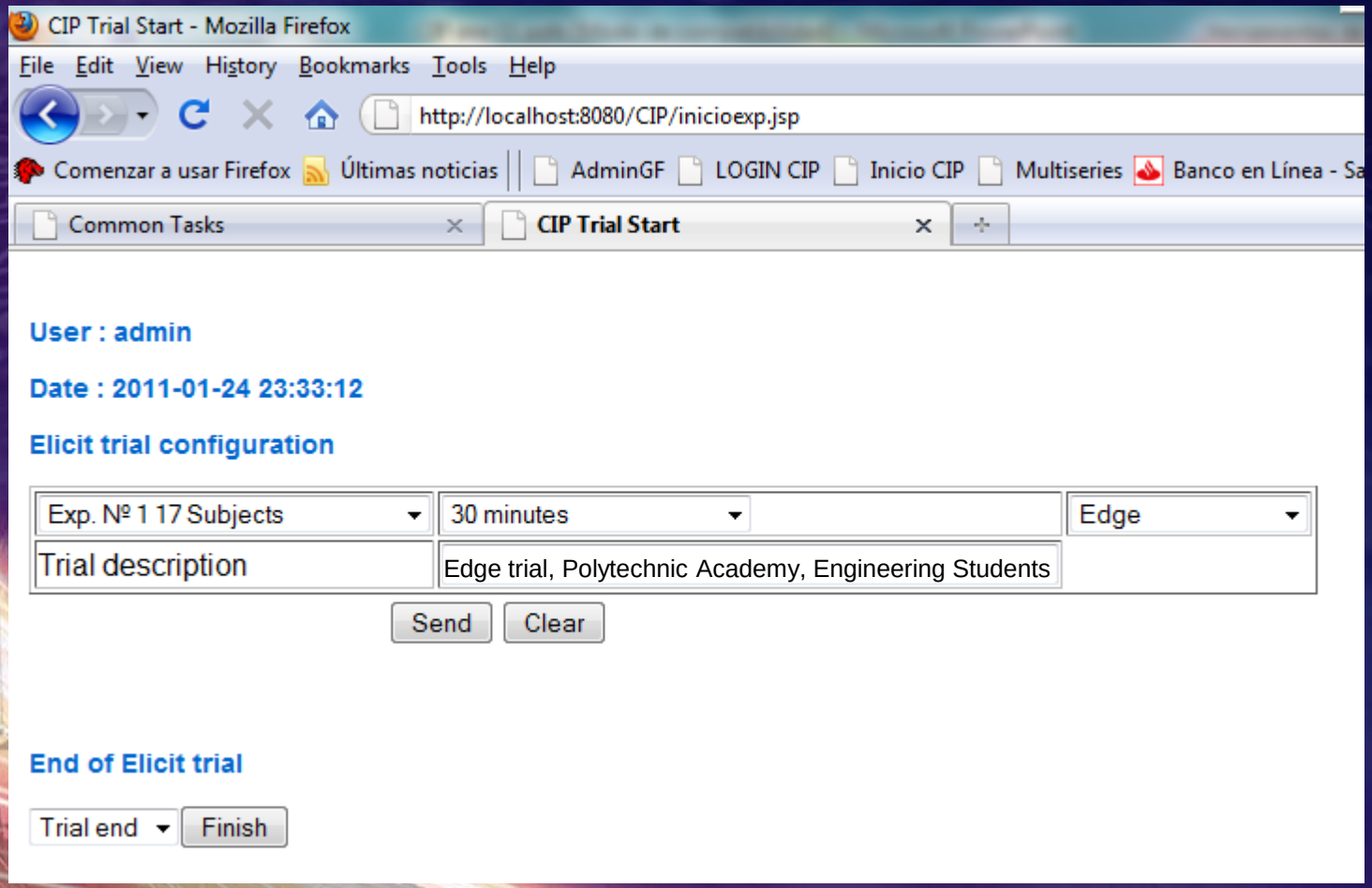
FROM INFORMATION SHARING

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.

