Steps beyond Tracks

Extending Naval C2 Systems to Support Tactical Thinking

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SMART OPERATIONS

Overview

- Introduction to the perceived problem
- A possible solution: the abstraction hierarchy
- Application to the naval domain
- Automated support: processing and HMI
- Evaluation
- Summary

Difficult Command and Control

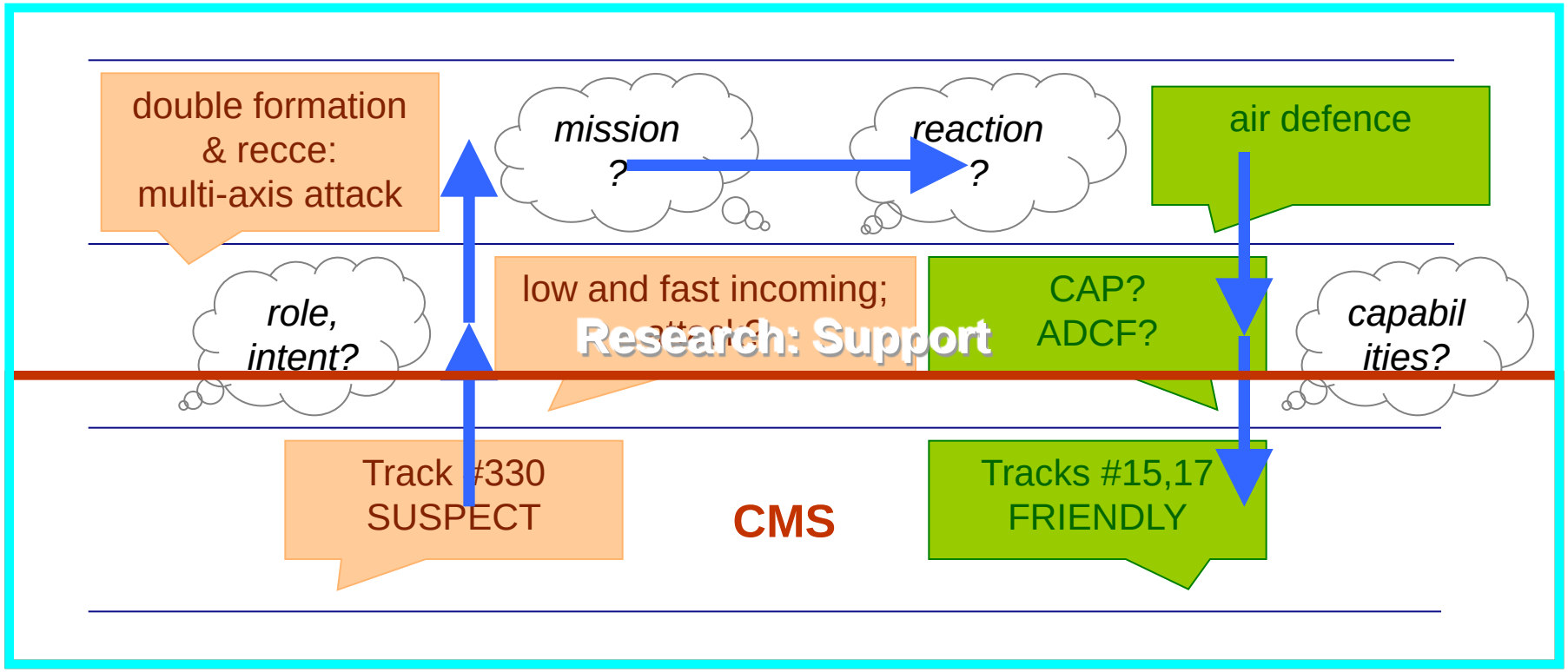
- C2 Systems have a hard time dealing with modern operations

