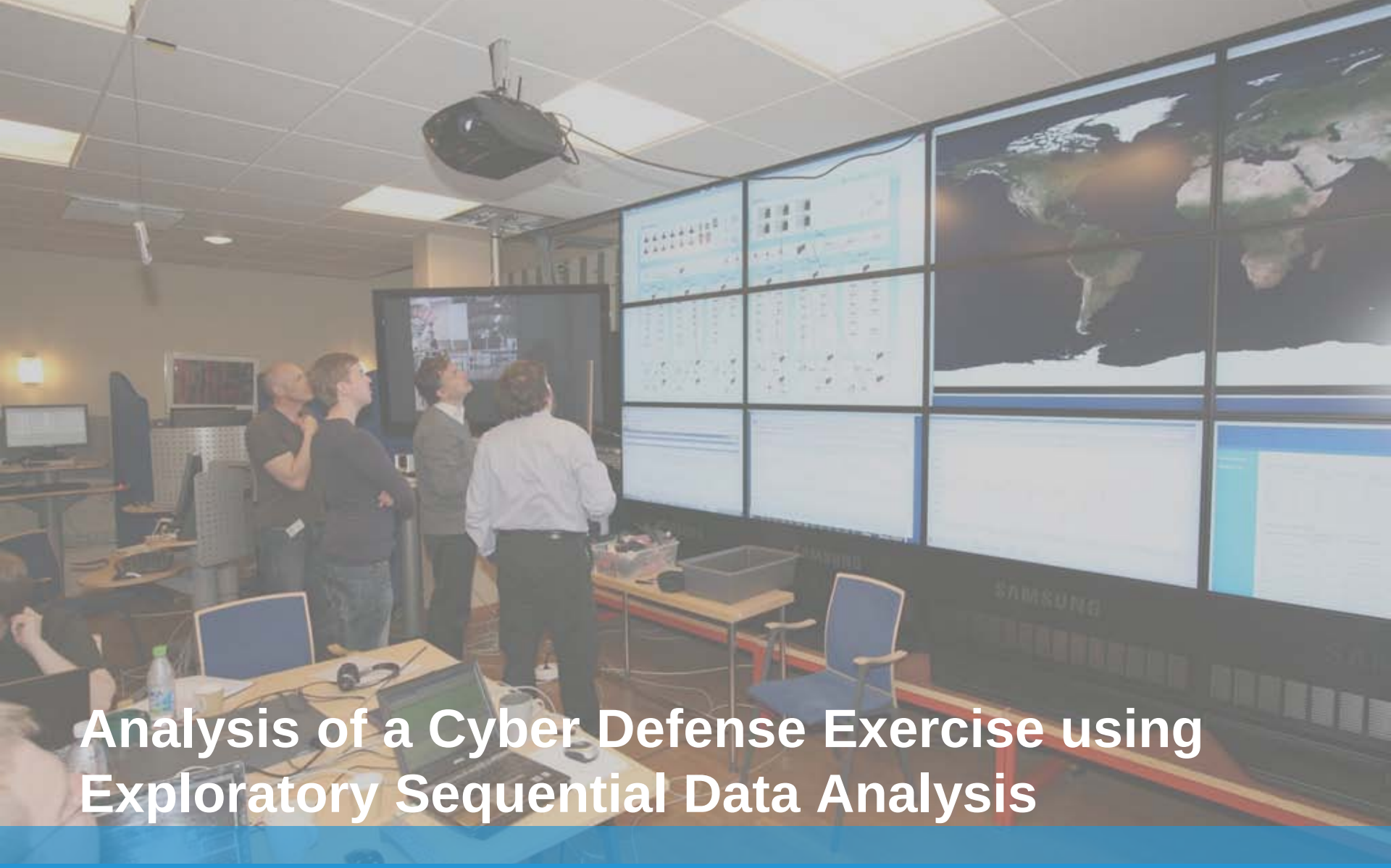

Analysis of a Cyber Defense Exercise using Exploratory Sequential Data Analysis

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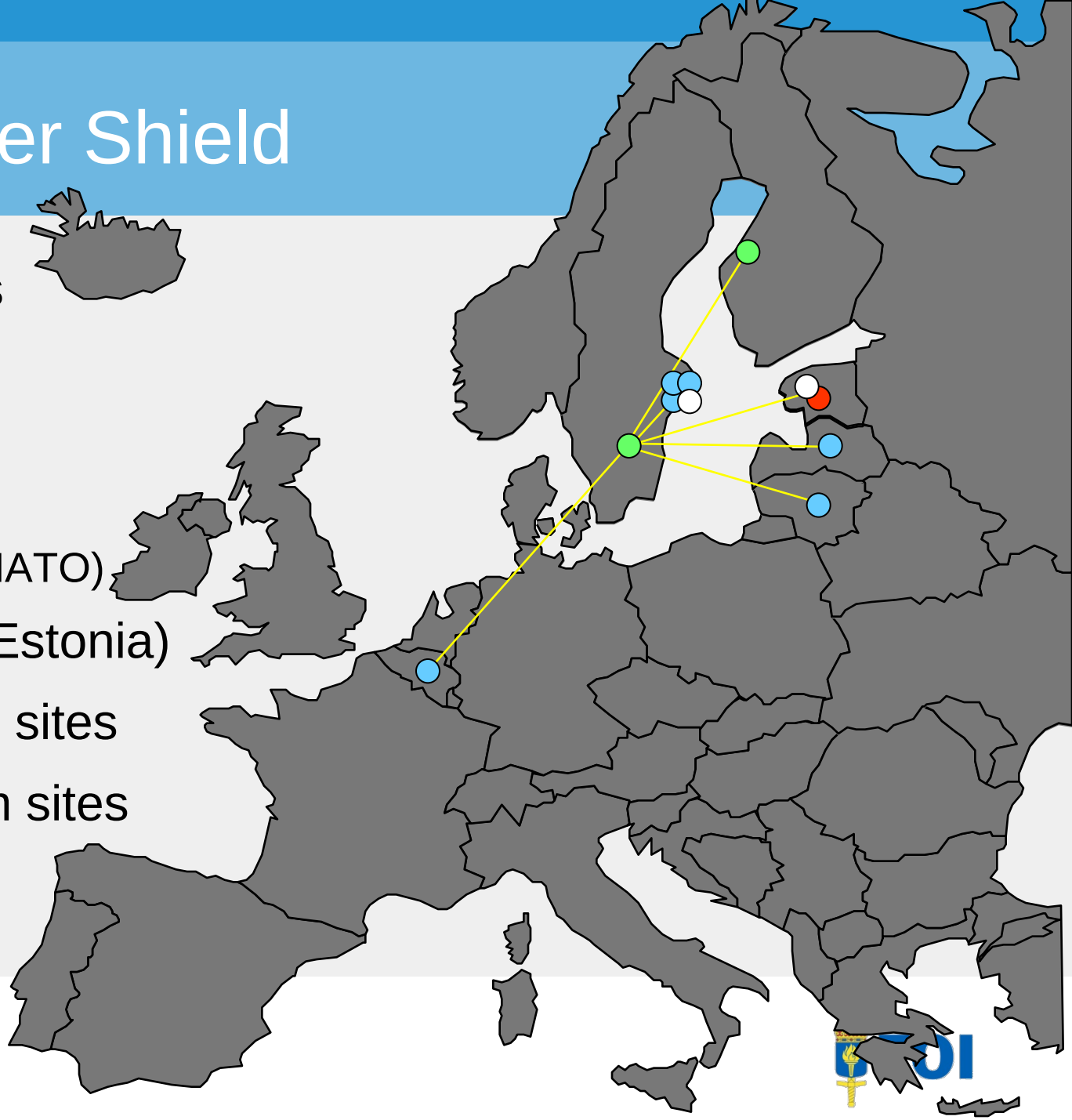
FOI

Baltic Cyber Shield

- Scenario-driven 2-day multinational CDX in 2010
  - Swedish side coordinated by MSB
- Motivated by cyber attacks on Estonia 2007
- Main objectives
  - Improve capability of conducting technical IT security exercises
  - Investigate how to study IT attacks and defence of critical infrastructure

Baltic Cyber Shield

- 6 blue teams
  - 3 Swedish
  - 1 Latvian
  - 1 Lithuanian
  - 1 Belgian (NATO)
- 1 red team (Estonia)
- 2 white team sites
- 2 green team sites

