Automated Crew Support in a Naval Vessel CC

TNO Defence, Safety and Security

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People (*Crew Support*)

- **The Hague** (*C2 + Information Management*)
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  - L. Prins
- **Soesterberg** (*Human Factors*)
  - J. van Delft
  - B. Bierman
  - K. Houttuin

Outline

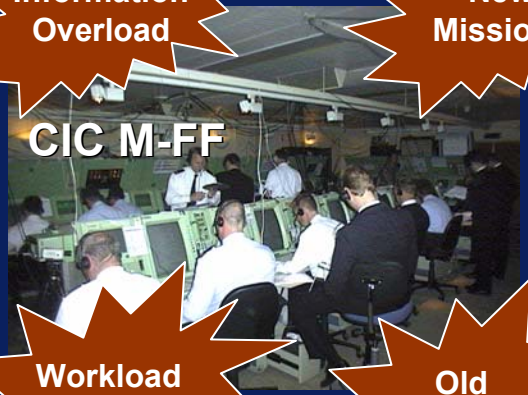
- **C2 Study**
  - Outline of the Study
- **Crew Support**
  - Situation Assessment
  - Information Management
  - Human-Machine Interface
  - Evaluation
  - Conclusions
- **C2 Study**
  - Conclusions

C2 Study Programme Goal

Problem Definition

