

# Experimentation with Network Enabled Joint Tactical Training



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13th ICCRTS  
17.-19. June 2008



# FFI – Norwegian Defence Research Establishment

- Established 1946
- Major defence R&D organization in Norway
- Staff about 640 (all civilians)
- FFI's charter
  - Give advice to the Ministry of Defence and the Norwegian Defence
  - Undertake development of weapons and equipment
  - Investigate scientific areas of interest
  - Contribute to the national scientific, technical, and industrial development





# Outline

- Motivation
- The Joint Air Defence Training Simulation (JADE) experiments
- The JADE II experiment formulation
- The JADE II Joint Tactical Training Capability Prototype (JJTTCP)
- Measurements
- Results from the experiment

# Motivation

- Network Based Defence (NBD) will introduce operational changes:
  - new technical solutions
  - altered C2 organization
- Power to the edge: Decision-making moves downwards in the military organization
- The need for training across traditional organization borders will increase
- Live joint collective training has high cost and low availability
- Interconnecting and adapting existing training simulation systems is a first step to provide cost-effective joint tactical training

**Is training based on interconnecting and adjusting existing trainers sufficiently realistic and relevant to be useful?**

# The Joint Air Defence Training Simulation (JADE) experiments

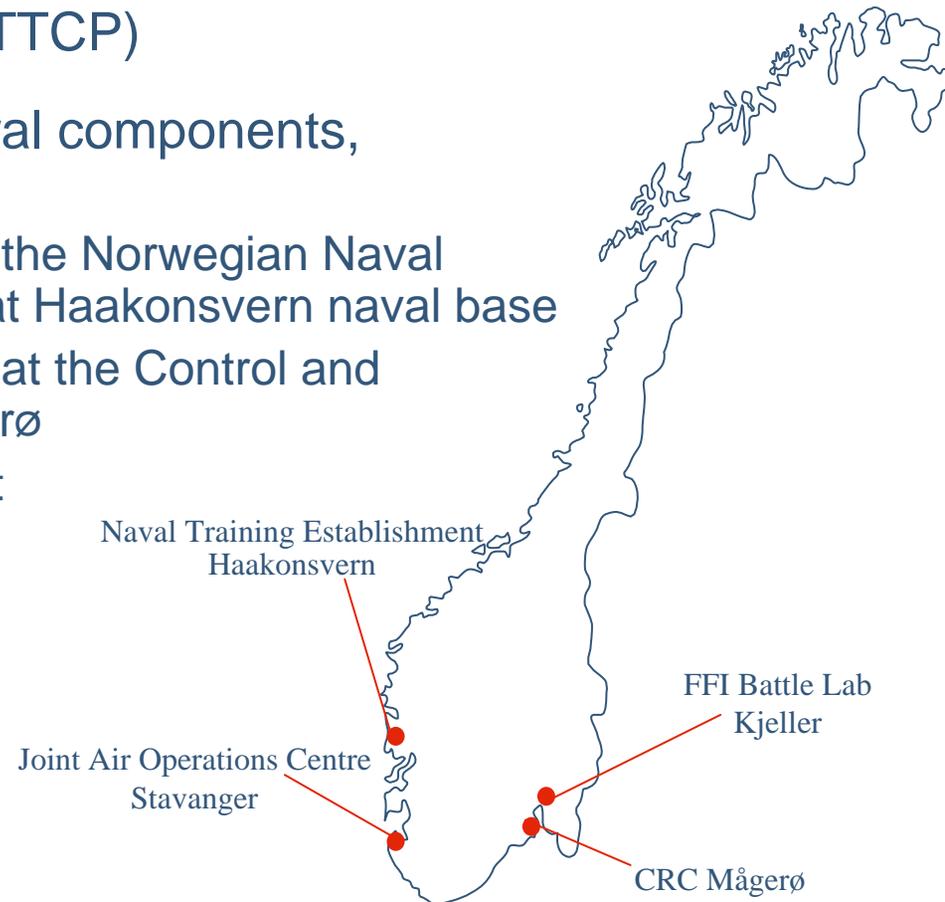


- A campaign of experiments investigating the use of distributed simulation based training
- JADE was a discovery type experiment
  - Evaluate the feasibility of interconnecting existing training simulation systems
- JADE II was a hypothesis testing and demonstration type experiment
  - Evaluate the training effectiveness of distributed simulation based training
  - Demonstrate the capability prototype to interested parties in the Norwegian Defence
  - Give advice regarding a permanent training capability based on distributed simulation