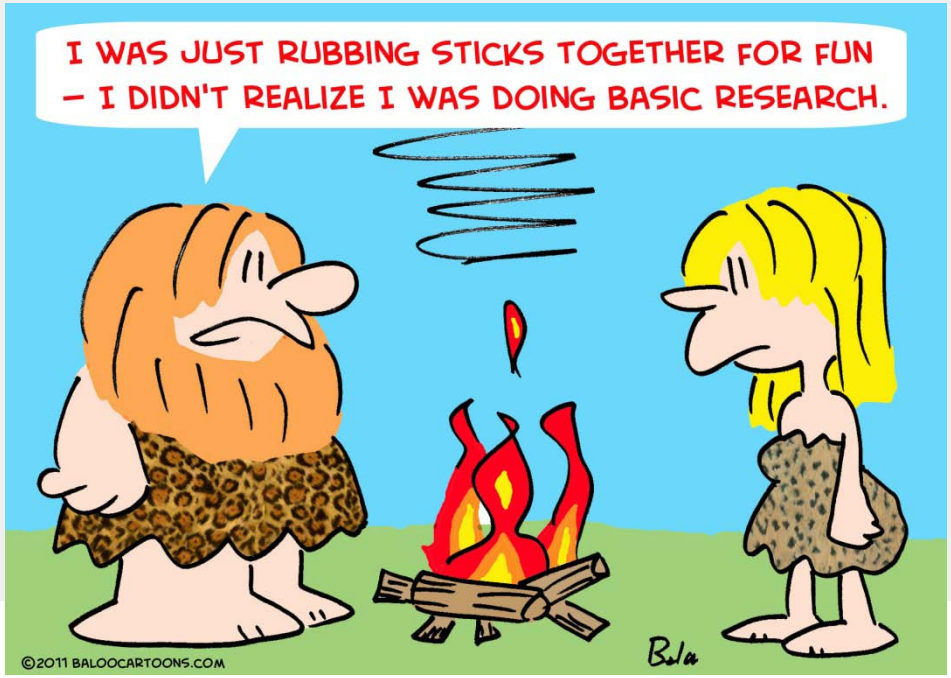


Baltic Cyber Shield

- Mixed-reality
  - Internet simulated at FOI cluster
  - Isolated corporate networks connect to cluster through VPN tunnels
  - Corporate factory replicas accessible through the cluster

Objectives

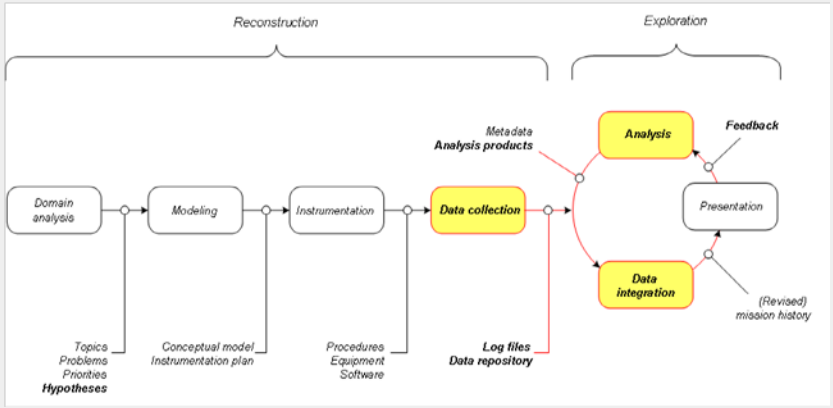
- Training aspect
  - Improve capability of conducting technical IT security exercises
- Scholarly aspect
  - Investigate how to study IT attacks and defence of critical infrastructure

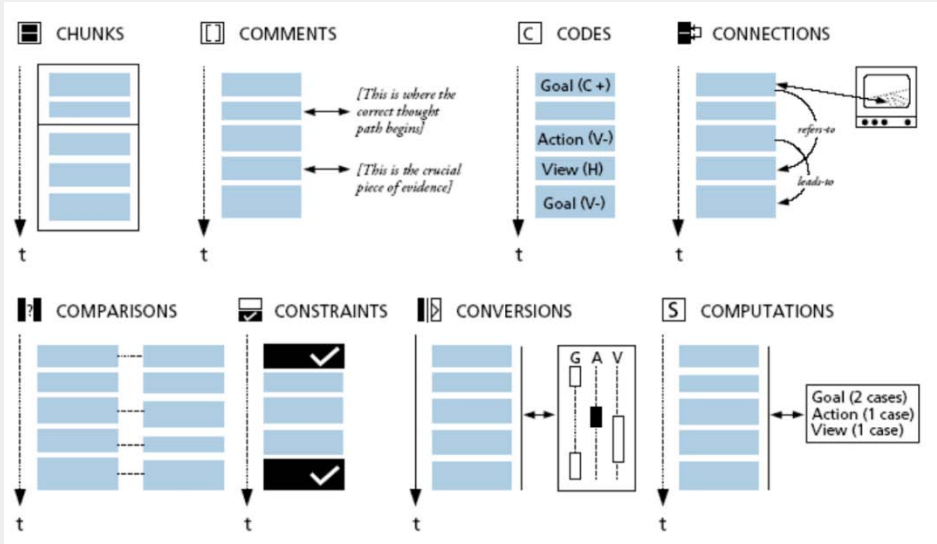


Used with permission from artist [Rex May]