Information Overload

New Missions



Workload Command Team

Old Technology

"Clean Slate" approach

- Workload Decrease
- Efficiency Increase
- Manning Reduction

Programme Goal

Organization

New Team Concepts

Increased Automation

Improved Information Presentation

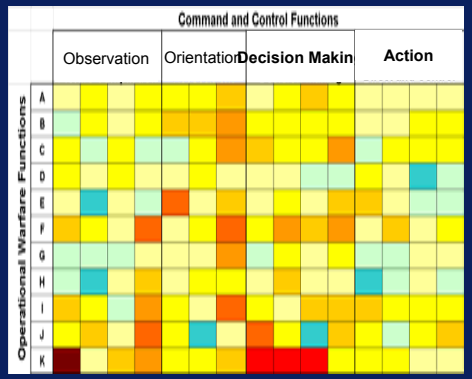
Technology

Human

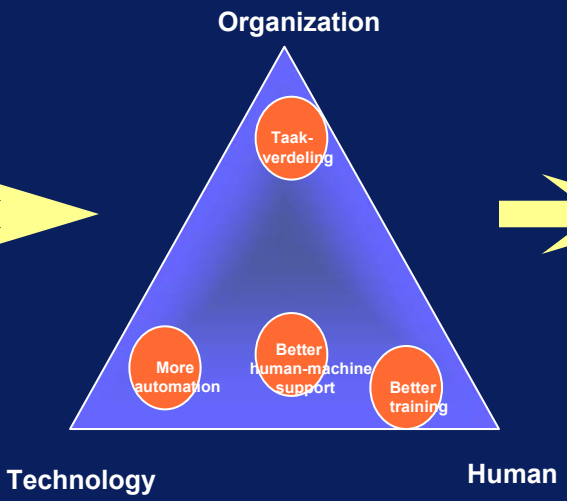
Future RNLN Ships

Phased Approach

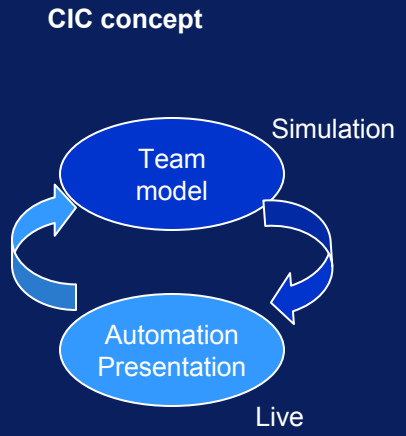
Hot-Spot Analysis



Partial Solutions



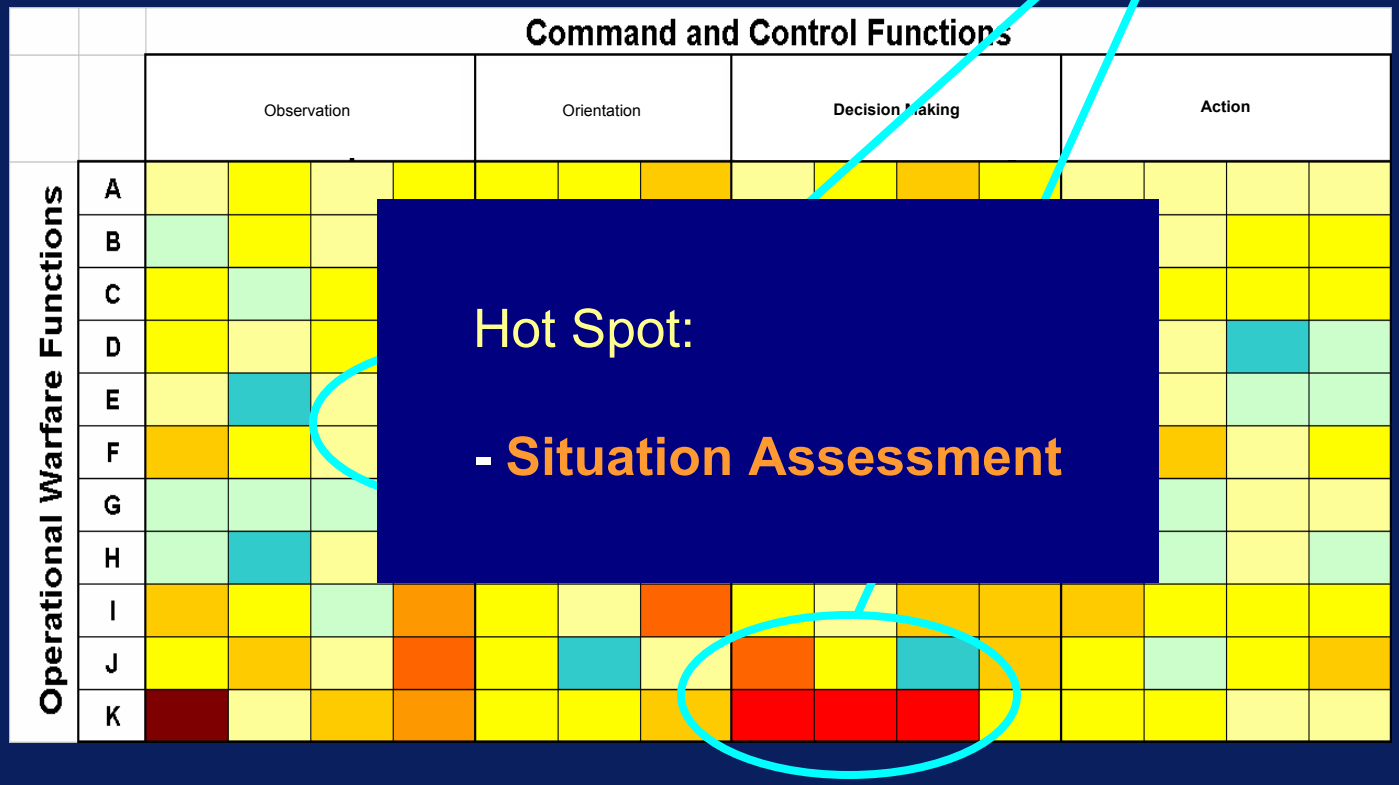
Integration



1998 — 2000 — 2002 — 2003

Phase 1: Analysis

Hot Spots:
- Time
- Volume
- Complexity

