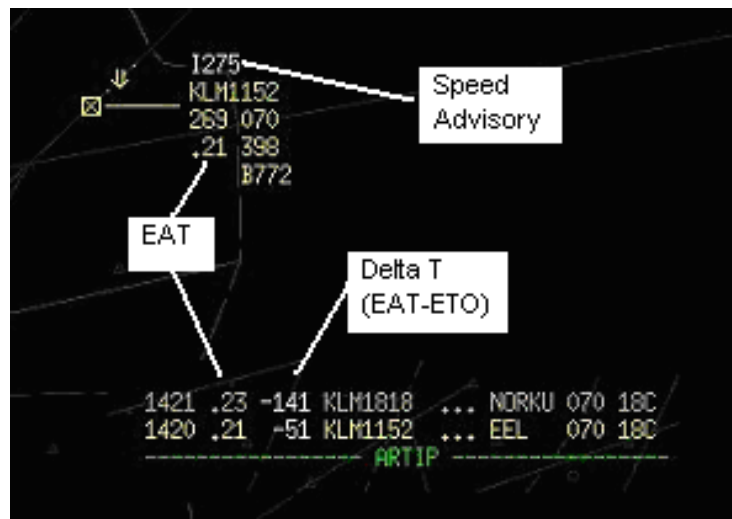


Impact of future time-based operations on situation awareness of air traffic controllers



Koen van de Merwe, National Aerospace Laboratory

Akos van der Plaat, ATC the Netherlands

SARA¹ Project Partners



Luchtverkeersleiding Nederland
Air Traffic Control the Netherlands

Contents

- Current operation
- LVNL strategy
- SARA project
- SARA functionality
- Real-Time Simulation
- Operational trial
- Conclusions

Current operation

- Schiphol = hub and spoke – peaks
- Schiphol fed by ACC via 3 IAFs
- Amsterdam FIR about 120 NM across
- Flights planned 14 mins
(about 90NM) before IAF
- 11 different adjacent centres/sectors
feed arrivals
- Bunching major problem
- Target over IAF: +/- 120 sec

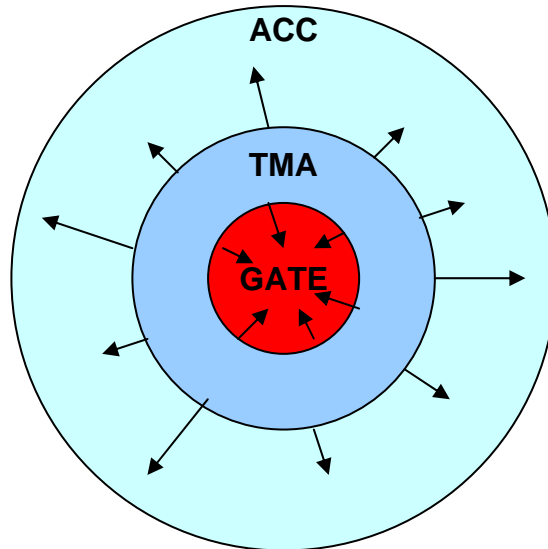
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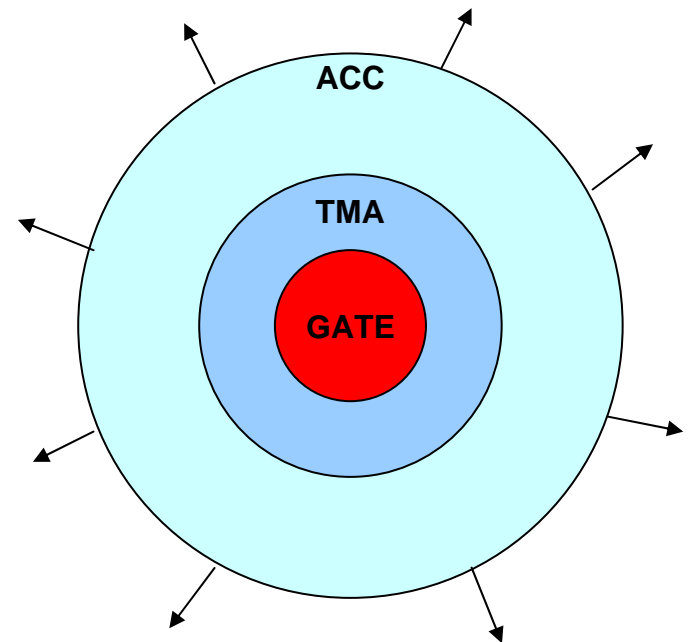
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LVNL Strategy for Time based operations

Metering at IAF to achieve efficient fixed routes and CDA's in the TMA



Avoiding conflicts pre-tactical in the TMA



Avoiding conflicts in the pre tactical in the Sectors

First Step: Ground based AMAN

- Meeting early SESAR and NextGen requirements
- Tailored arrivals on the whole fleet in high density airspace
- Short term implementation
- Striving to comply with SESAR - CTA

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SARA project

- Concept of Operations
 - Develop & Validate
- Increase accuracy at IAF
 - Increased predictability for air and ground
- Efficient aircraft descents
 - Flight efficiency
 - To manage workload for controllers and aircrew
- Inter-centre coordination