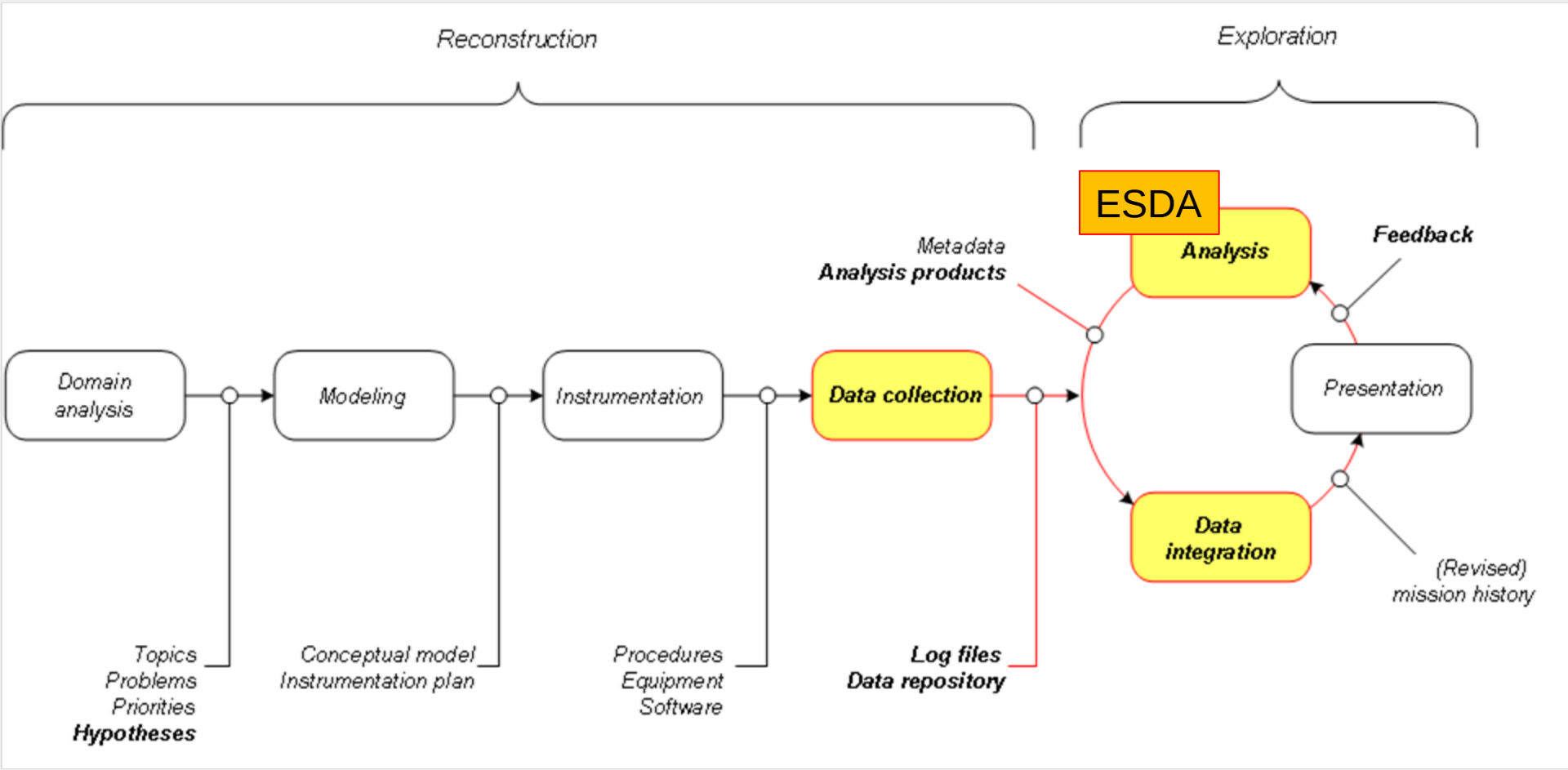
Scholarly aspect

- Can we use Reconstruction & Exploration (R&E) to capture and analyze CDXs?
- Can Exploratory Sequential Data Analysis (ESDA) be combined with R&E to analyze CDXs?