Focus of the Project: Naval Command and Control

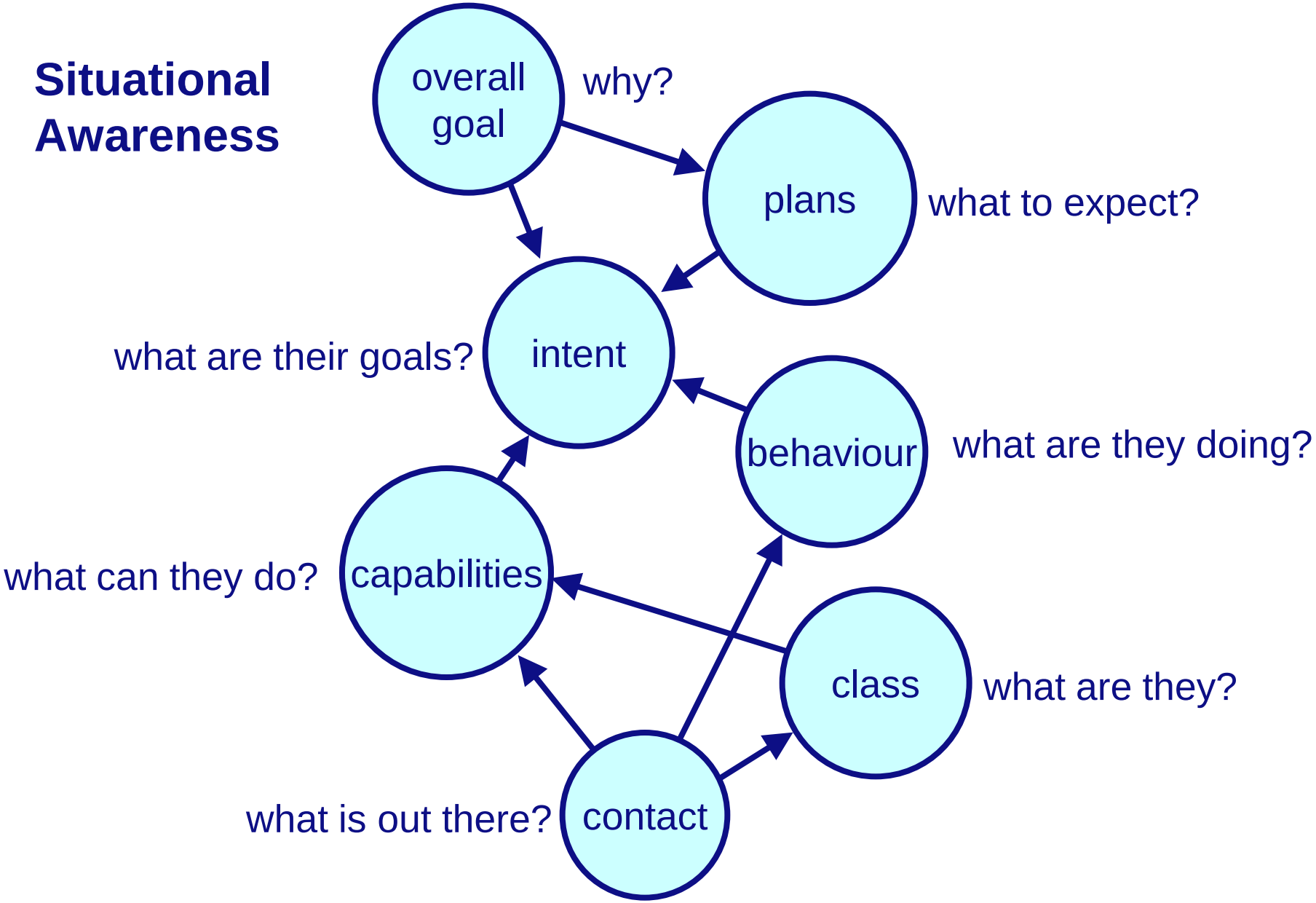
- **Naval Combat Management Systems are not Perfect**
  - Tactical representation (BLUEFOR, OPFOR, others) is not well suited to current operations (*peace keeping, law enforcement,* ...).
  - Higher-order information (roles, intent, goals) is not integrated (*communicated by orders, voice, chat, presentation sheets*).
  - Information exchange is across technical, cultural and linguistic barriers between (joint/combined) forces.

- **Project Goal: Better Information**
  - **Better (shared) understanding of the tactical situation** in a (distributed) command team through the exchange of higher-level information.
  - Automated support for building / maintaining / adjusting the higher-level information.