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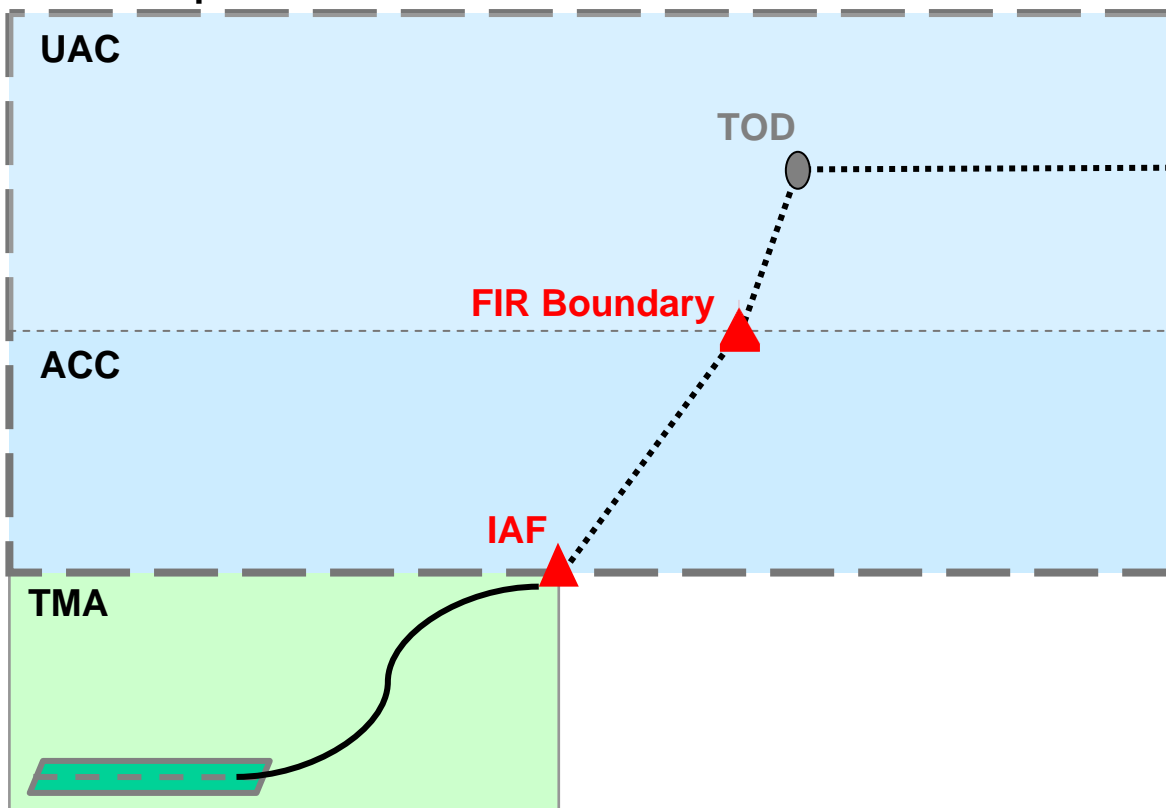


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SARA functionality

SARA is an Area Control tool

SARA Scope



SARA Concept overview

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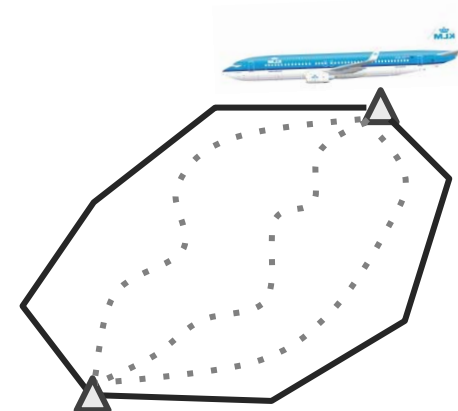
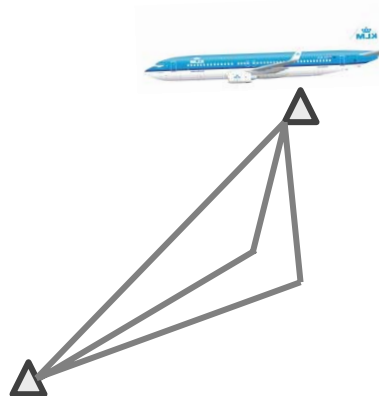
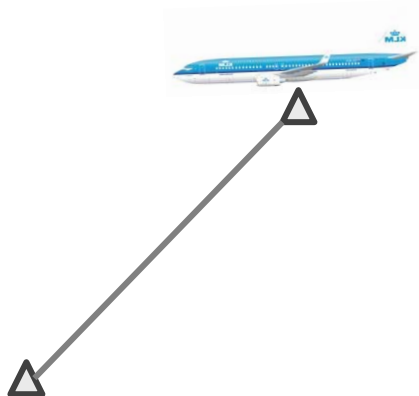