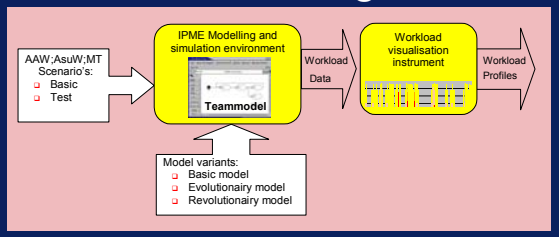


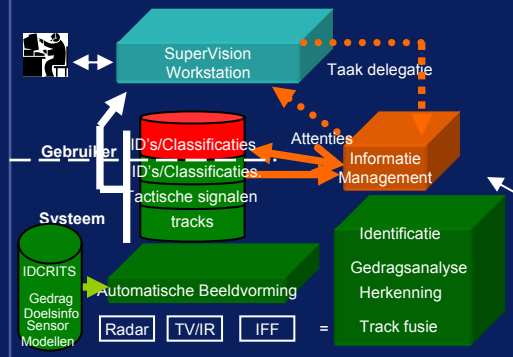
Phase 2: Partial Solutions

Interpretation support

Organization

Team modelling





CMS functionality

Team Organisation

Automation

Beter Support

Beter Training

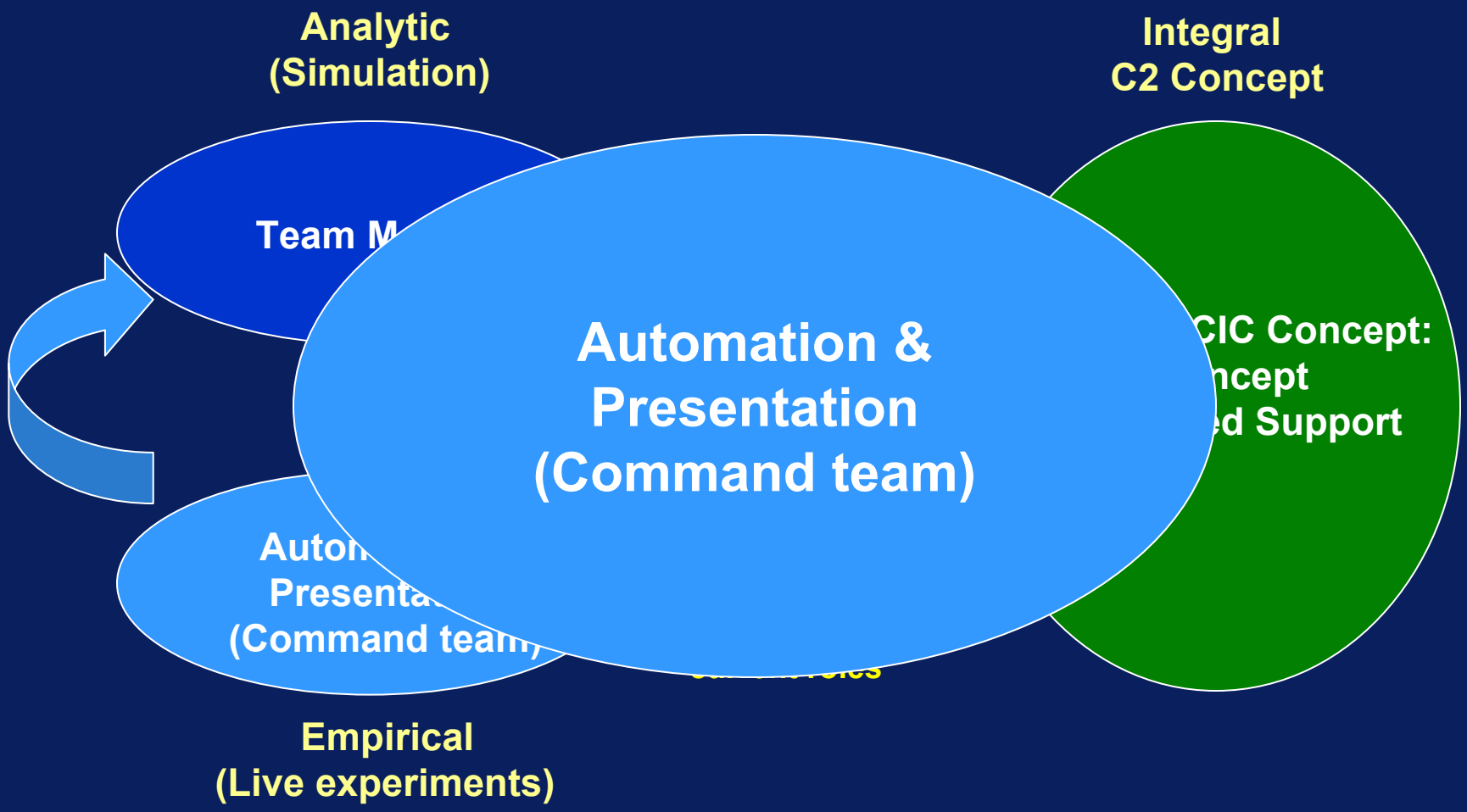
Technology

Human

Better Training

Decision support

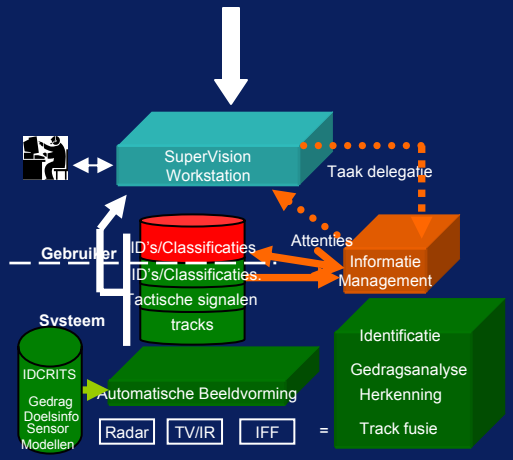
Phase 3: Integration



Workstation + Automation

“Future CMS”

5 Scenarios:
- AAW: Basis and Test
- ASuW: Basis and Test
- AWW Threat



RMP
Tactical information
Tactical alerts

Tactical decisions
Task delegation

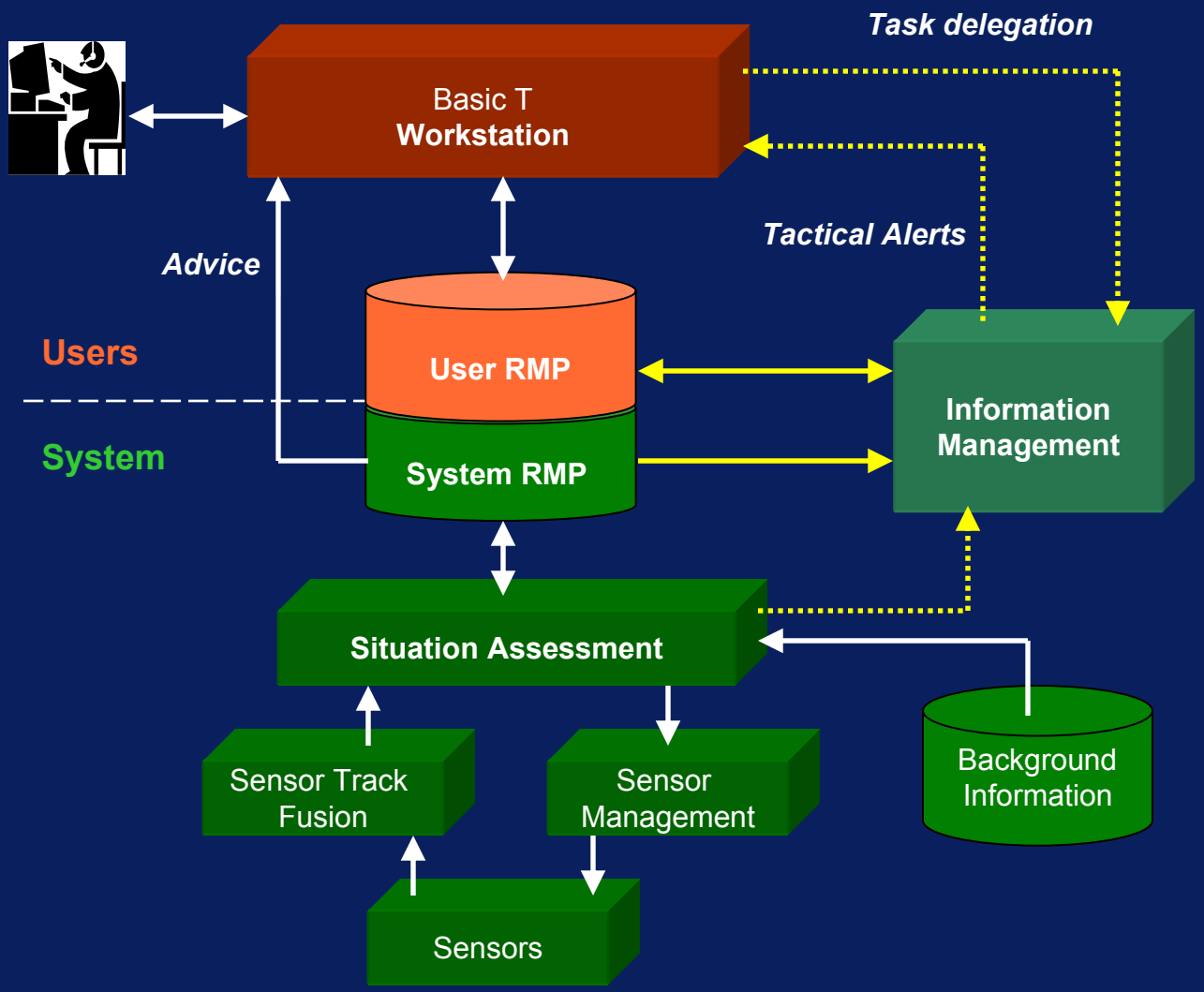
“Basic T”