Thinking at Different Abstraction Levels

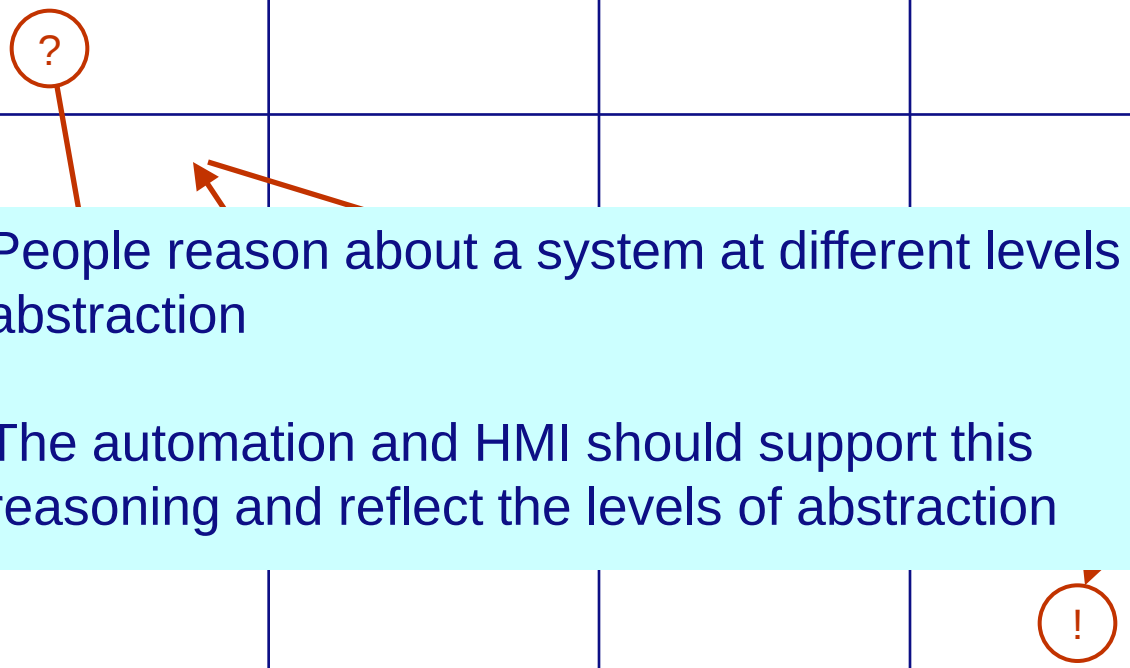


Situational Awareness



Framework: Abstraction Decomposition Spaces
(*Rasmussen, Vicente, et al)*

Part-Whole Means-Ends	Total System	Subsystem	Unit	Component
Purpose of the system				
Laws and principles				
Processes				
Equipment Function				
Equipment Form				



People reason about a system at different levels of abstraction

The automation and HMI should support this reasoning and reflect the levels of abstraction

Abstraction Hierarchy of a Military Operation

Level	Abstraction	Question
Functional Purpose	Goal of the Military Operation	**what is its** (group) **overarching purpose?** (*goal*)
Abstract Function	Balance of force and risk; military, socio-economical considerations	**what influence will its** (group/ platform) **actions have?** (*balance*)
Generalized Function	Platform/Unit/Group missions, tasks	**what is its** (platform/group) **intention?** (*mission*)
Physical Function	Platform capabilities and possible roles	**what is it doing?** (*behaviour*) **what can it do?** (*capabilities*)
Physical Form	Platform type and identity; platform position and velocity	**is there something there?** (*presence*) **what is it?** (*class, identity*)

Abstraction Decomposition Space of a Military Operation: Part-Whole

Level	Total System	Subsystem	Unit
Functional Purpose			
Abstract Function			
Generalized Function	task force mission	group mission	platform mission
Physical Function			platform role
Physical Form			platform class, type

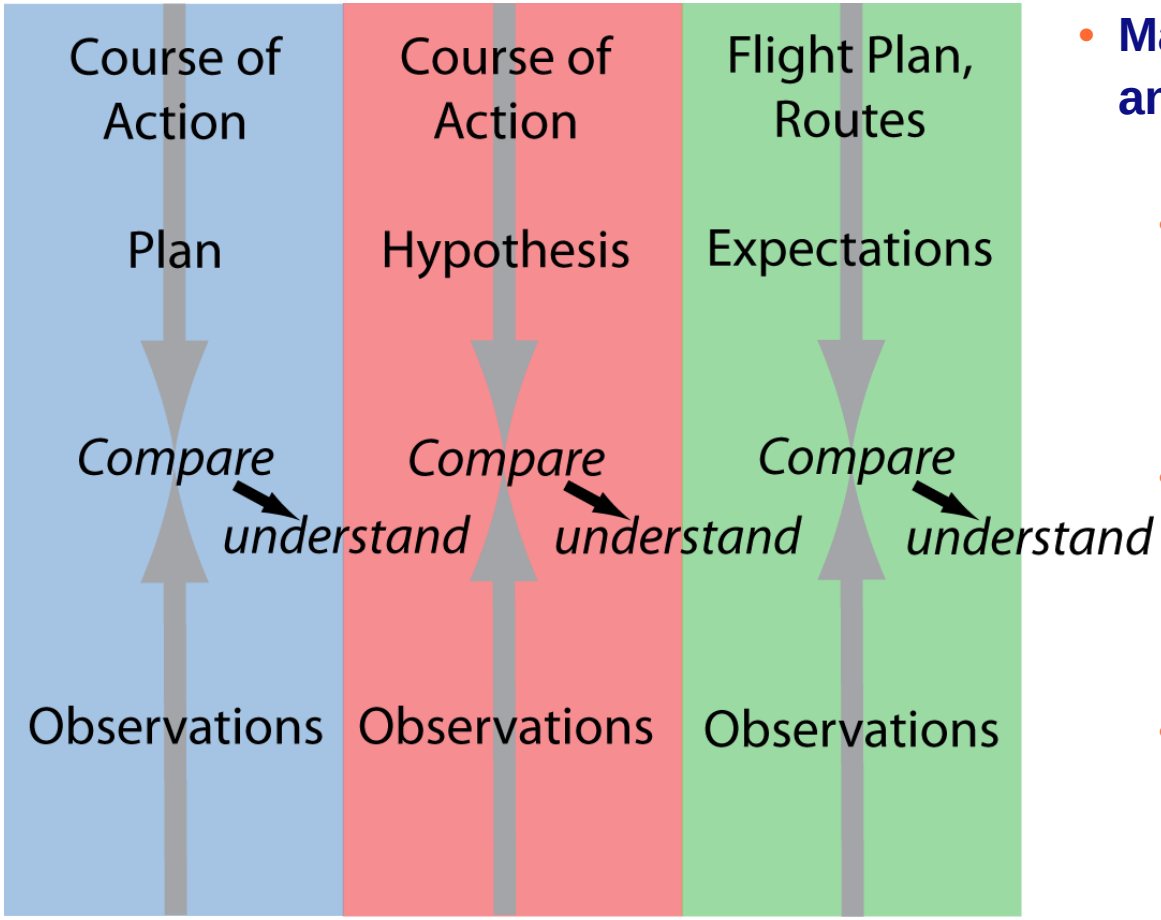
Hierarchical information model

- Using a hierarchical information model we expect better (human-system) performance

- **Hypotheses**
  - Better (shared) understanding of the tactical situation in a (distributed) command team through the exchange of higher-level information.
  - Less explicit communication needed.
  - Less time needed for critical decisions.
  - New people need less time to get acquainted with the situation.
  - People need less time to become aware of deviations of plans.