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Concept 1
Speed

Concept 2
Speed
Static Route

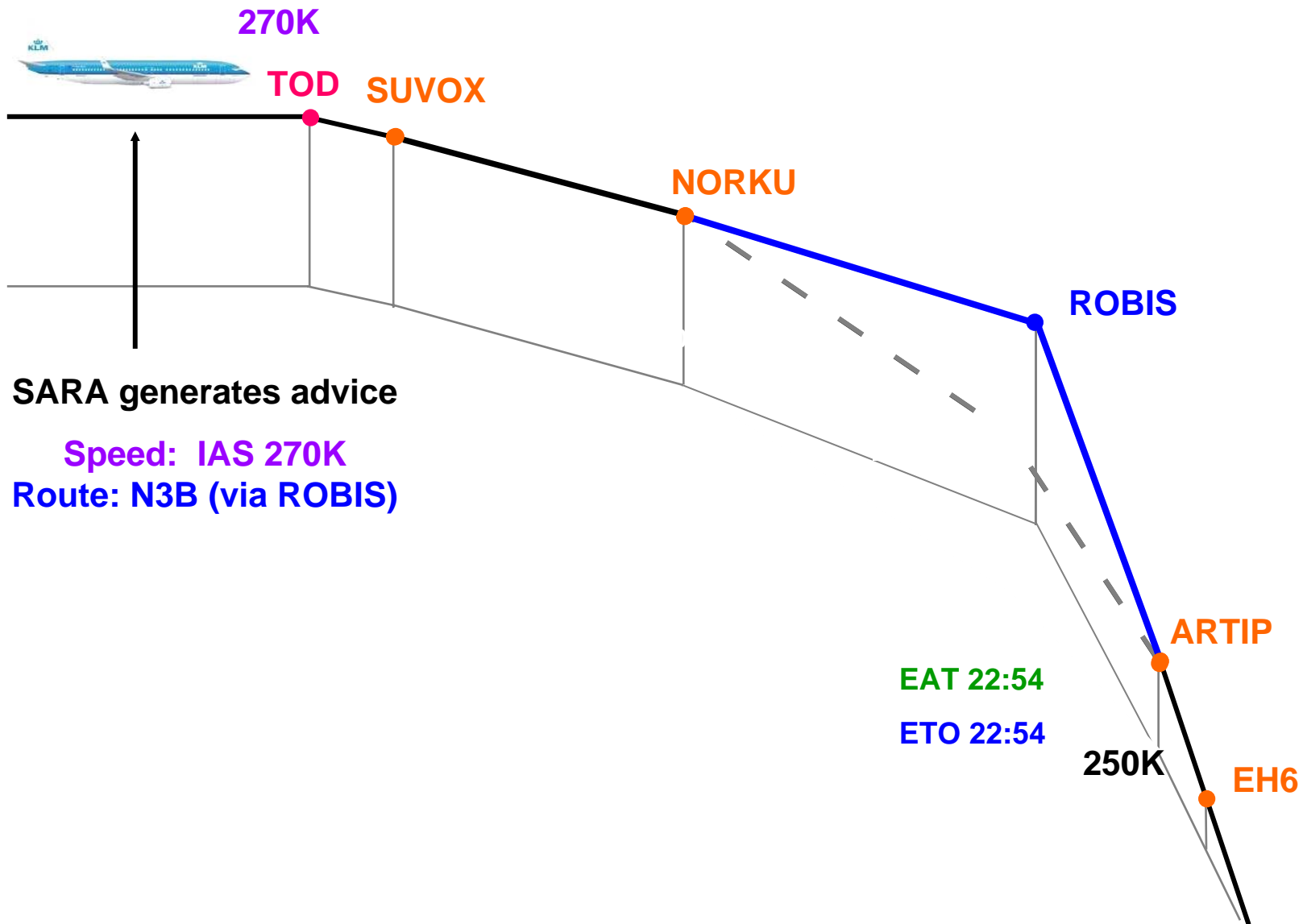
Concept 3
Speed
Dynamic route
Conflict
Management
Tool



SARA functionality



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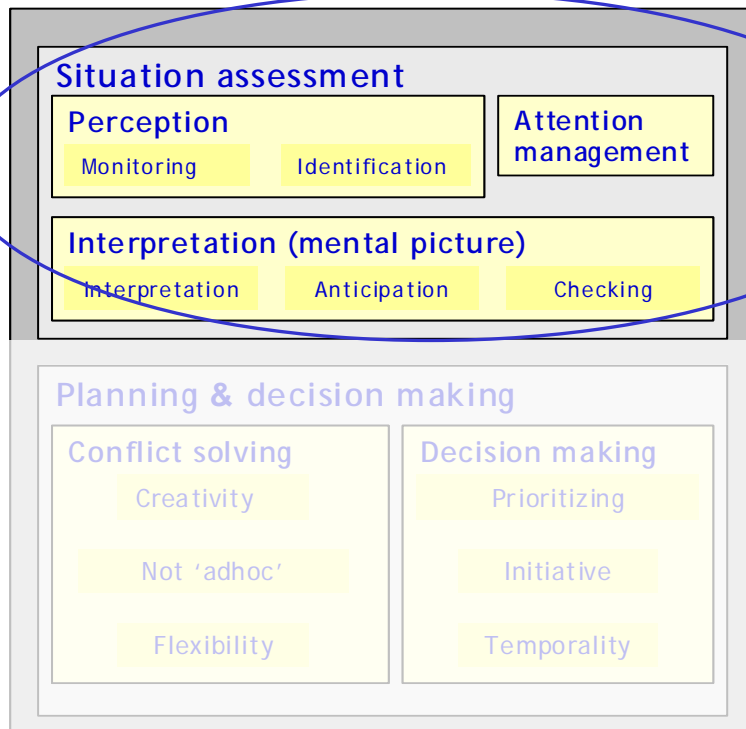
ATC Performance Model¹