# JADE II

- The JADE II experiment was conducted as an experimental synthetic exercise distributed over four sites
- The exercise was enabled by the JADE II Joint Tactical Training Capability Prototype (JJTTCP)
- The JJTTCP was built from several components, including:
  - a generic naval tactical trainer at the Norwegian Naval Training Establishment (KNMT) at Haakonsvern naval base
  - the embedded training capability at the Control and Reporting Centre (CRC) at Mågerø
  - two game-based desktop combat aircraft simulators at FFI, Kjeller
- The JJTTCP also had an interface to the Joint Air Operations Centre (JAOC) in Stavanger





# JADE II experiment formulation

- The treatment of the experiment was use of the JADE II Joint Tactical Training Capability Prototype (JJTTCP)

- The hypothesis was:

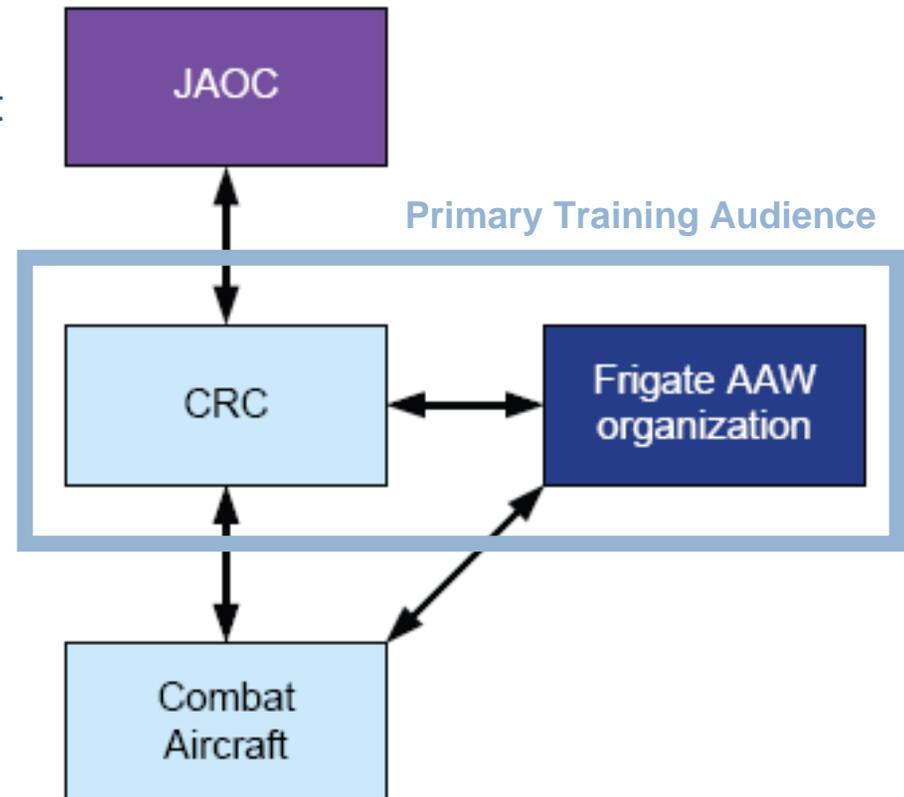
If the JJTTCP is used, then the training of air-maritime cooperation and coordination procedures will improve compared to today's training methods.

- The main variables considered were cost, availability and training effectiveness, with focus on the latter
- The baseline was joint live exercises, which has considerable cost and low availability