  - Automated support for building / maintaining / adjusting the information becomes possible.

From Theory to Practice

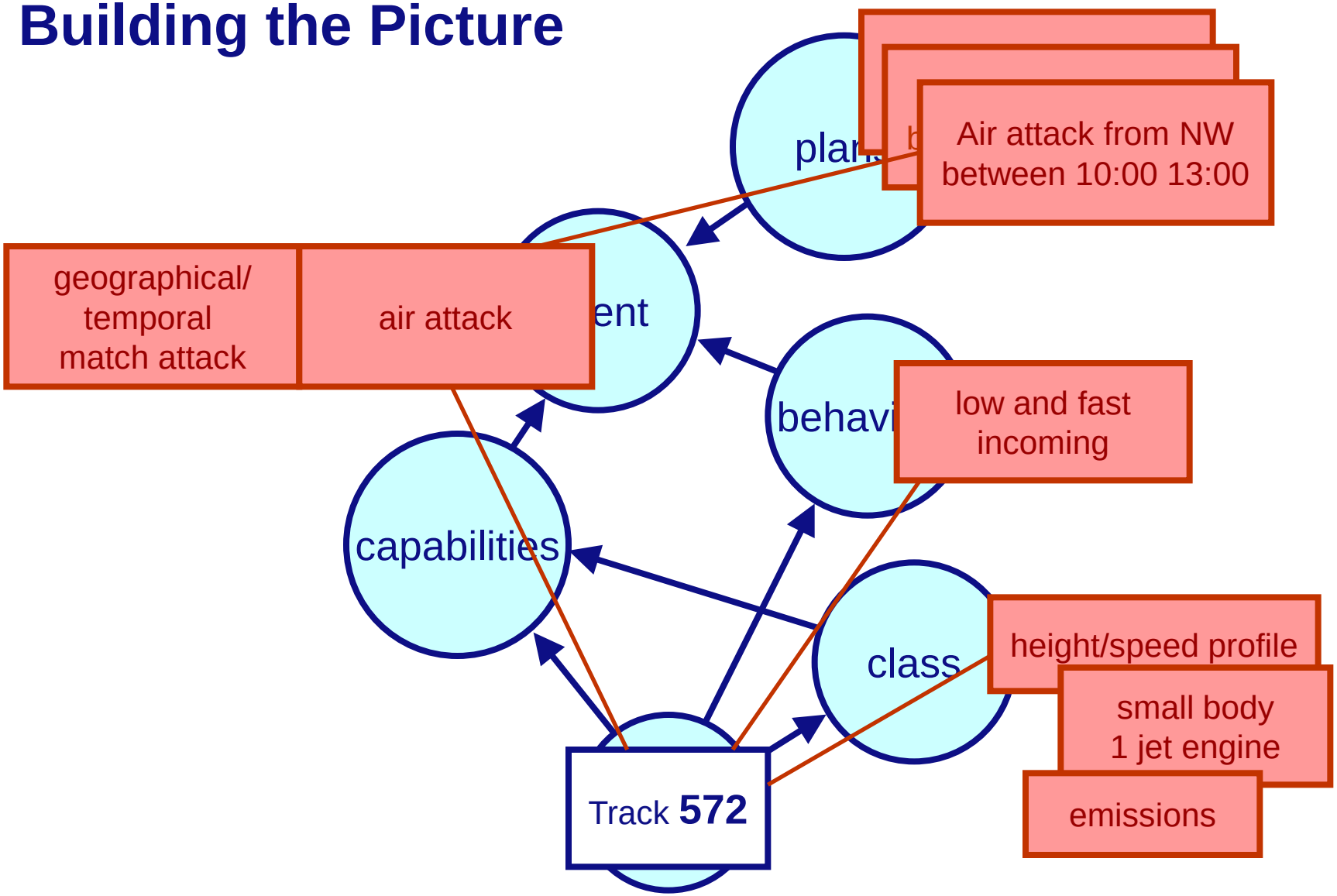


- **Matching observations and expectations**
  - Preconstructed plans describe the ***expectations***
  - A constructed reality describes the ***observations***
  - Matching expectations with observations ‘explains’ the situation