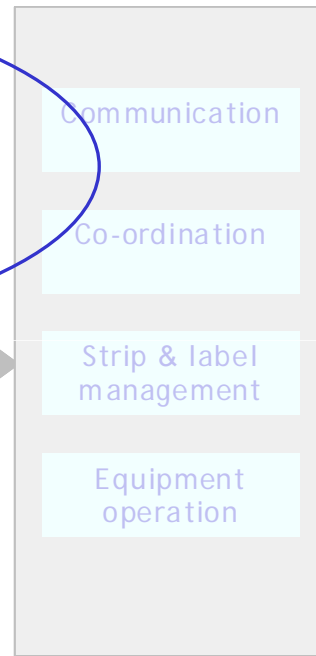
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PROCESS

Information processing



Actions

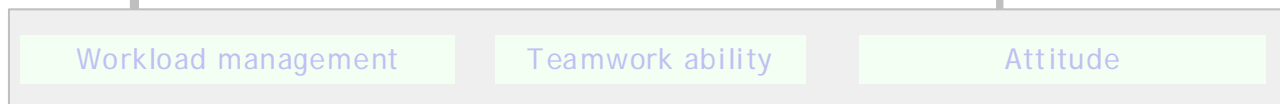


OUTCOME

Traffic handling



Influences



¹ Oprins, Van Weerdenburg and Burggraaf, 2006

Automation support & SA

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- SA is a key competence¹
- Increase in automation expected²
- Out-of-the-loop performance³
 - Less insight in system versus;
 - Mitigation reduction of SA

- SARA partial automation

¹ Oprins, 2008

² SESAR, 2007; NextGen, 2008

³ Endsley, 1995

Real-Time Simulation Setup

- 8 LVNL controllers & 8 pseudo pilots
- Measurements
 - EAT accuracy
 - SA (SASHA-Q)¹
 - Workload (R/T load, TID & ISA)
 - Observers & interviews

Run	Target time over IAF	System support
1	Within plus or minus +/- 120 sec	Present
2	Within plus or minus +/- 30 sec	Delta-T in label
3	Within plus or minus +/- 30 sec	SARA Speed only
4	Within plus or minus +/- 30 sec	SARA Speed & Route

Real-Time Simulation Setup

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Real-Time Simulation Results

- EAT accuracy
 - Improved



- Situation Awareness
 - Affected



- Workload
 - Affected



Real-Time Simulation Results - Qualitative



1. Stricter focus on time
 - Different traffic handling
 - Impact on mental process
2. Automation support
 - Different strategy
 - Conflict solving: late vs. early
3. Familiarity

Operational trial Setup

- Live setup
- 8 sessions
- Speed-only SARA

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Operational Trial Preliminary results



1. Improvement in EAT accuracy
2. Focus on time
 - Different traffic handling
3. Automation support
 - Monitoring
 - Situation Awareness

Conclusion & Discussion

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- Improved EAT accuracy
- Change in working method
 - Time-based Operations
 - Automation support
- SA in TBO influenced by system design
 - Trade off between accuracy, SA and WL
 - Gradual implementation required
- Requirements for SA in TBO
 - Active controller
 - Responsible controller

Thank you for your attention

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Slides for additional discussion

