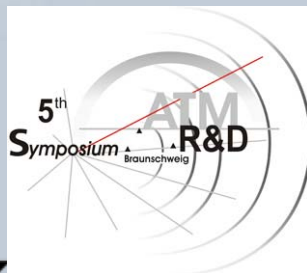


AT-One **The ATM Research Alliance**

ATM-Airport Simulation and Development Environment Kurt Klein (DLR) / Jan Terlouw (NLR)



Airport – Bottleneck or Booster for Future ATM

11.–13. Oct. 2005

DLR-Institute of Flight Guidance, Braunschweig, Germany



Content

- Towards the future of ATM
- The product life cycle
- The Validation Cube
- ATM Validation Infrastructure
- What exists and what is missing
- Conclusions



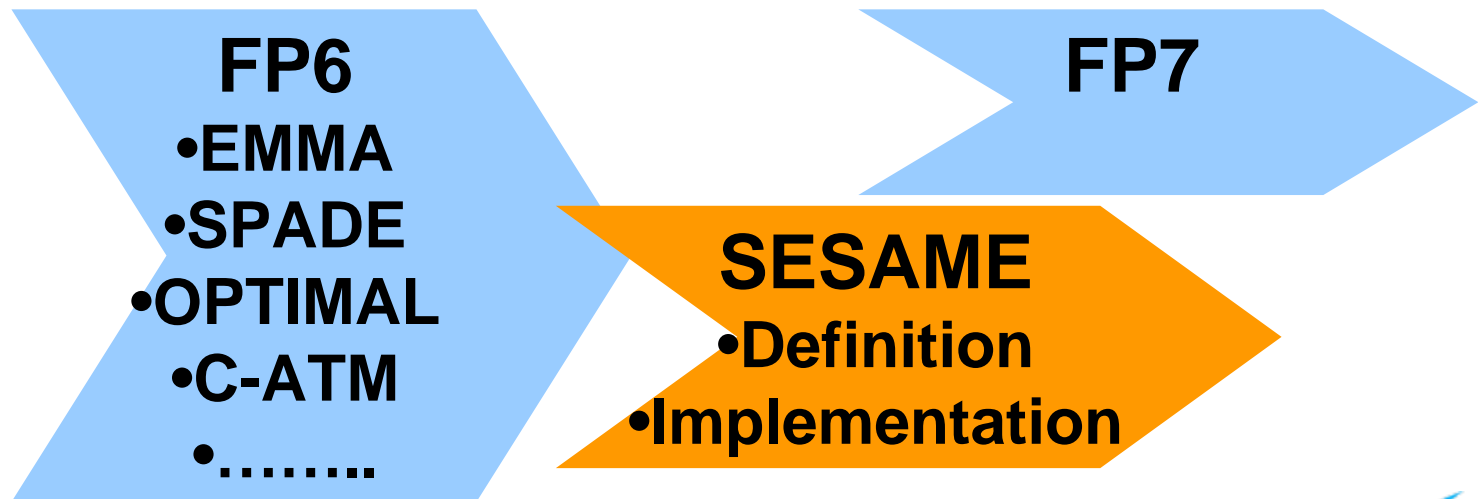
Eurocontrol CDM Manual

What is ATM validation and verification?

- The process of answering two questions:
 - Validation: are we building the right system?
 - Verification: are we building the system right?

Towards the future of ATM

Single European Sky National & Local Programmes
ACARE SRA1/2



Airport CDM: Common Objectives



Product life cycle (1/3)

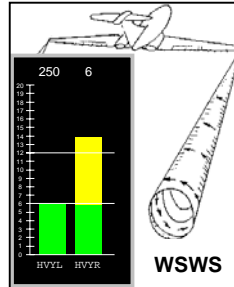
Idea



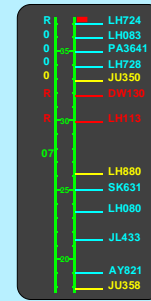
Concept



Prototype

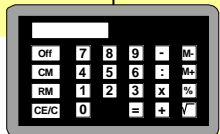


Realisation

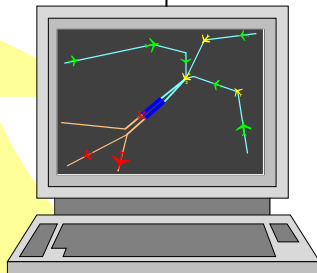


Research and Development

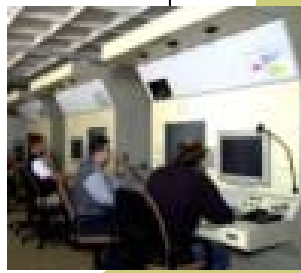
Assessment (Tools, Methods)



