



# AIR NAVIGATION SERVICES OF SWEDEN

An Empiric Approach to Risk Assessment of Human Error in Multi Remote Tower

# DATS – WORKSHOP ON DIGITAL AIR TRAFFIC SERVICES

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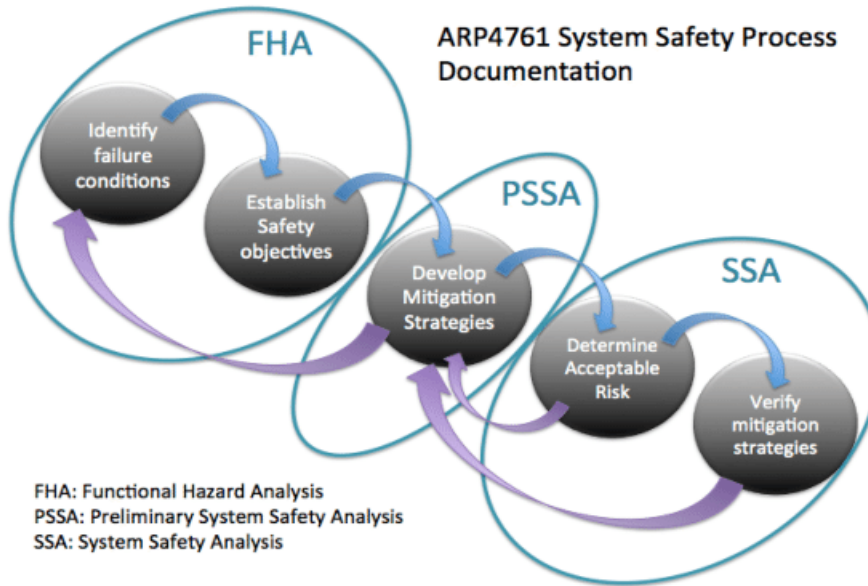
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# LFV Multi Remote Tower



# Safety Assessment of Socio Technical Systems



- ✓ Safety Workshop
- ✓ Are identified hazards relevant?
- ✓ Subjective influence from personal experience
- ✓ Empiric evidence needed
- ✓ Human In The Loop Simulations

Source: Decadi 2016

# The MERASSA Concept

- ✓ Experimental verification  
of the safety-relevance  
of identified hazards

# Test Procedures

## ✓ Visual Testing

- Car on Runway
- Moose on Runway
- VFR flying into CTR without permission

## ✓ Equipment handling

- Finding the helicopter on the backside
- Push emergency button
- Push frequency button

## ✓ Situational Awareness Test

- Wind
- Braking Action
- Position of A/C
- QNH
- Vehicle on Runway

### **Primary Dependent Metrics**

- Reaction Time and
- Error Rate

# Hazard Relation

# Testing Procedure Theory



# Statistic Test Methods

- ✓ **Paired Testing** means that the test person is compared with itself (Single vs Multi)

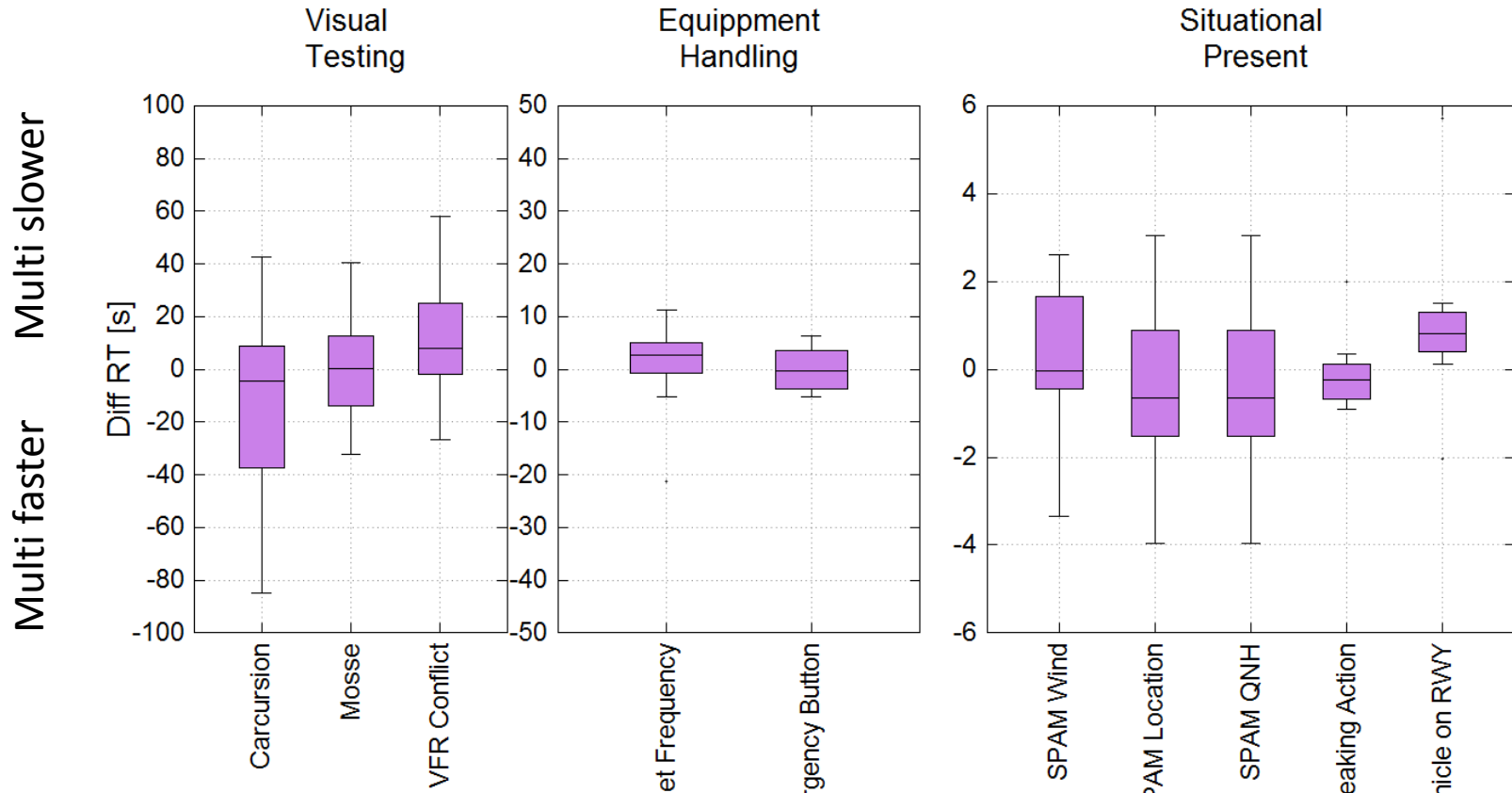
$$\Delta RT = RT_{Multi} - RT_{Single}$$