- Judgement Automation and Presentation
- Determination of Workload

Automated RMP Support:
- Classification & Identification
- Signaling of tactically relevant events
- Comparison human/system RMP
- Task delegation

Improved MMI Concept:
- 3D ‘Awareness’
- Information Presentation
- Information Management
- Decision Support

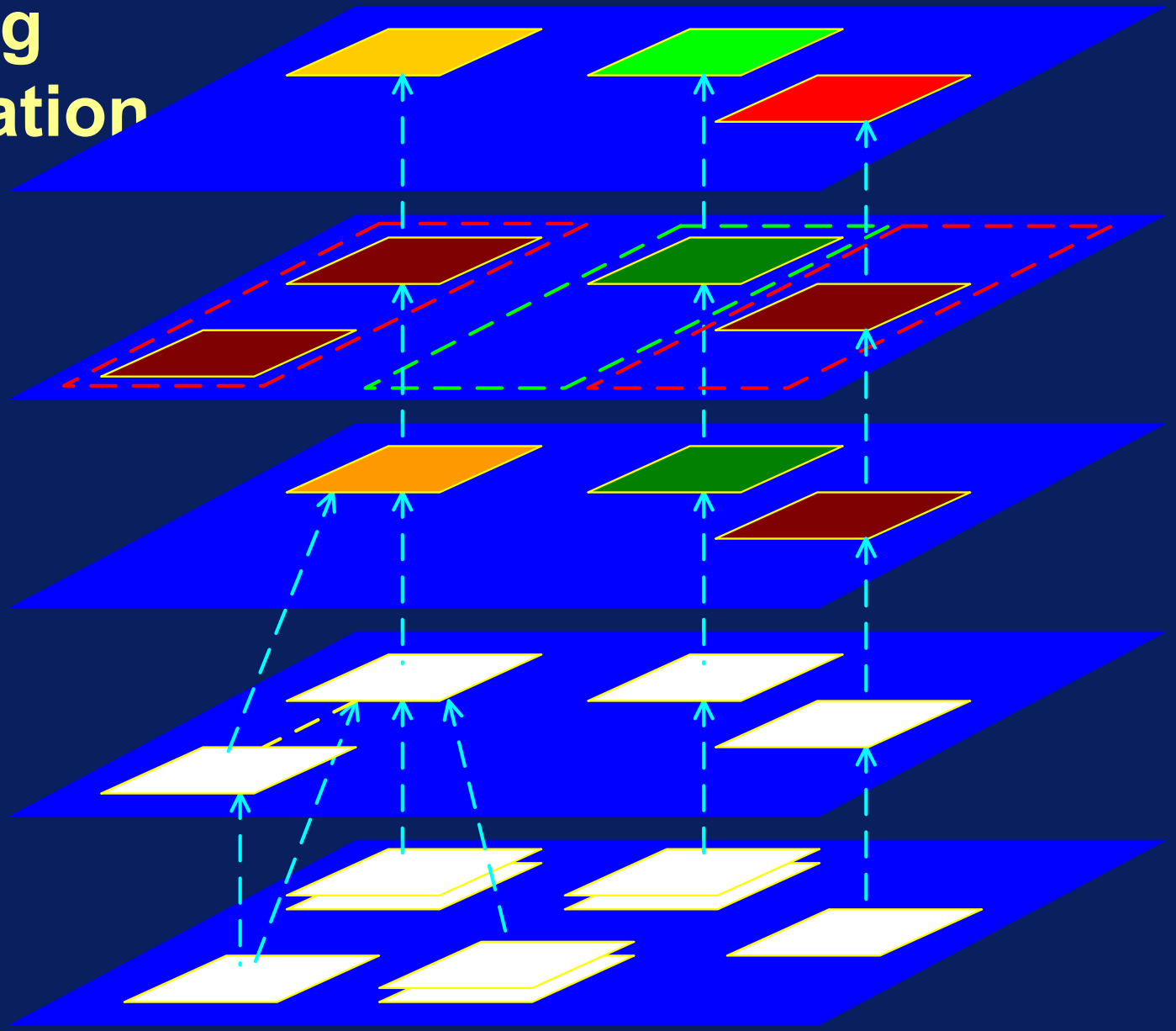
Automation Concept



Situation Assessment

- **Autonomous Sensor Track Fusion**
- **Autonomous Platform Classification**
  - Based on radar (RCS, NCTR), ESM (emitter), VISID, ...
- **Advice on Identification only**
  - Rule-based Identification (IDCRITS)
    e.g. **if** (“In Airlane” **and** “IFF-3”) **or** (“In Airlane” **and** “Big”) ⇒ Neutral
- **Track Monitoring**
  - Continuously Monitor all Tracks
  - Signal *Tactical Events* (deviations from “expected” behaviour)