Applications of the model

- Selection of ATCOs
- Assessment in training
- ATM system design

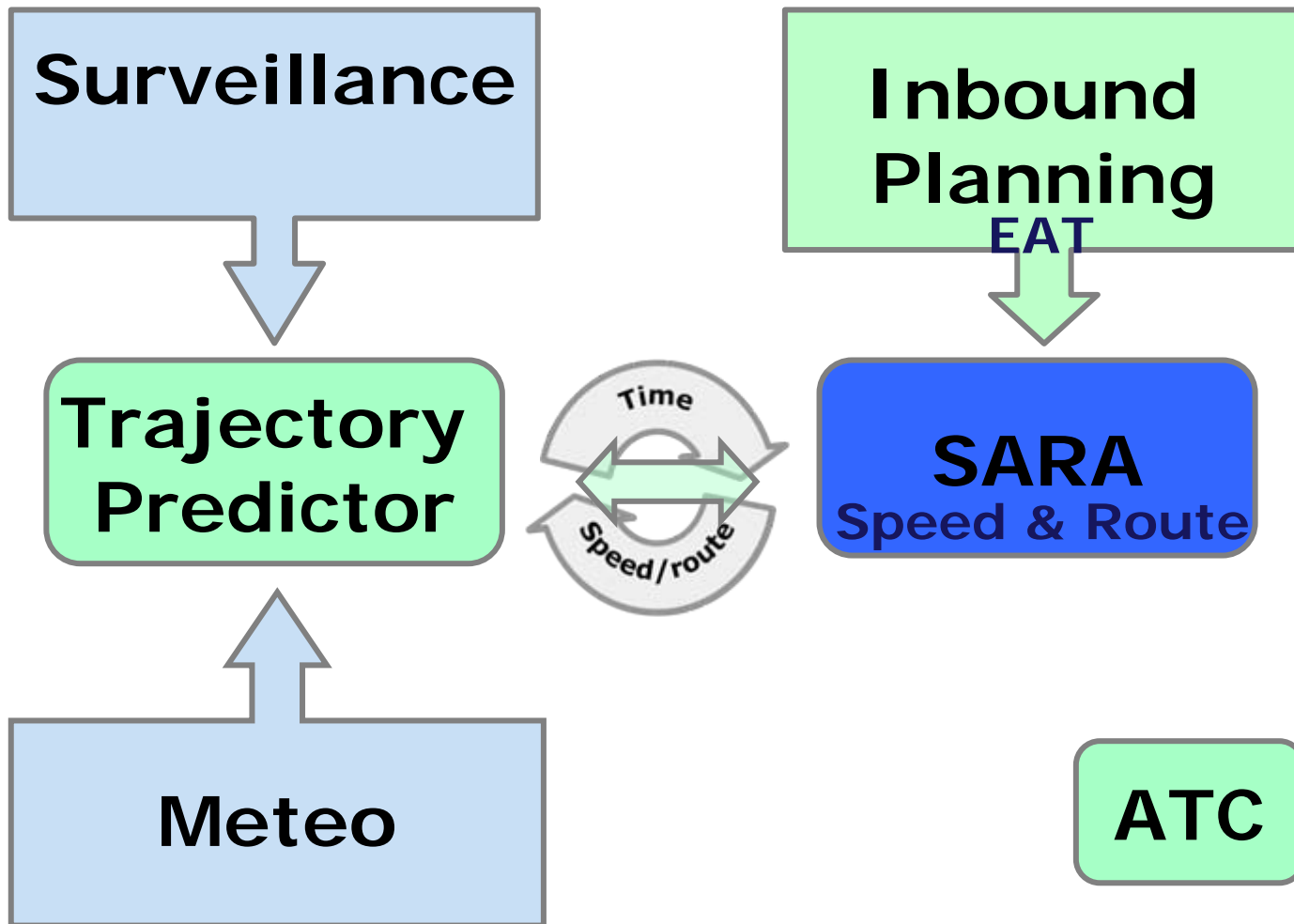
Goal: reduction of work complexity

2 most important reasons for failing
(research all trainees 2003–2006)

- Situation Awareness
- Workload Management

'Less learnable' competences

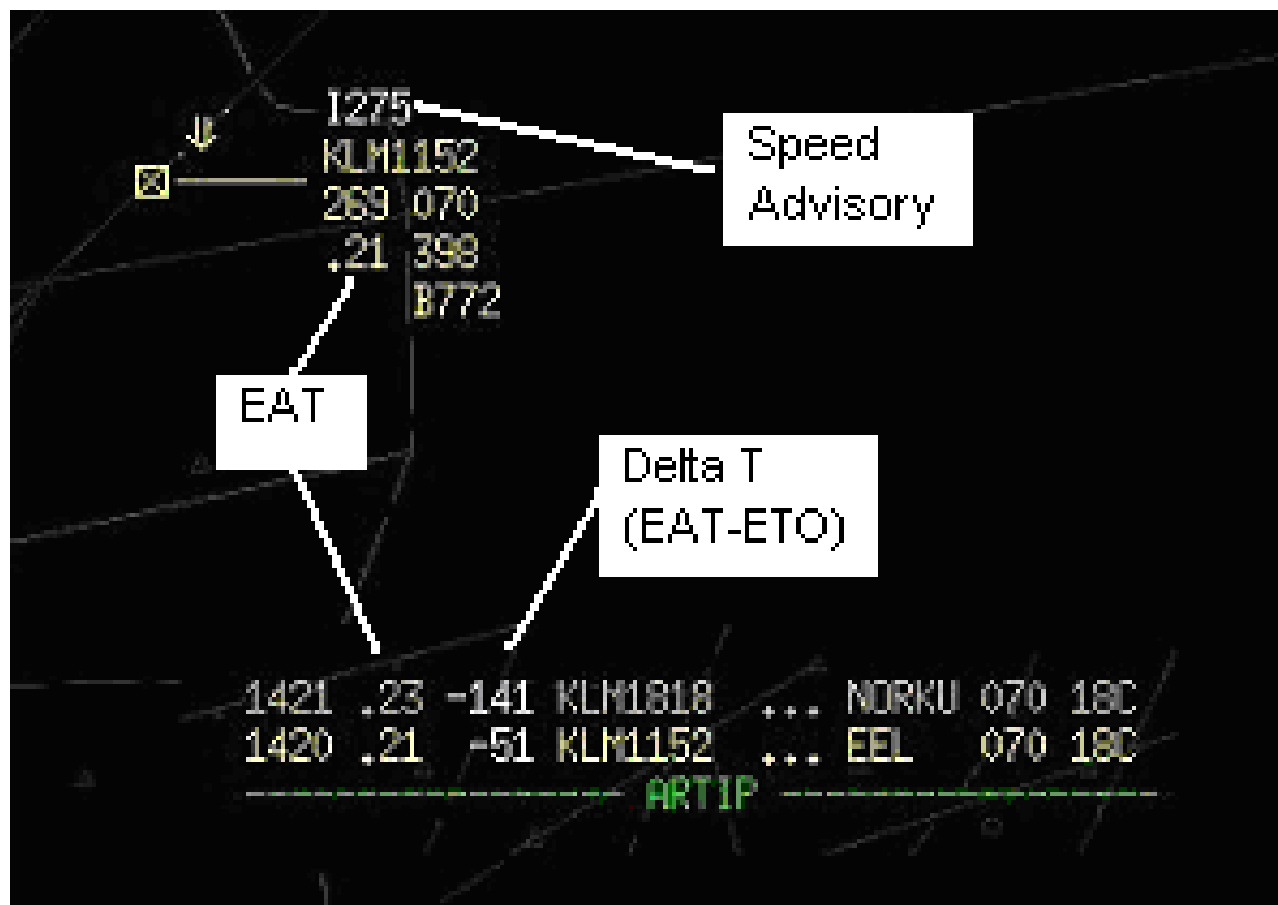
SARA Technical Principle



Real-Time Simulation HMI



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Real-Time Simulation SARA design cycle