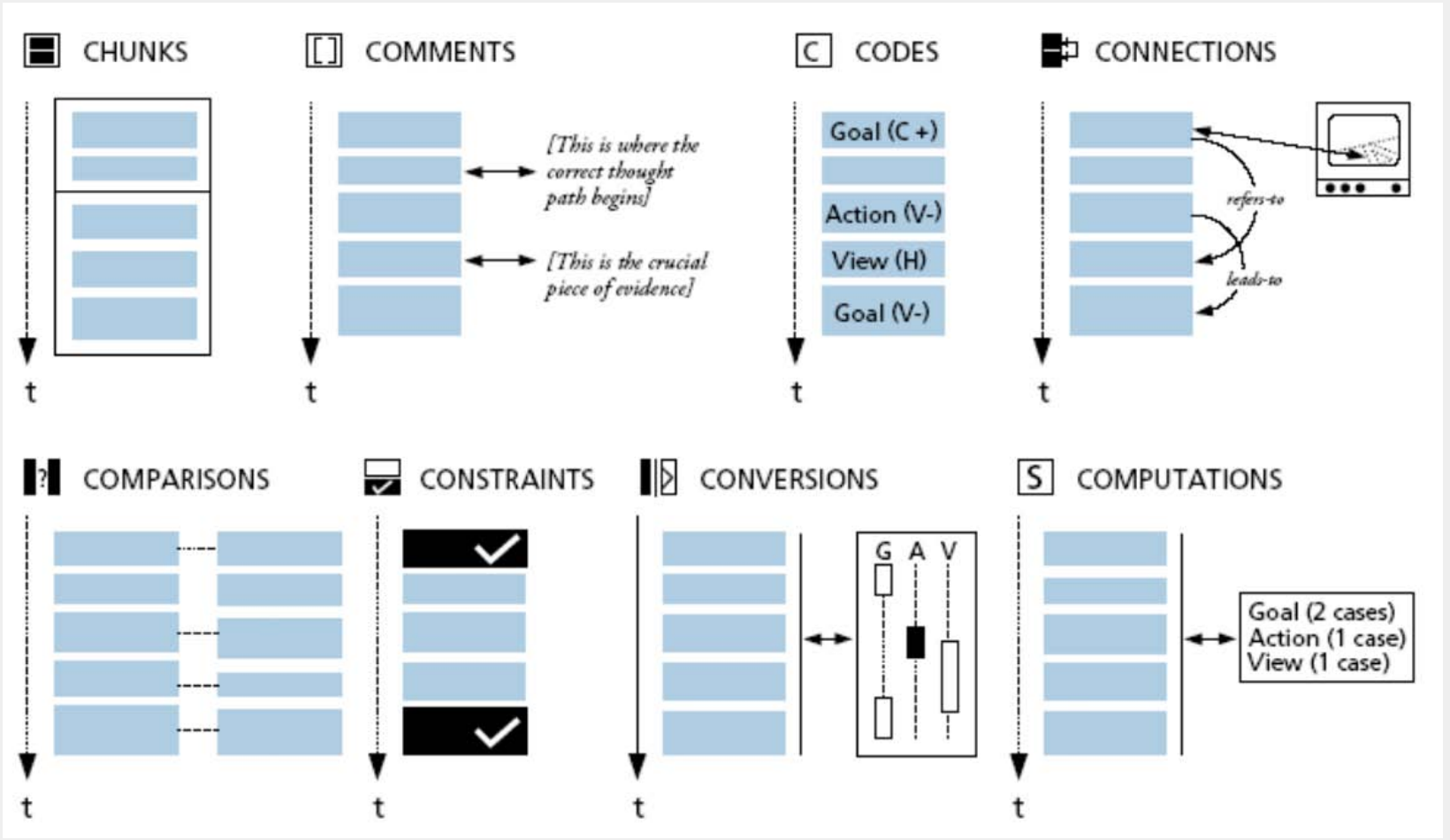




Reconstruction & Exploration

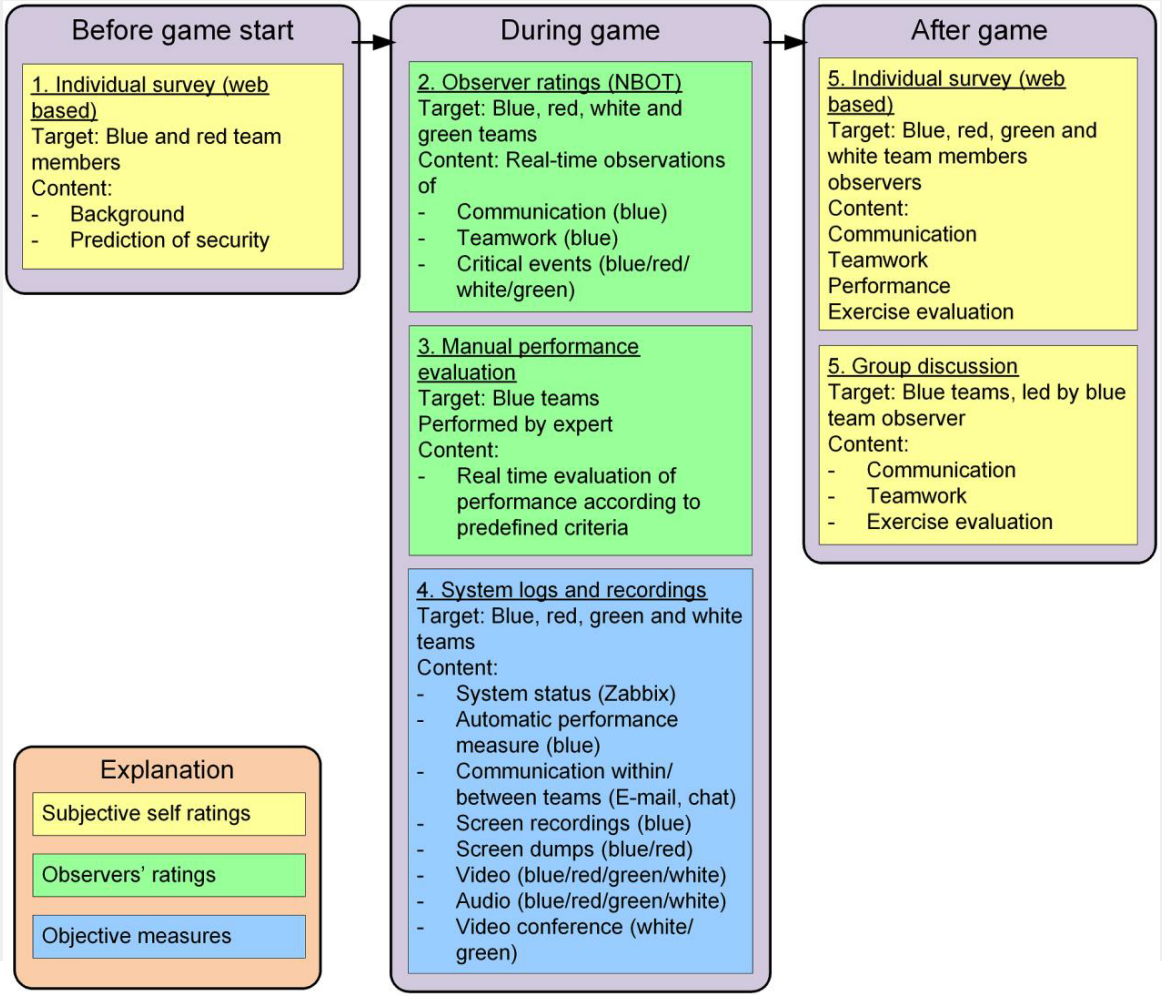


Exploratory Sequential Data Analysis