- ✓ Test on difference in the distribution of the RT pair samples
  - Is there a significant shift in the reaction time? Mann-Whitney-U-Test.
  - **NO?** Thats fine. Thank you for your cooperation!
  - **YES?** The test person tries to compensate something. Which direction?
    - **Multi slower:** The test person tries to cope with uncertainty or difficiencies
    - **Multi faster:** The test person feels challenged. Competetive behaviour.
- ✓ Test significance of correlation RT vs Error Rate
  - Fitts Law!

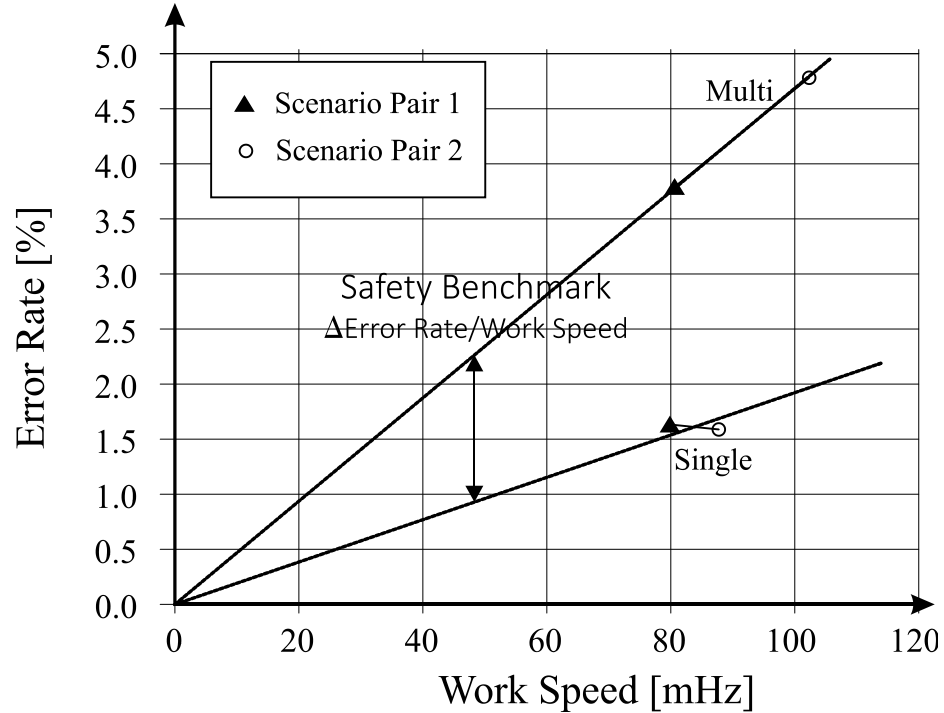
# Results Second Iteration (Sep 2018)

Multi faster      Multi slower

# Results First Iteration (Dec 2017)



# Work Speed vs Human Error (Dec 2017)



# Workload

- ✓ ISA scale 1 – 5
- ✓ No significant differences found

## Post Questionnaire (2nd iteration)

1. I think that the artificiality of the simulation had an impacted on my behavior.
2. In general, I could predict the events more than in reality.
3. I prepared for the events because I could predict the occurrence
4. I'm of the opinion that the tests treat single and multi-remote tower unfair
5. I'm of the opinion that my attention was significantly impacted by the need to control two airports