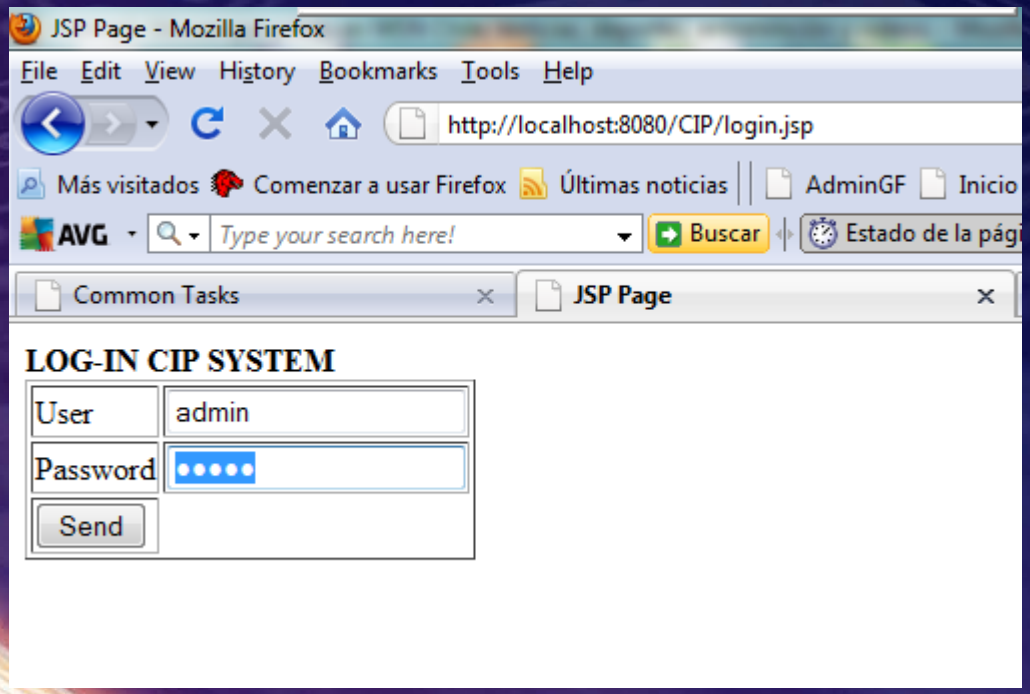
COMMON IDENTIFICATION PICTURE TOOL (CIP)

CIP ADMINISTRATOR INTERFACE



COMMON IDENTIFICATION PICTURE TOOL (CIP)