Building Information



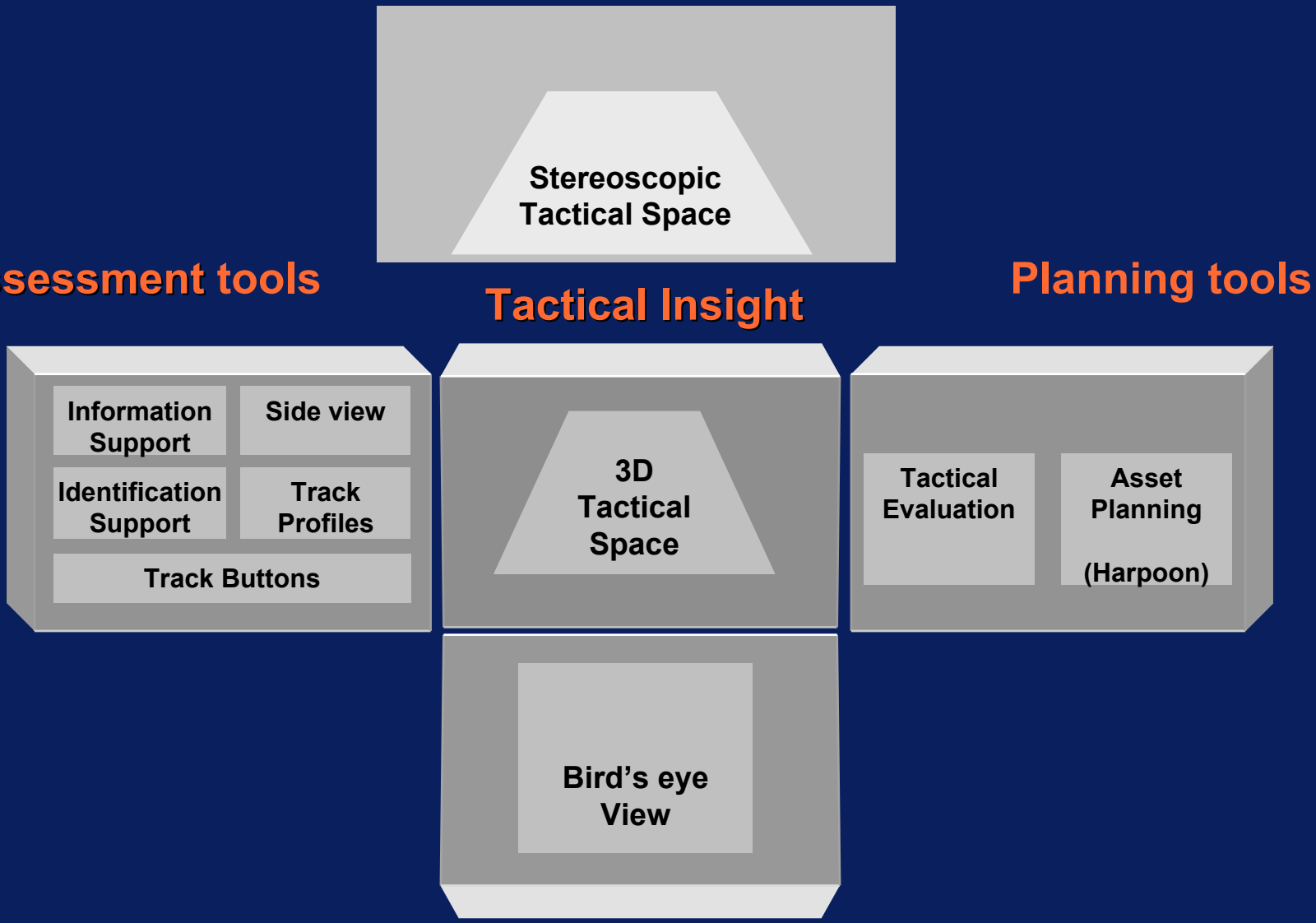
Information Management

- **Worldview Comparison**
  - Signaling of Discrepancies or Counter Evidence
- **Information Aggregation and Filtering**
  - All events are equal but some events are more equal than others
  - Collation of Tactical Signals (***significant*** changes in State Vector)
  - Track Relevance Indication
- **Task Delegation**
  - If the system generates a good interpretation why bother the operator?
  - Delegation of “easy” and “safe” Identification cases to CMS:
    robustness, trust
  - Leave “complicated” situations (and more time) to operator

Fine-grained Identification Delegation

		System Identity						
		P	U	F	AF	N	S	H
User Identity	P	NA	✓	✓	✓	✓		
	U	NA	NA	✓	✓	✓		
	F	NA		NA				
	AF	NA			NA			
	N	NA				NA		
	S	NA					NA	
	H	NA						NA