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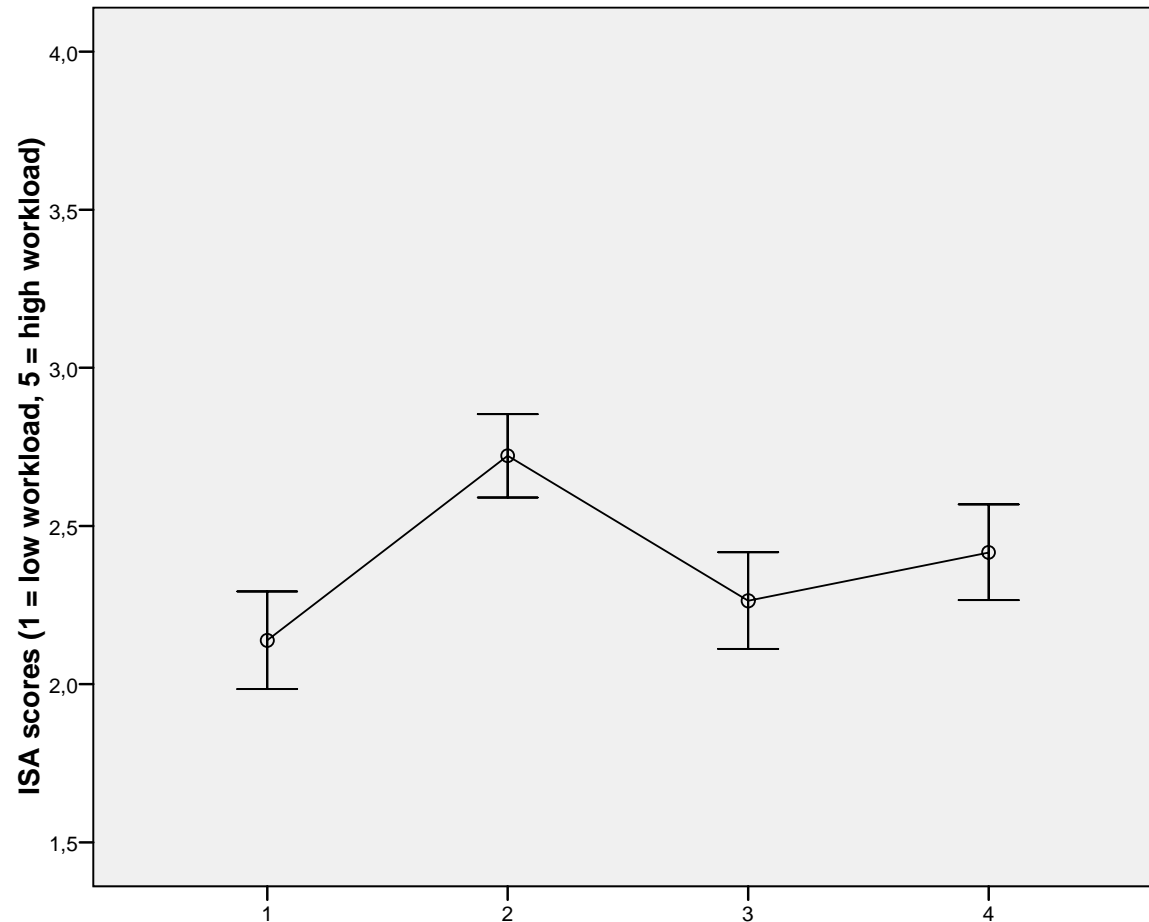


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Real-Time Simulation Results - Workload

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- Run 2 highest ISA score
- $F(3,68) = 17.256, p < .001 \eta_p^2 = .432$