CIP USER INTERFACE

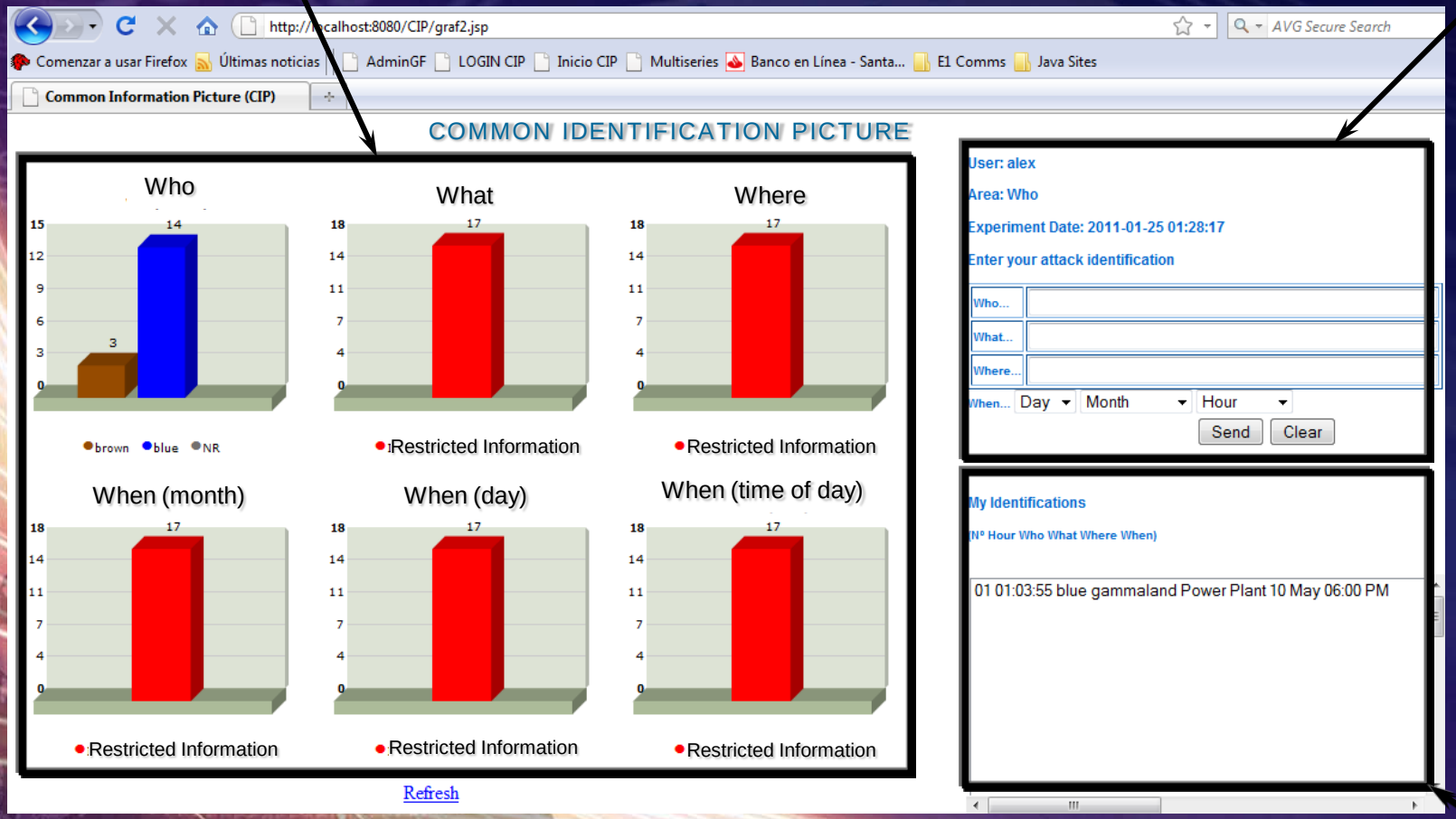


COMMON IDENTIFICATION PICTURE TOOL (CIP)