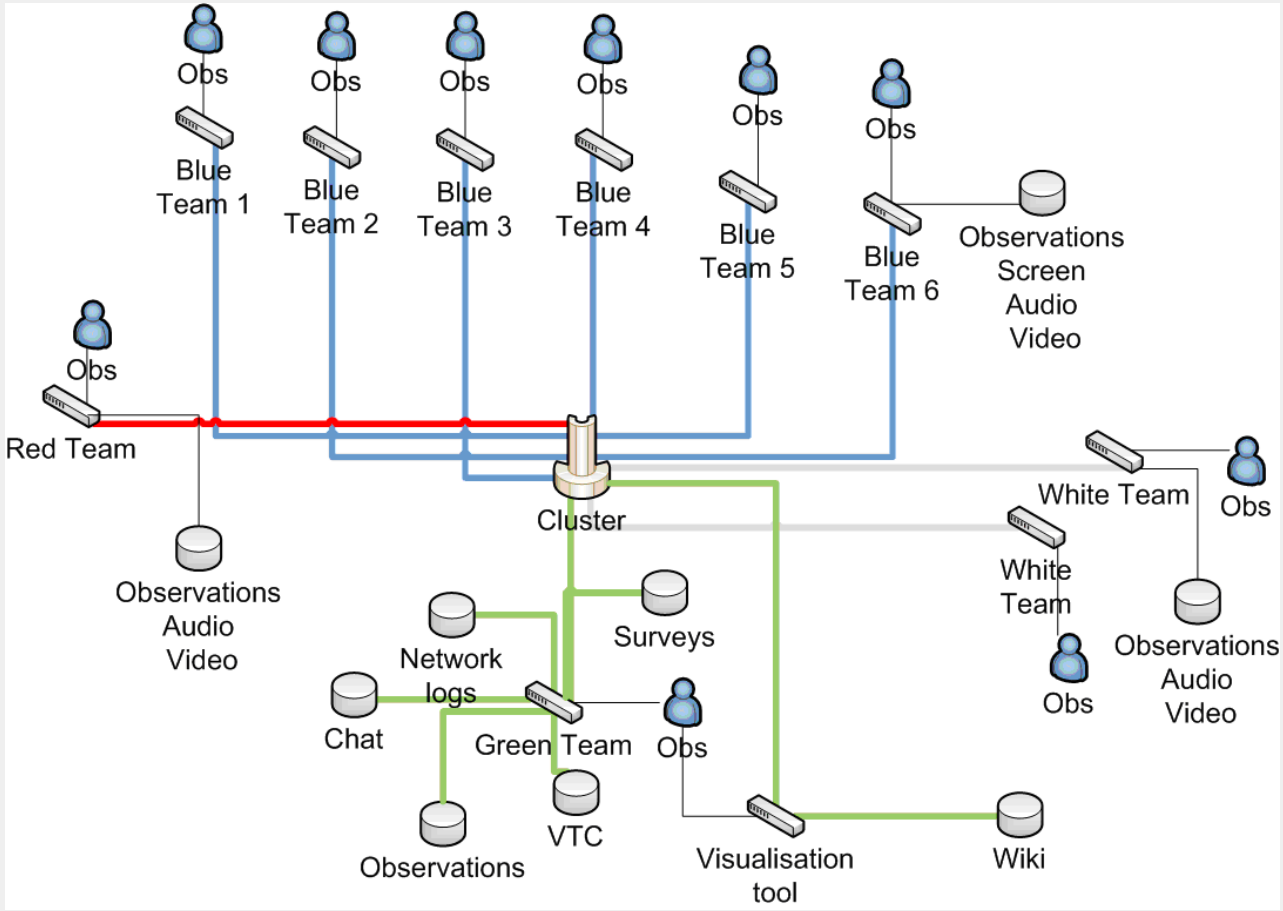
Conceptual model

- Behaviour aspects
  - team performance
  - decision-making
  - collaboration
  - communication
- Technical aspects
  - network status
  - processor utilization
- Background
  - Expertise
  - Background
- Exercise feasibility
  - Training aspect
  - Scholarly aspect