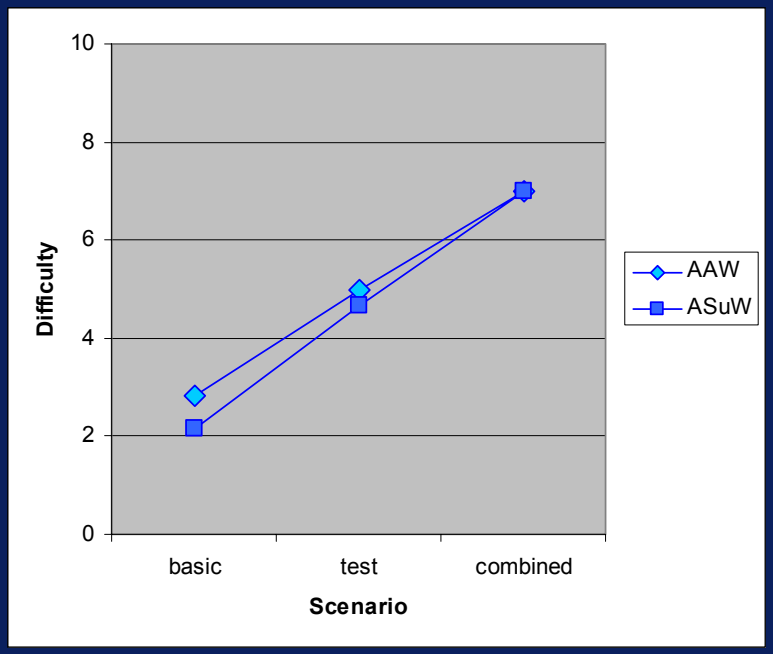
Workstation Concept: “Basic-T”



Basic-T

Evaluation

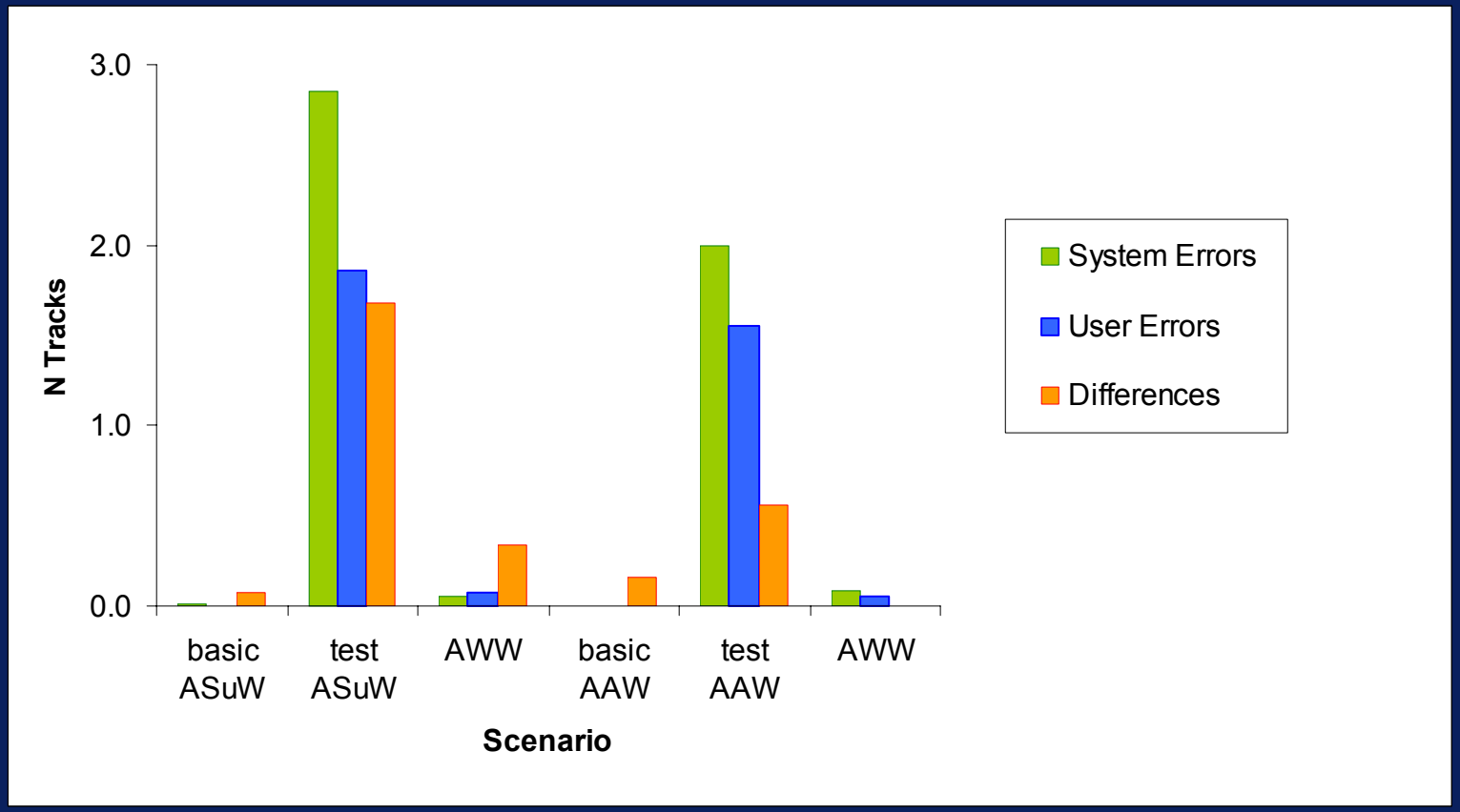
- **Evaluation**
  - Air Warfare and Surface Warfare Officers
  - Five scenarios: two AAW, two ASuW, one AWW; increasing complexity
  - No ‘null measurement’ – interviews and expert opinion