CIP USER INTERFACE

CHART SECTION

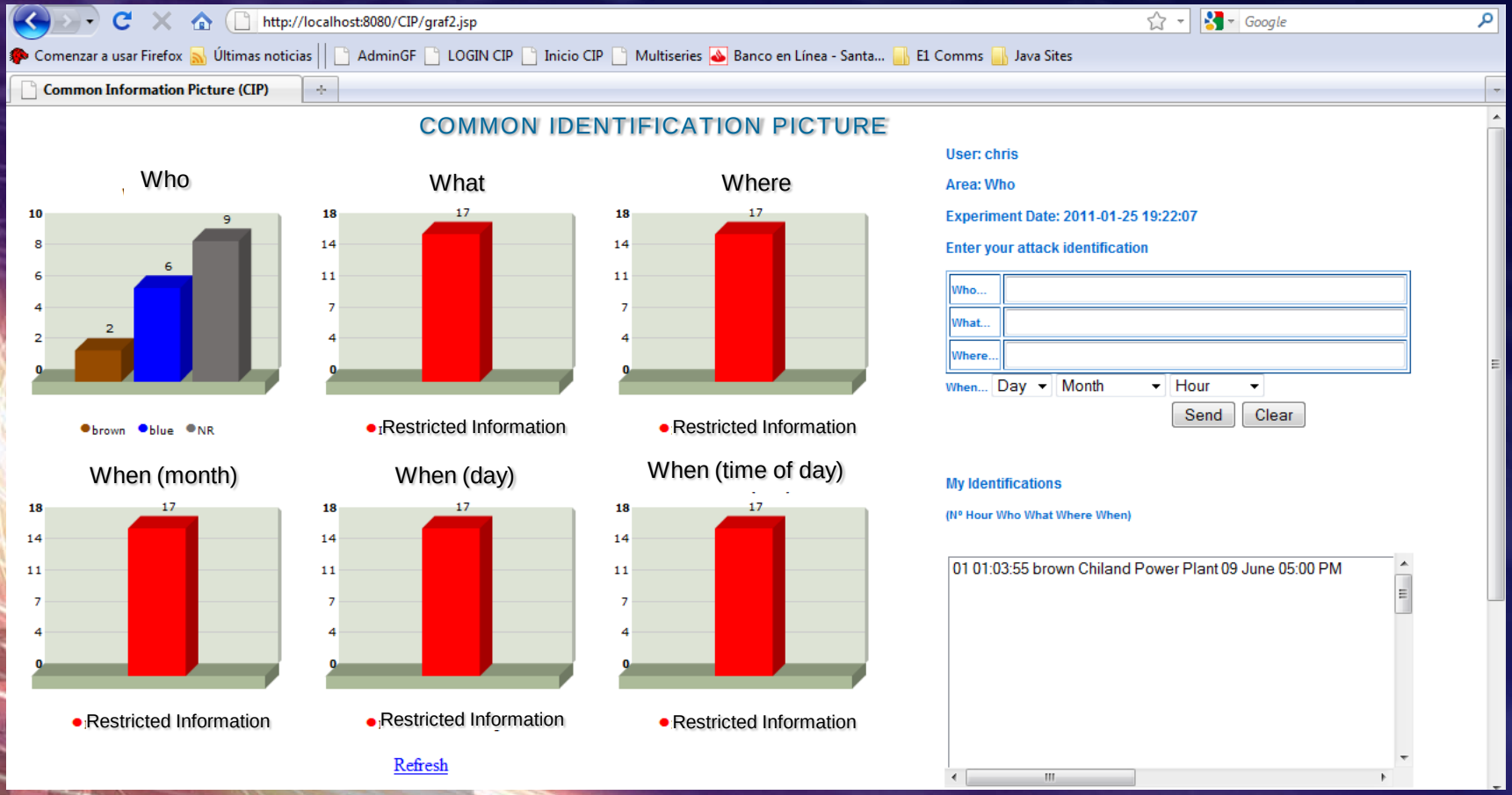
IDENTIFICATION SECTION



HISTORY SECTION

COMMON IDENTIFICATION PICTURE TOOL (CIP)