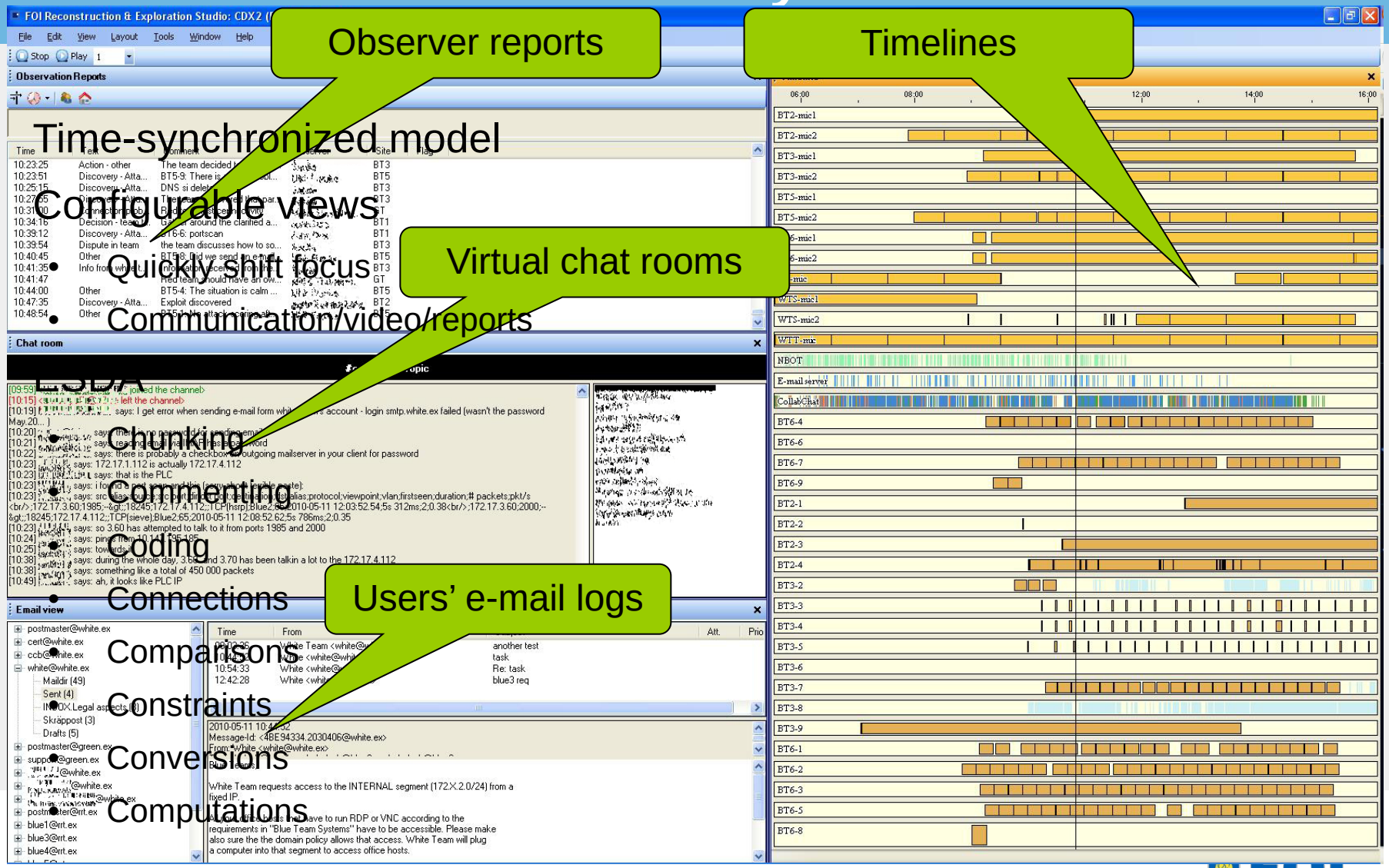


Instrumentation plan

- Interactions
  - Human-Machine
  - Human-Human
  - Machine-Machine
- Technical logging
- Observer reports



Presentation and analysis with F-REX



- Time-synchronized model
- Configurable views
  - Quickly shift focus
  - Communication/video/reports
- TESDA
  - Chunking
  - Coding
  - Connections
  - Comparisons
  - Constraints
  - Conversions
  - Computations

Results (case: reported attacks)

Service	# s_a	# s_d	s_d/s_a
Operator	2	1	0.500
Fileserver	5	1	0.200
External firewall	4	3	0.750
Historian	8	3	0.375
Mail server	6	9	1.500
News server	4	5	1.250
DNS/NTP	1	3	3.000
Database	3	3	1.000
Intranet	3	2	0.667
Public web server	11	12	1.091
Portal	6	7	1.167
Other	7	13	1.857

Results (Experimental study)

- Experimental studies
  - Weak indications from first study
    - The historian and the fileserver were easiest to attack without being detected by the defending team
  - More investigation needed
    - We have the data, i.e. network traffic and some detailed system logs
    - Detailed studies are under way from FOI and KTH

Conclusion

- The teams' self-reporting provide an excellent source of information in the early stages of analysis

- Scholarly objectives
  - R&E has shown great potential for analyzing CDXs
  - The ESDA 8C's have been found very useful as guidelines for R&E exploration

Conclusion (cont'd)

- A comprehensive dataset like the collected BCS data is a great resource for many different kind of studies

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- Thank you for your attention!