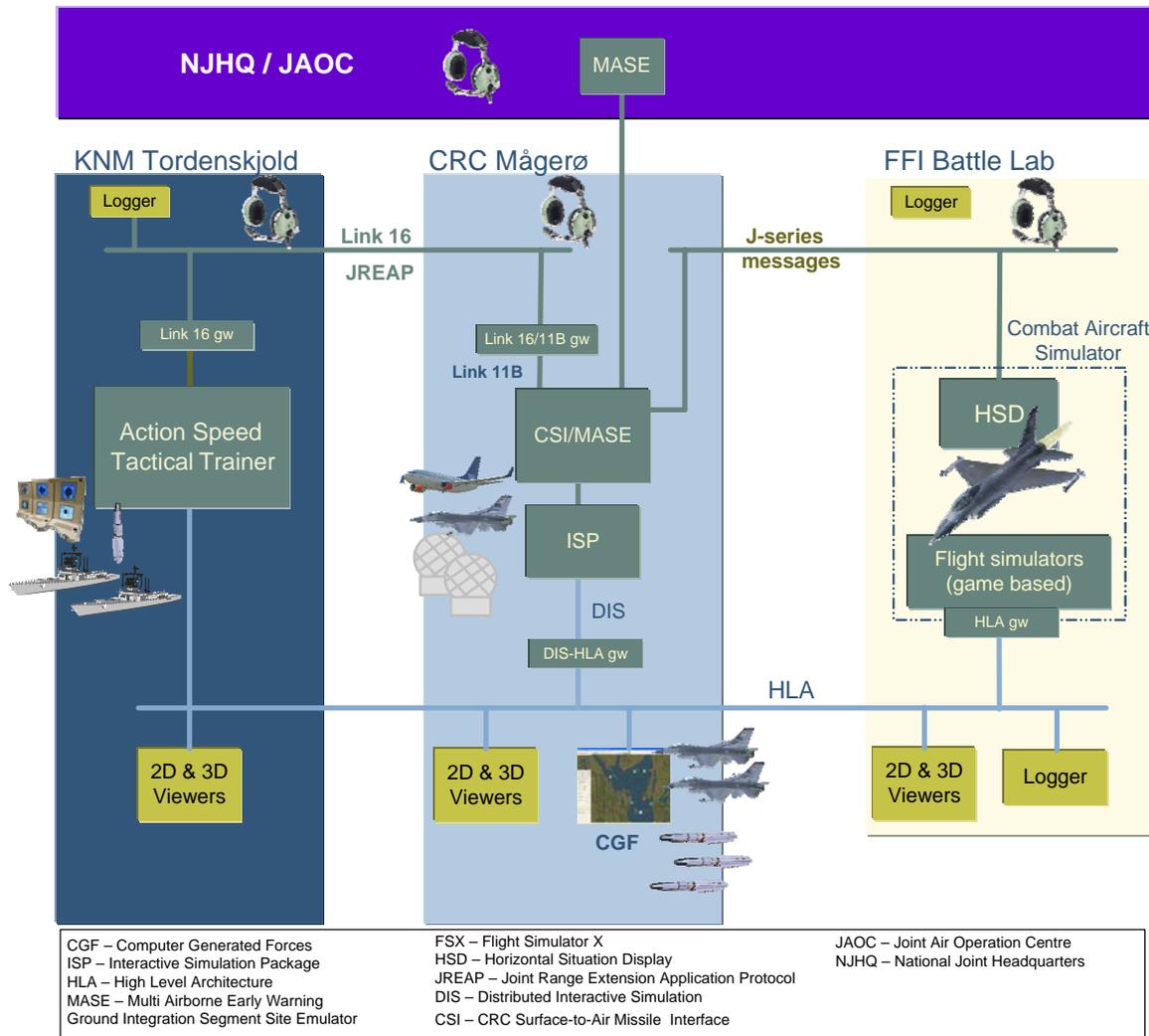
# JADE II trainee organization

- JADE II included:
  - an air surveillance and combat management element
  - a maritime task group
  - combat aircraft
  - a (minor) part of an air operational command element
- Existing trainers were federated, creating a heterogeneous synthetic environment consisting of real, emulated and simulated systems





# The JADE II Joint Tactical Training Capability Prototype (JJTTCP)



Real operations and training systems

# Experiment planning

- Training objectives
- Scenario vignettes
- Development of the JTTCP
- Experiment measurements





# Training objectives and scenario

- Training objectives established in dialog with the instructors from the CRC and KNMT
- Some of the training objectives were:
  - Use of basic Recognized Air Picture (RAP) production procedures
  - Electronic Support Measures (ESM) data exchange between frigates and CRC
  - Handover of combat aircraft control to frigate Fighter Controller (FC)
  - Coordination of weapon usage between frigates and combat aircraft
- Scenario made to address the objectives
- Peace time via crisis to war time
- Vignettes of special interest



# Training sessions 22.-25. October 2007

- 9 training sessions took place, where each vignette was run 2 - 3 times each
- In all the JADE II amounted to 9 hours of training for 20 trainees.