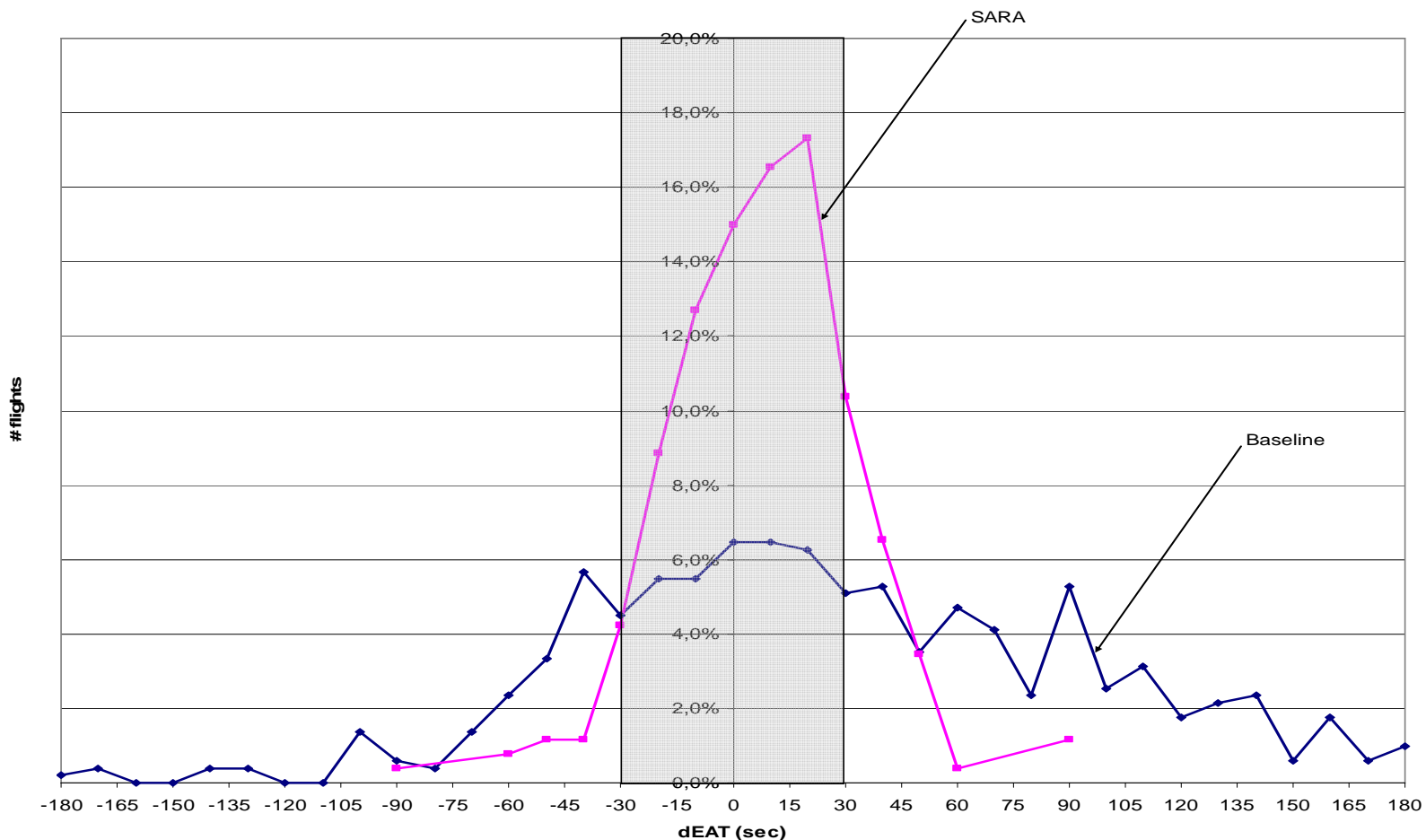
Operational Trial Preliminary results



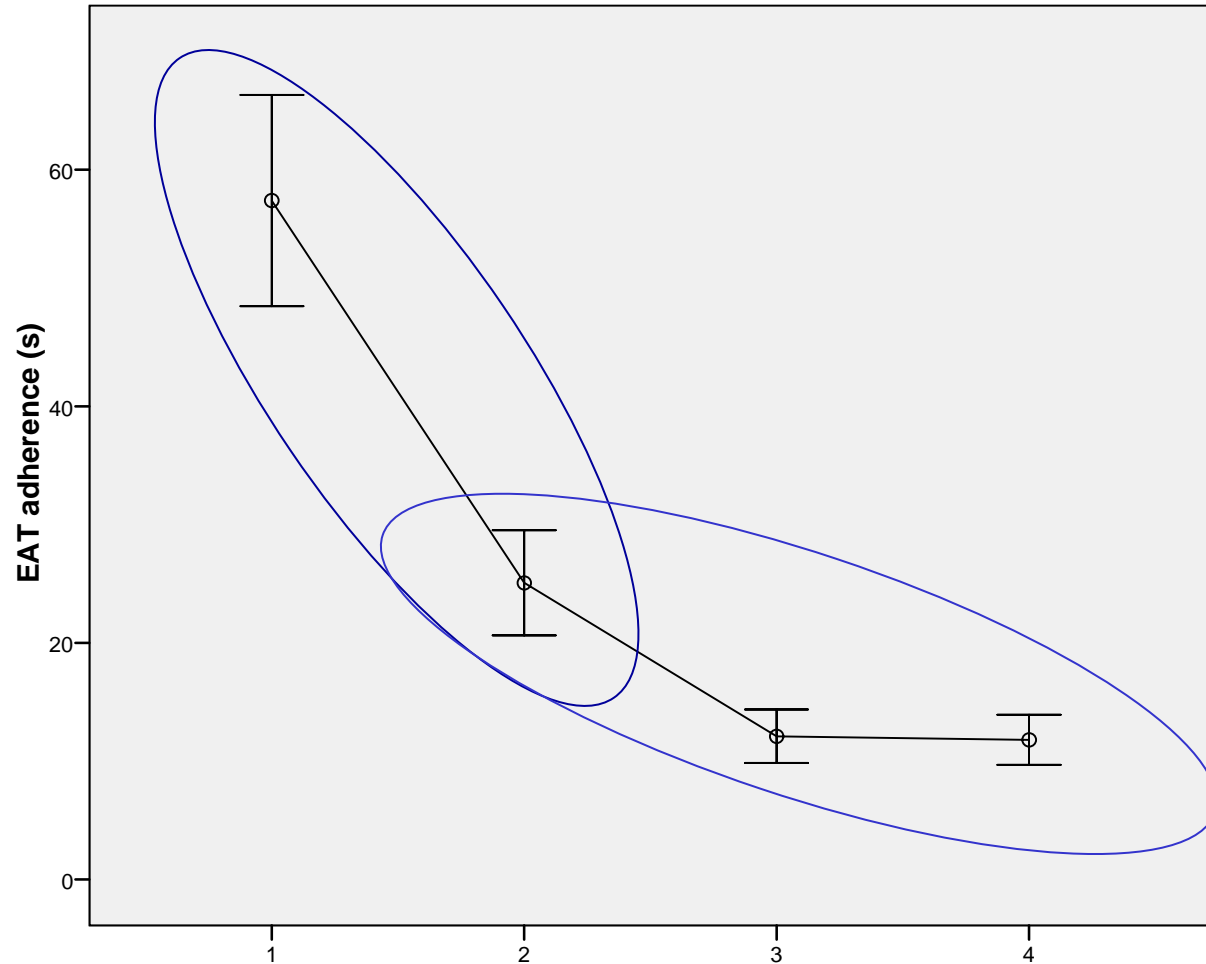
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- EAT adherence