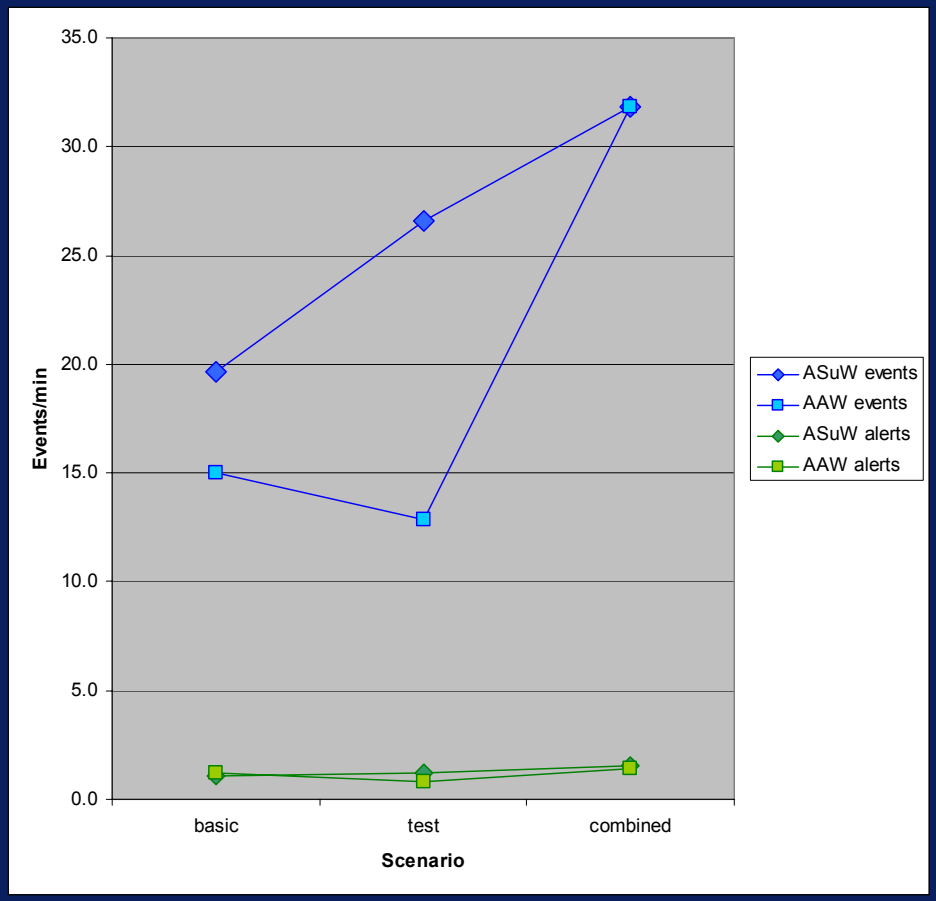
Evaluation - Interviews

- **Positive reactions**
  - Fast and consistent picture compilation thanks to automation
  - Reduction of routine work
  - System advice and tactical events aid situational awareness
  - 3D Tactical Space aids situational awareness