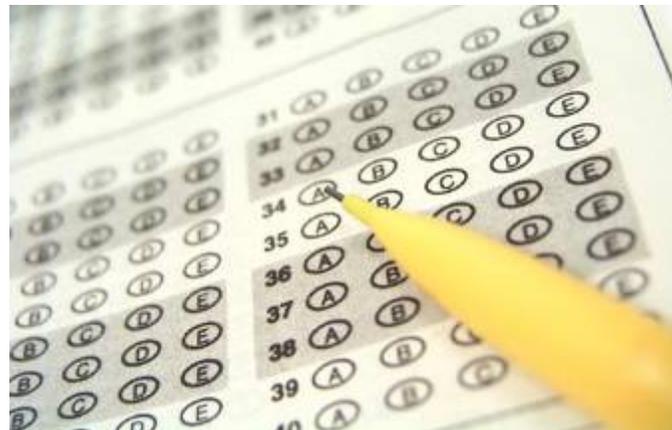




# Measurements

Several measurements are needed:

- Theoretical tests
  - Pre-exercise
  - Post-exercise
- Normative models
  - ESM reporting
  - FC handover
- Questionnaires
- Logs
  - Voice
  - Tactical Data Link (TDL)
  - High Level Architecture (HLA)



Task	Performed
A authenticates himself to B	✓
B authenticates himself to A	✓
A informs B about C	✓
A informs B about D	X
A informs B about E	✓
A informs B about F	X
B verifies receipt of information	✓
B makes contact with G	✓
B informs G of H	X
B contacts I to inform about J	✓
SUM	7 out of 10

Questionnaire				
This questionnaire is a part of the evaluation of JACE II. The questionnaire should be answered individually and anonymously. The results will also be treated anonymously.				
The following are questions and statements that you need to consider. Read the answer alternatives thoroughly and mark the alternative that best suits your experience.				
<b>Background</b>				
a) Defence branch / department				
b) Do you have any experience from just air defence with air warfare forces?				
<input type="checkbox"/> Live operations	<input type="checkbox"/> Live/field exercises	<input type="checkbox"/> None		
<input type="checkbox"/> Simulator based training	<input type="checkbox"/> Theoretical training			
c) How positive, generally speaking, are you towards new technology?				
Very positive	Positive	Neutral	Negative	Very negative
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) What describes your relationship to training and/or experimentation?				
<input type="checkbox"/> User	<input type="checkbox"/> Here/there had a job with connections	<input type="checkbox"/> No particular relationship		
e) Where did you observe JACE II?				
<input type="checkbox"/> KVM Torshavn	<input type="checkbox"/> CDC MSgene	<input type="checkbox"/> FFI		
f) Other comments about your background that you feel matters for your assessment of JACE II:				





# Theoretical tests

- Two theoretical tests containing air-maritime coordination and cooperation questions
- Developed based on existing Navy and Air Force multiple choice tests
- One test was performed before the exercise, one after

## RESULTS

- An increase of 6 percentage points between pre-exercise test and post-exercise test.
- The largest absolute improvement was seen among those with the lowest score on the pre-exercise test (up to 40 percentage points increase)



# Normative models

- Developed two normative models of procedures that were to be performed during the exercise
  - FC handover
  - ESM reporting
- Created observation forms to be completed by instructors during the exercise
- Alternately, forms can be completed post-exercise based on voice and TDL logs if applicable

Normative model	
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# Normative models - results

- Instructor shortage
- The observation forms that were completed showed a high, nearly constant score
- The procedures chosen were familiar to the trainees
- The procedures chosen did not call for enough interaction between the organizations
  - ESM-reporting was mostly internal to the maritime task force
  - FC handover happens between Air Force FCs

# Questionnaires

- Surveys were conducted that charted the trainees', instructors' and guests' opinion about
  - the concept
  - the JJTTC
  - what they learned from the exercise

## Questionnaire

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**The following are questions and statements that we want you to consider. Read the answer alternatives thoroughly and mark the alternative that best suits your assessment.**

### Background

**a)** Defence branch / department

**b)** Do you have any experience from joint air defence with air/maritime forces?

<input type="checkbox"/> Live operations	<input type="checkbox"/> Live/field exercises	<input type="checkbox"/> None
<input type="checkbox"/> Simulator based training	<input type="checkbox"/> Theoretical training	

**c)** How positive, generally speaking, are you towards new technology?

	Very positive	Positive	Neutral	Negative	Very negative	
	○	○	○	○	○	

**d)** What describes your relationship to training and/or experimentation?

<input type="checkbox"/> User	<input type="checkbox"/> Have/have had a job with connections with the area	<input type="checkbox"/> No particular relationship
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**e)** Where did you observe JADE II?