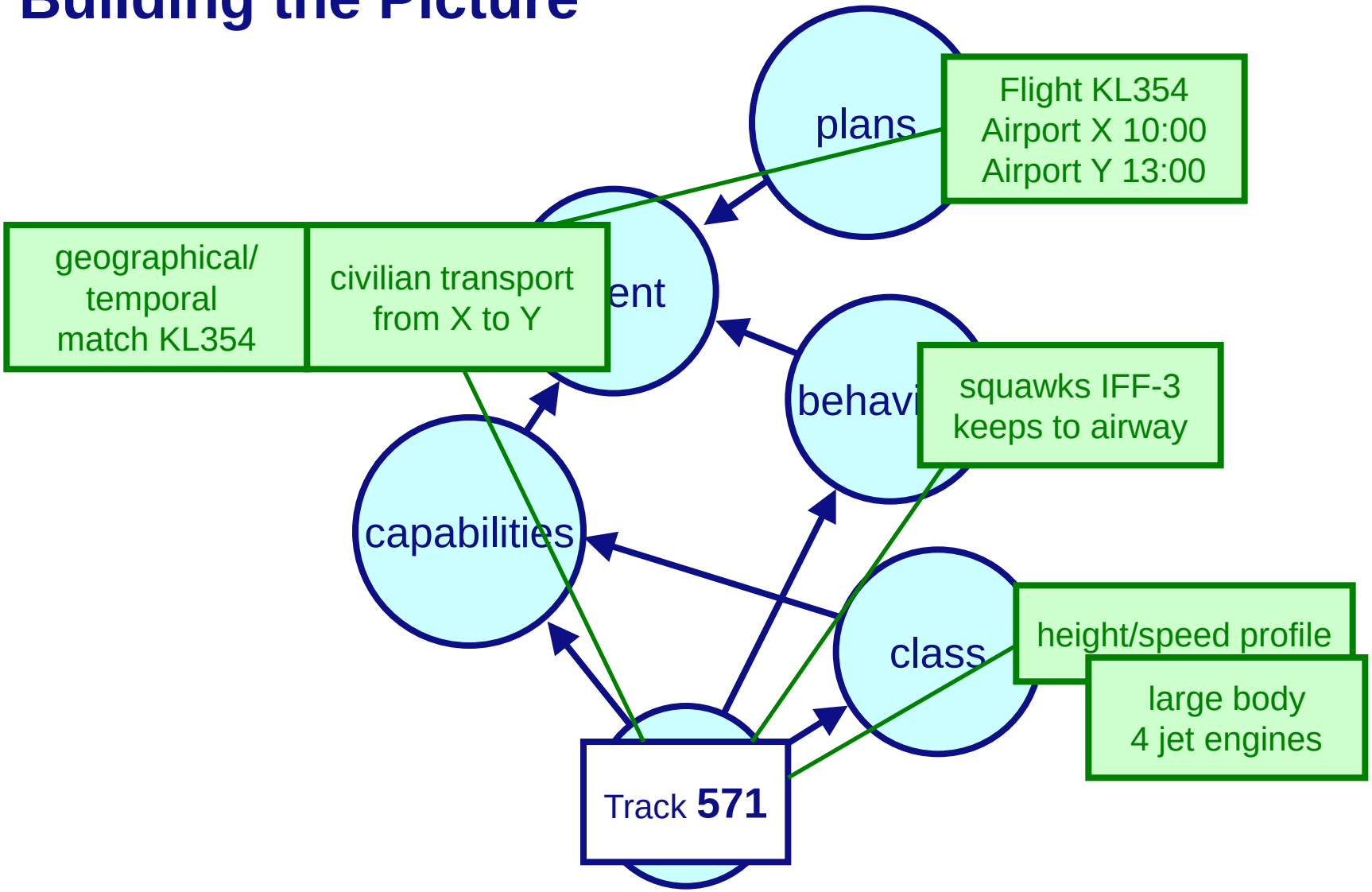
Comparisons at Different Levels

Question	Processing
what is its overarching purpose? (*goal*)	
what influence will its actions have? (*balance*)	
what is its intention? (*mission*)	**Comparison with courses of action, flight plans, shipping tables**
what is it doing? (*behaviour*) what can it do? (*capabilities*)	**Comparison with behavioural patterns;** Extraction of database information
is there something there? (*presence*) what is it? (*class, identity*)	**Comparison with signatures**