EAT adherence distribution SARA & Baseline



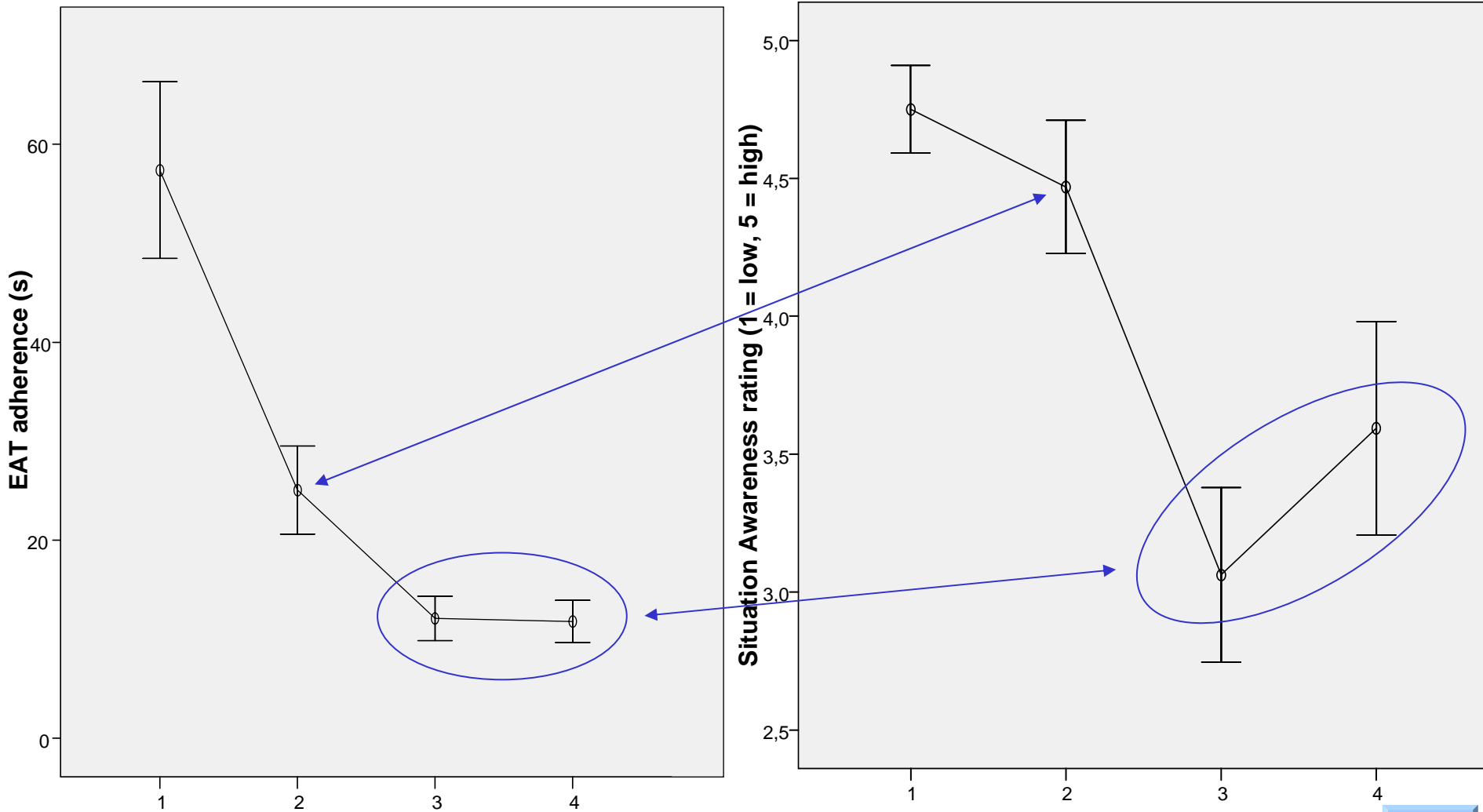
Real-Time Simulation Results - EAT adherence



- Significant difference between runs
- $F(3,63) = 40.918, p < .001, \eta_p^2 = .661$



Situation Awareness



Workload