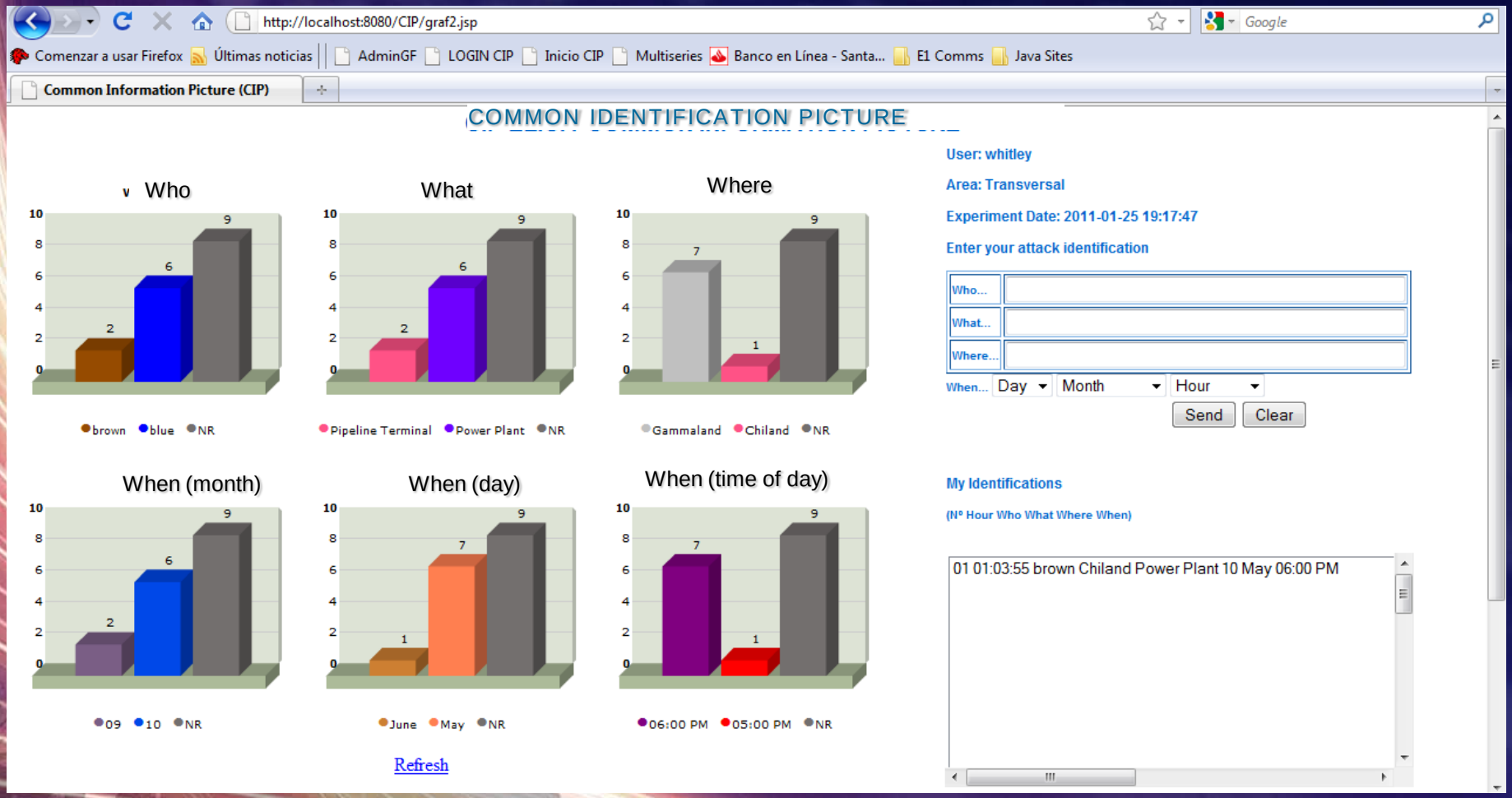
CIP USER INTERFACE



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

COMMON IDENTIFICATION PICTURE TOOL (CIP)

CIP USER INTERFACE

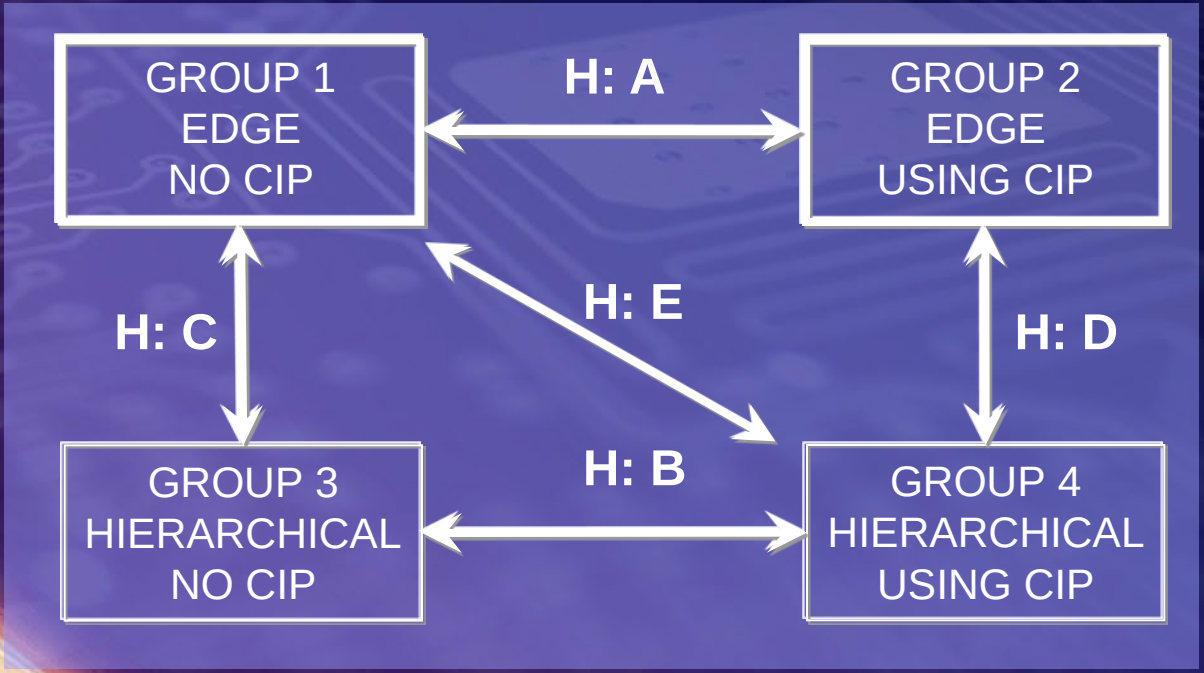


Edge Organization, 8 IDs already made

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

ID	HIPOTHESES	p (α = 0.05)	RESULT	KEY FACTOR*
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 DISCUSION

- 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.