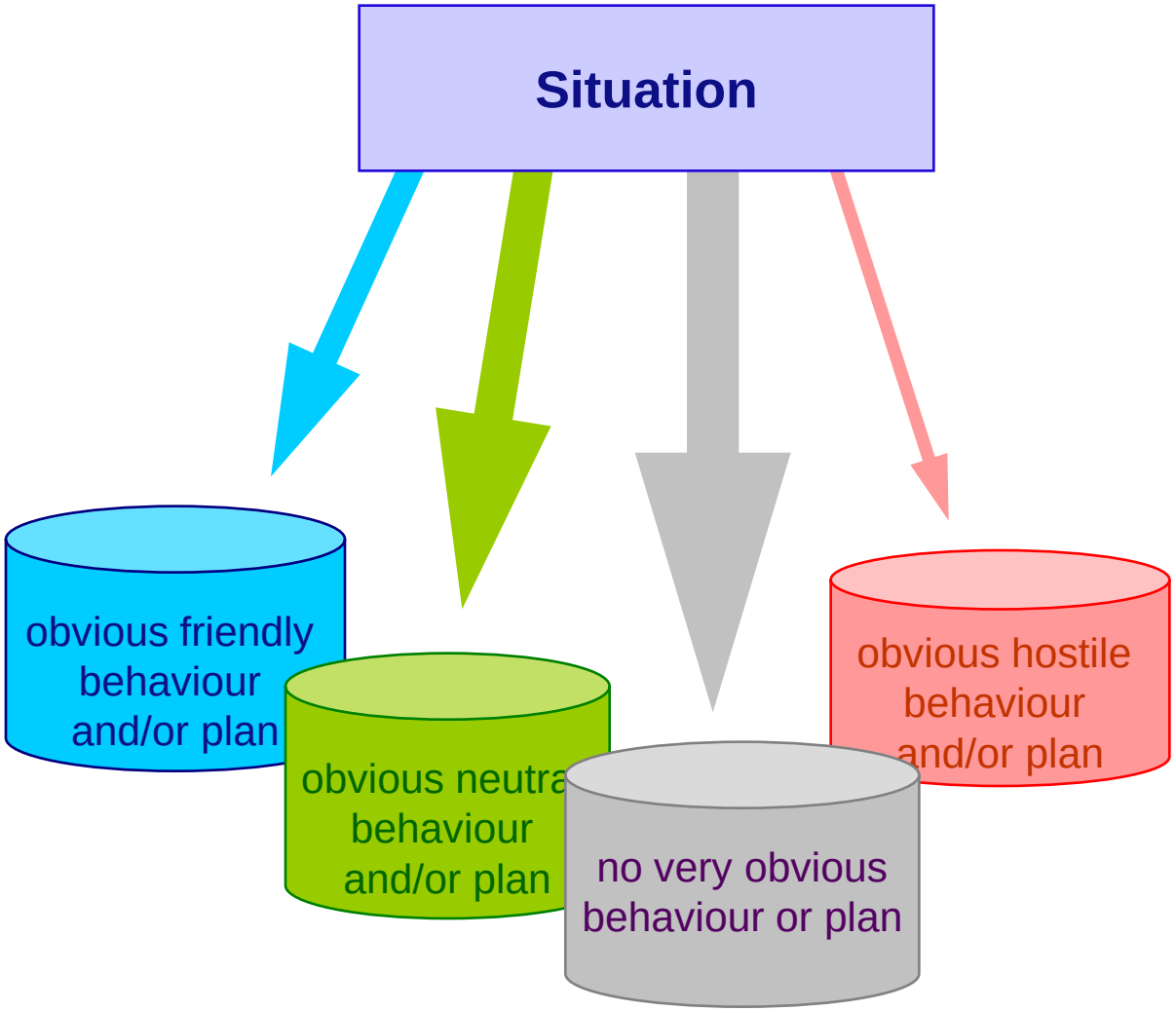
Building the Picture



Building the Picture

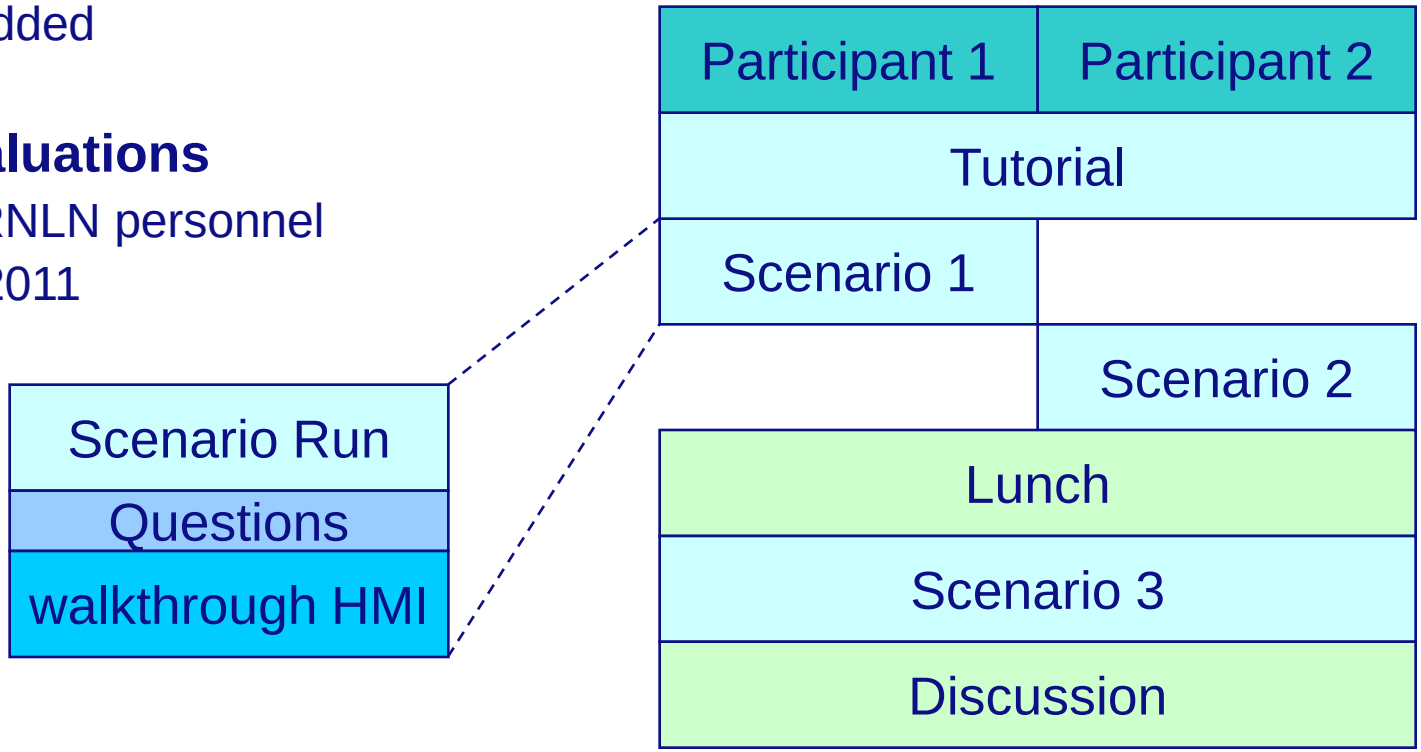


Understanding

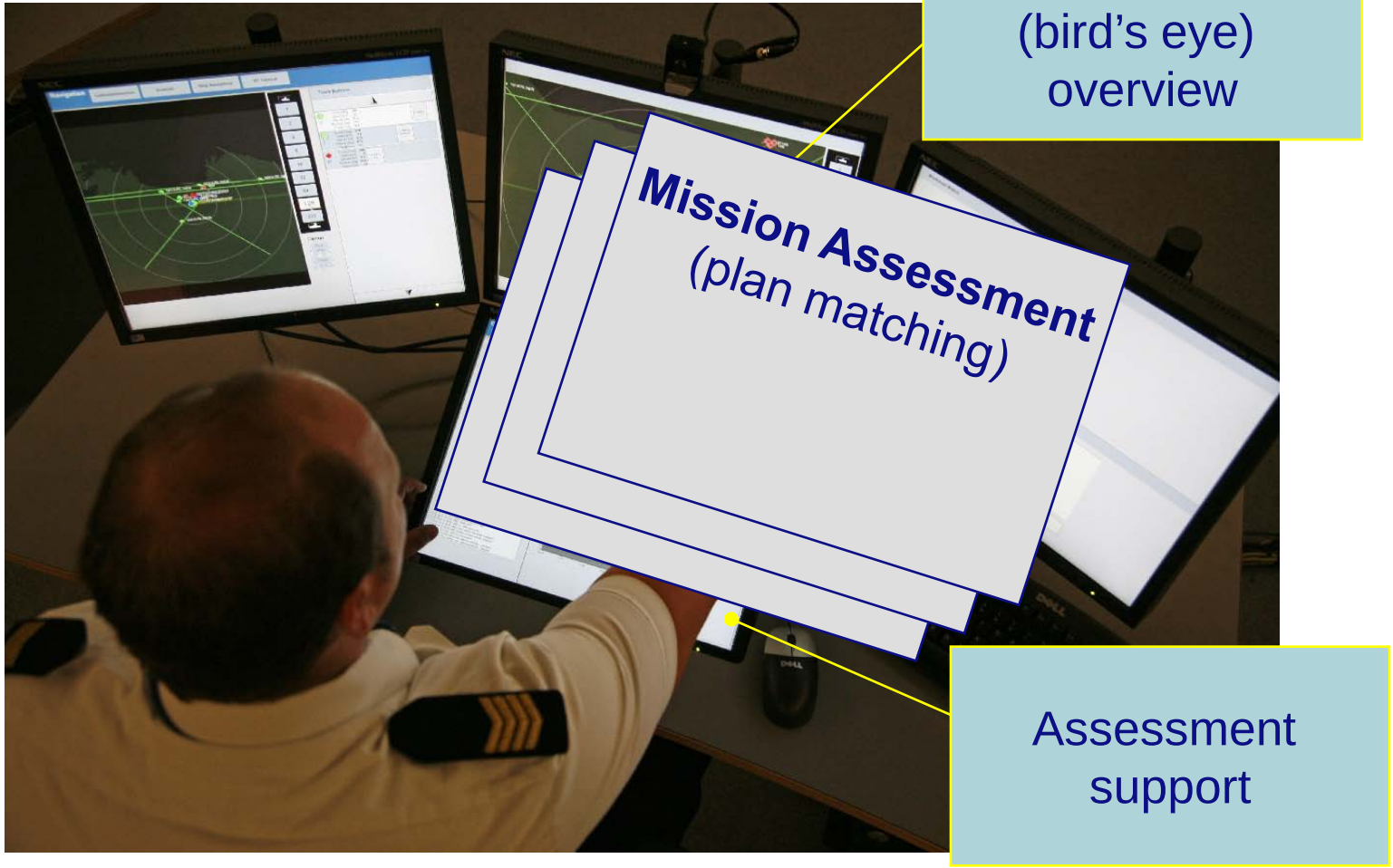


Evaluation

- **Naval Simulation Environment**
  - Based on existing high-fidelity simulation environment (JROADS)
  - Role and Mission Definitions added
  - HMI added
- **First Evaluations**
  - With RNLN personnel
  - June 2011