<input type="checkbox"/> KNM Tordenskjold	<input type="checkbox"/> CRC Mågers	<input type="checkbox"/> FFI
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**f)** Other comments about your background that you feel matters for your assessment of JADE II:

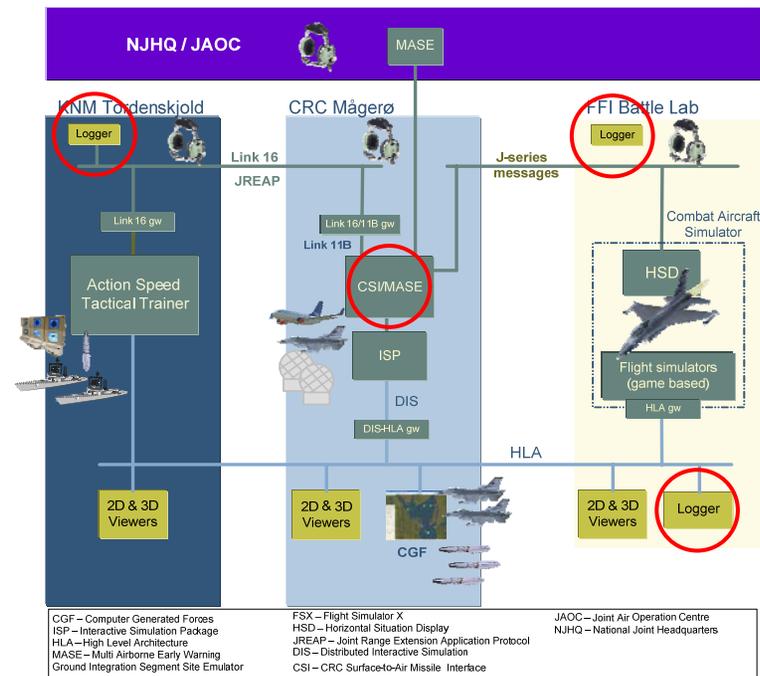



# Questionnaires - results

- The JJTTCF is a useful tool to
  - gain basic skills for operating in a joint environment and to prepare for live exercises
  - develop and improve tactics and procedures
- The instructors reported observing more capable trainees after the exercise
- The trainees reported improvement in their own competency
- The trainees stated that involvement of other teams made their training more realistic and relevant
- Both organizations wished to include higher echelon elements in the training

# Logged data

- Several measurements were taken directly from the JJTTCP
  - Simulation data (HLA) logging
  - TDL logging
  - Voice channel recordings
- HLA and TDL logs were not analyzed



- The voice recordings showed signs of improvement in the communication between the organizations
- The exercise revealed a need for more voice communication channels between the organizations



# Uneliminated threats to the experiment

- The Guide for Understanding and Implementing Defense Experimentation (GUIDex) lists 21 threats to defense experiments
- The JADE II experiment did not eliminate all threats
- Uneliminated threats:

<b>GUIDEX threats</b>	<b>Explanation</b>
1: Capability variability, 8: Trial conditions variability, 11: Capability changes over time	The JJTTCF was not stable enough to fully eliminate these threats. The technical problems introduced variability in the training capability between runs and during runs.
9: Low statistical power	The size of the organizations trained was not sufficient to obtain statistically significant results.
12: Player changes over time	There were personnel changes in the teams during the exercise.



# Conclusions

- The JJTTCP successfully enabled joint tactical training between a CRC, a frigate AAW organization and combat aircraft
- Several measurements were devised to test the hypothesis of the experiment
- Measurements indicate increased level of competency after the exercise, but results are not strong enough to conclude
- Instructors and trainees were very positive to the prototype, and reported improvement in their own competency from using it
- The JJTTCP is an environment in which to experiment with C2 organization, introduce trainees to network enabled concepts, and prepare trainees for live joint exercises



## Related papers

### **Technical experiences and evaluation of the JJTTCF:**

- Nielsen, M. N., Staal, O. M., Brathen, K. and Mevassvik, O. M., "Joint Air Defence Training Simulation (JADE) II – Reuse and interconnection of stand-alone training simulation systems enabling joint tactical training“. In Proceedings of the Spring Simulation Interoperability Workshop (SIW), 2008.

### **Study of transactive memory system development**

- Valaker, S. and Brathen, K., "An Exploratory Study of Transactive Memory System Development in a Geographically Distributed Temporary Organisation", The 13th International Command and Control Research and Technology Symposium, 2008.



Luftforsvaret  
LSTN Mågerø



**FFI** Forsvarets  
forskningsinstitutt  
Norwegian Defence Research Establishment



KONGSBERG

**JADE II collaboration partners**



# Questions