1 – don't agree at all.....5 – Totally agree

# Self Evaluation

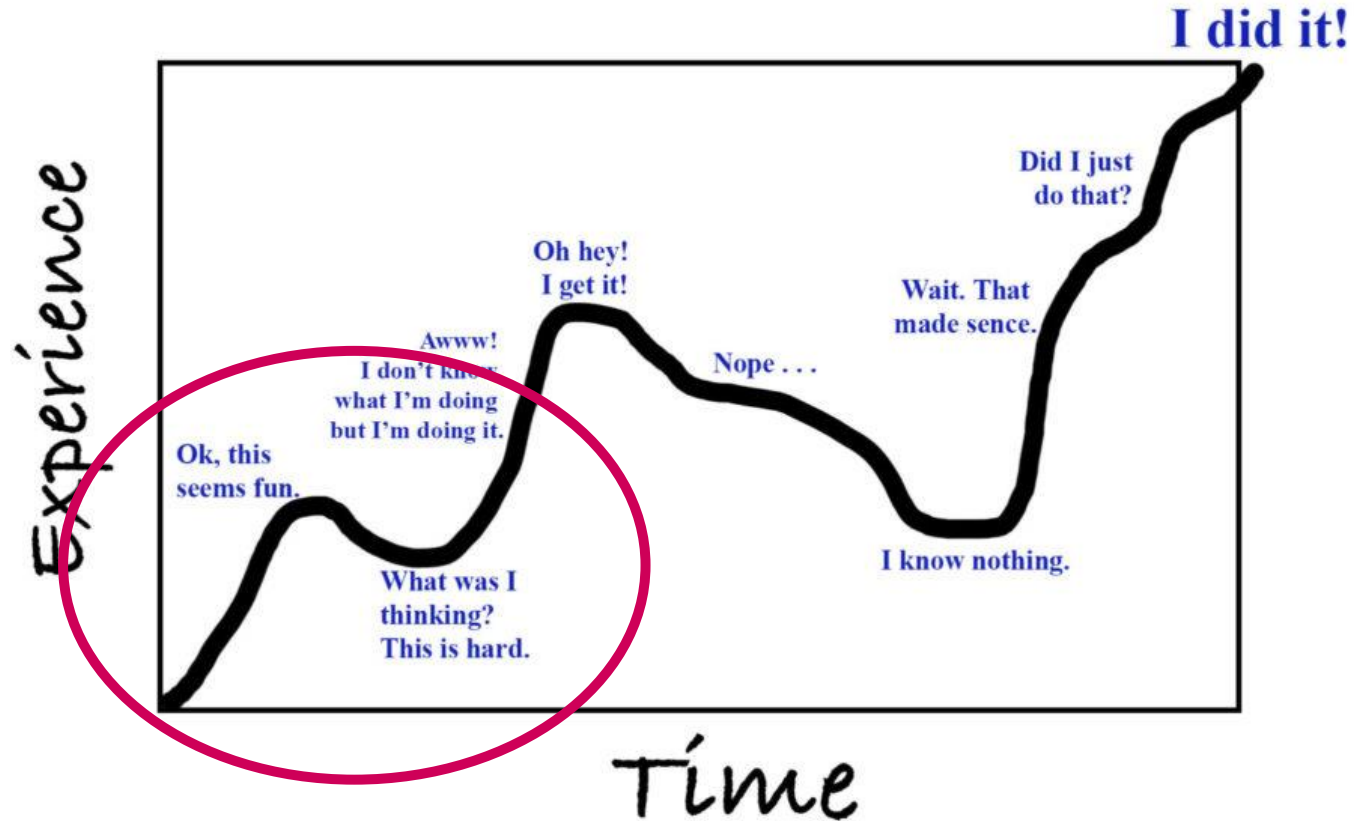
- ✓ Post Questionnaire
- ✓ Test the satisfaction with the own performance

## Conclusions from MERASSA

- ✓ SPAM tests were most successful because of the accuracy of the test
- ✓ Equipment handling was mostly OK but suffered of "queuing tactics"
- ✓ Conflict tests were sometimes not responded according to the test procedure
  - Test persons regarded any car and moose appearance without prior notice as unrealistic
- ✓ Multi mode operations regarded as stressful
  - Visual scanning and mental efforts were regarded as higher
  - Incompatibility due to the working methods complying to the single remote tower
  - Visual separation regarded as not possible due to limited FoV
- ✓ Lack of training
- ✓ During the 2nd iteration only one error in the QNH SPAM test!!!!!!!



# The Learning Curve



# Evaluation of Safety Assessment Methodology

- ✓ Development of Safety Performance Indicators for simulator studies
- ✓ Use of eye tracking technologies



# Thank you!

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