HMI based on three abstraction levels



Measurement: scenario runs

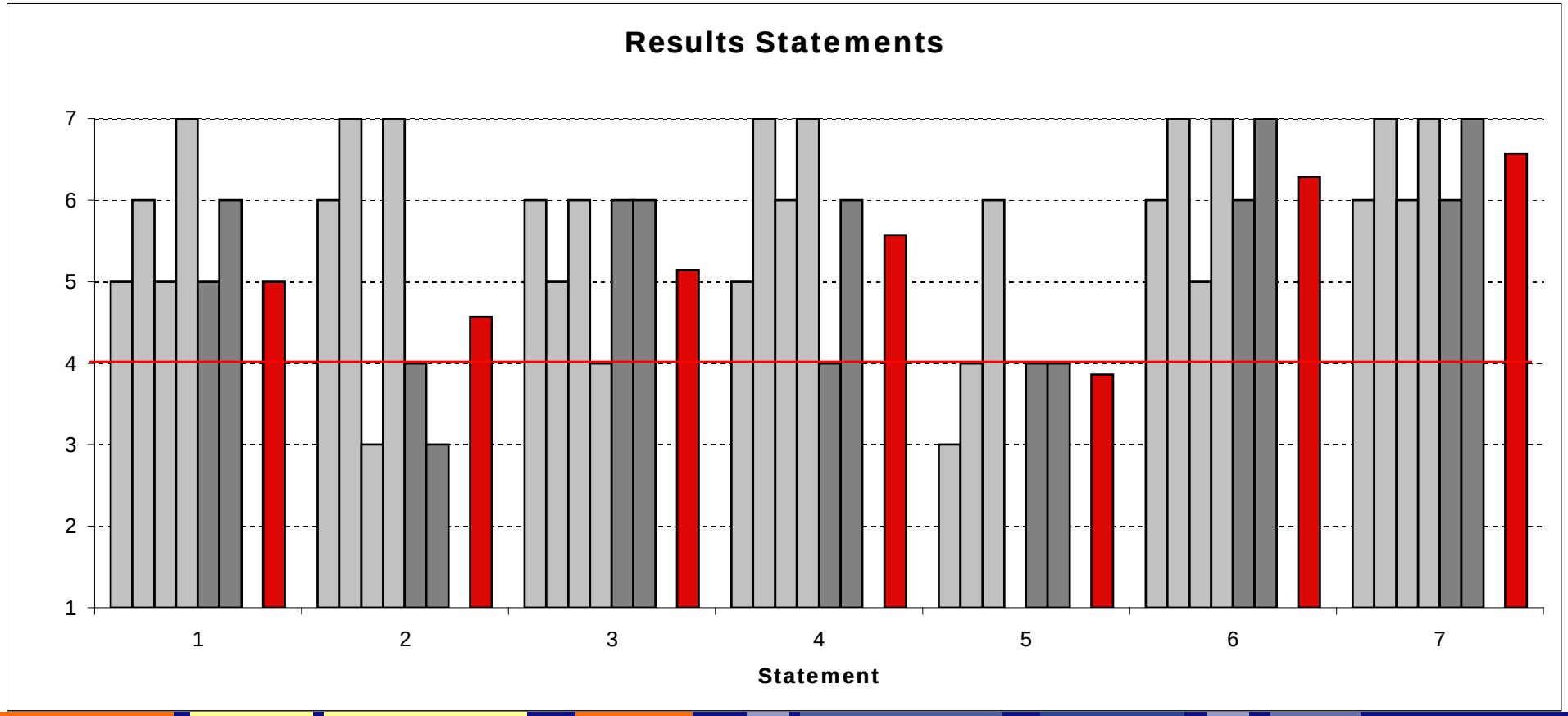
- Situation Awareness Probes
  - Freeze after 7 mins
  - Two freezes during, one after

- Statements after trial (both participant and expert)
  - Response on a 7-point Likert Scale
  - #1: Better/faster understanding
  - #2: Less communication in CIC
  - #3: Briefing
  - #4: International Ops
  - #5: Workload
  - #6: fits thought process
  - #7: TAH allows to describe tactical situation

Results

- Situation Awareness Probes
  - Observed: good

- Statements after trial



Summary

- Current Naval Combat Management Systems do not fully support complex operations (*peace keeping, law enforcement,* ...)
- Expanded information model can be based on framework of Abstraction Hierarchies, Abstraction Decomposition Spaces
- Naval abstraction hierarchy proposed of
  - overall goal
  - operational balance
  - platform/group missions
  - platform capabilities and role
  - platform presence, class and identity
-
- First evaluation with prototype June 2011
- Good reception by participants

Future Automated Support