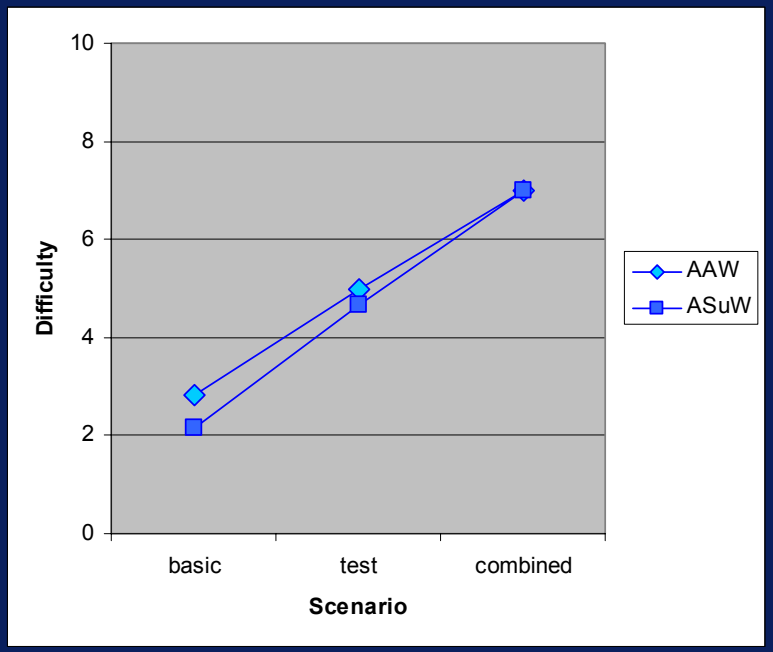
User/System Agreement

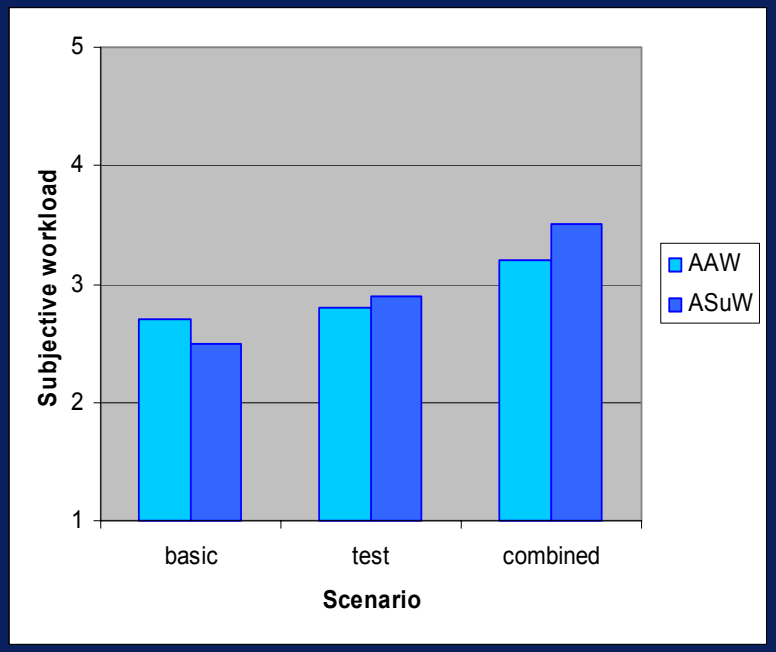


Suppression of Alerts



Difficulty vs.Workload

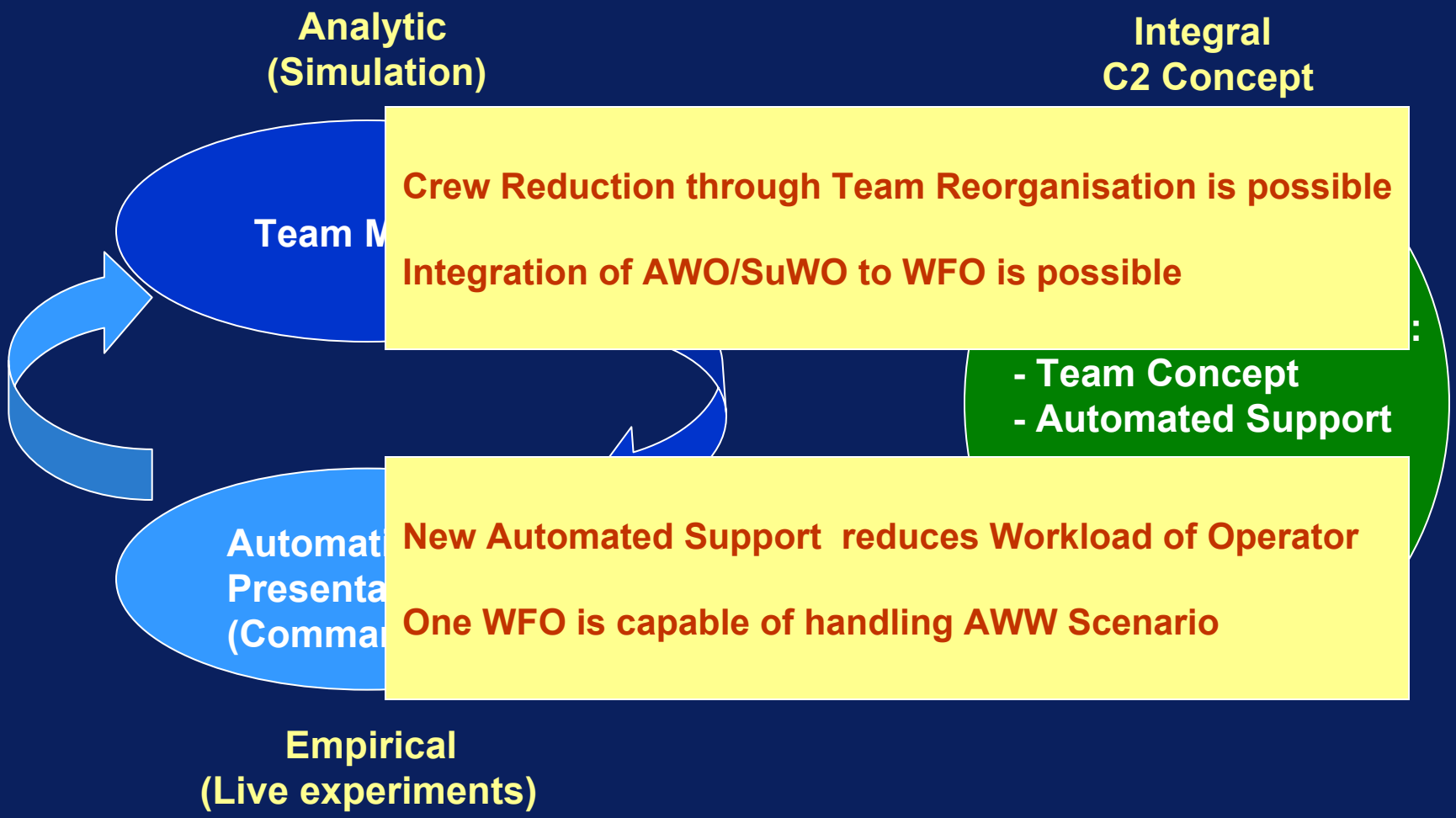




Conclusions Crew Support

- **Workload Reduction and Increase of Effectiveness**
- **Based on General Principles**
  - Separate system and user world views
  - Robust rules and algorithms for simple cases (*trust*)
  - Warning aggregation (tactical signals)
  - Delegation of simple cases

Results C2 Study



Overall Conclusions C2 Study

Results

- **A significantly smaller team seems *feasible***
  under the assumptions and constraints
- **The crew support concepts are usable now or in the near future (ADCF)**

Constraints

- The team concept has not been tested in an experimental environment (CC)
- Simplifications (no ASW, limited communication)