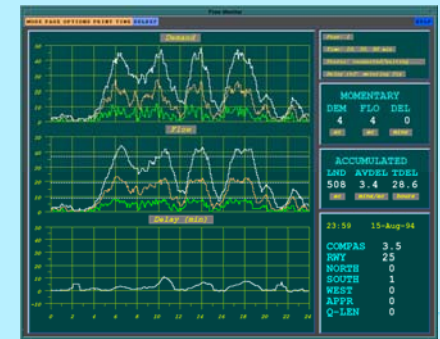
Analytical Model



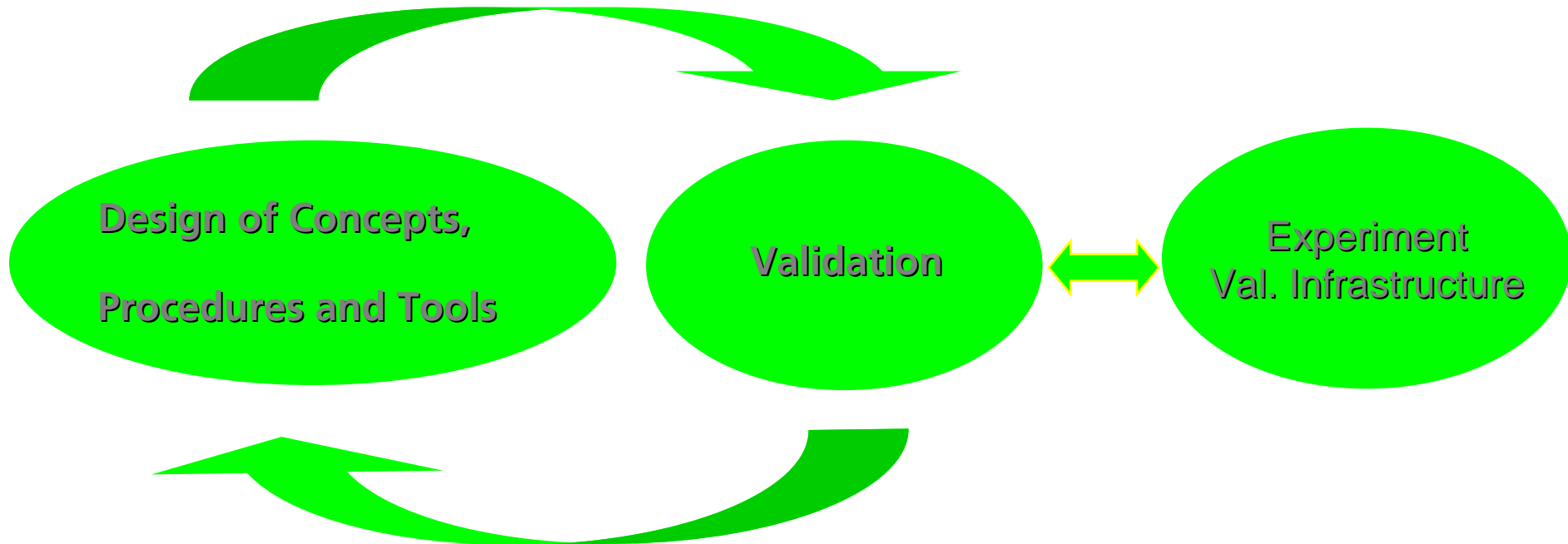
Fast-Time Simulation



HiL Simulation

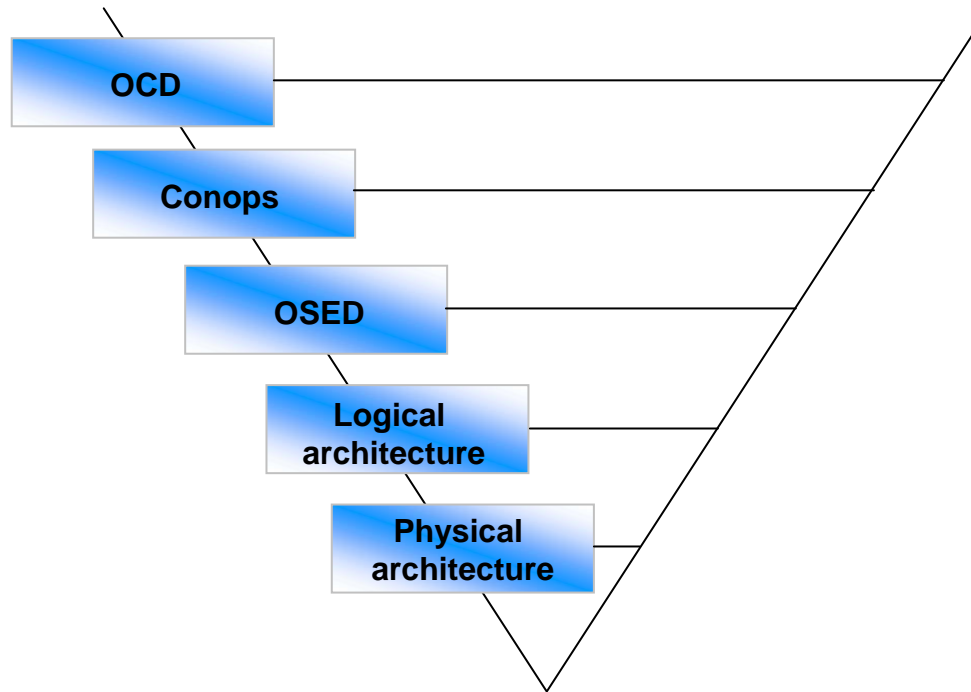


The product life cycle (2/3)



The product life cycle (3/3)

Detail Level View

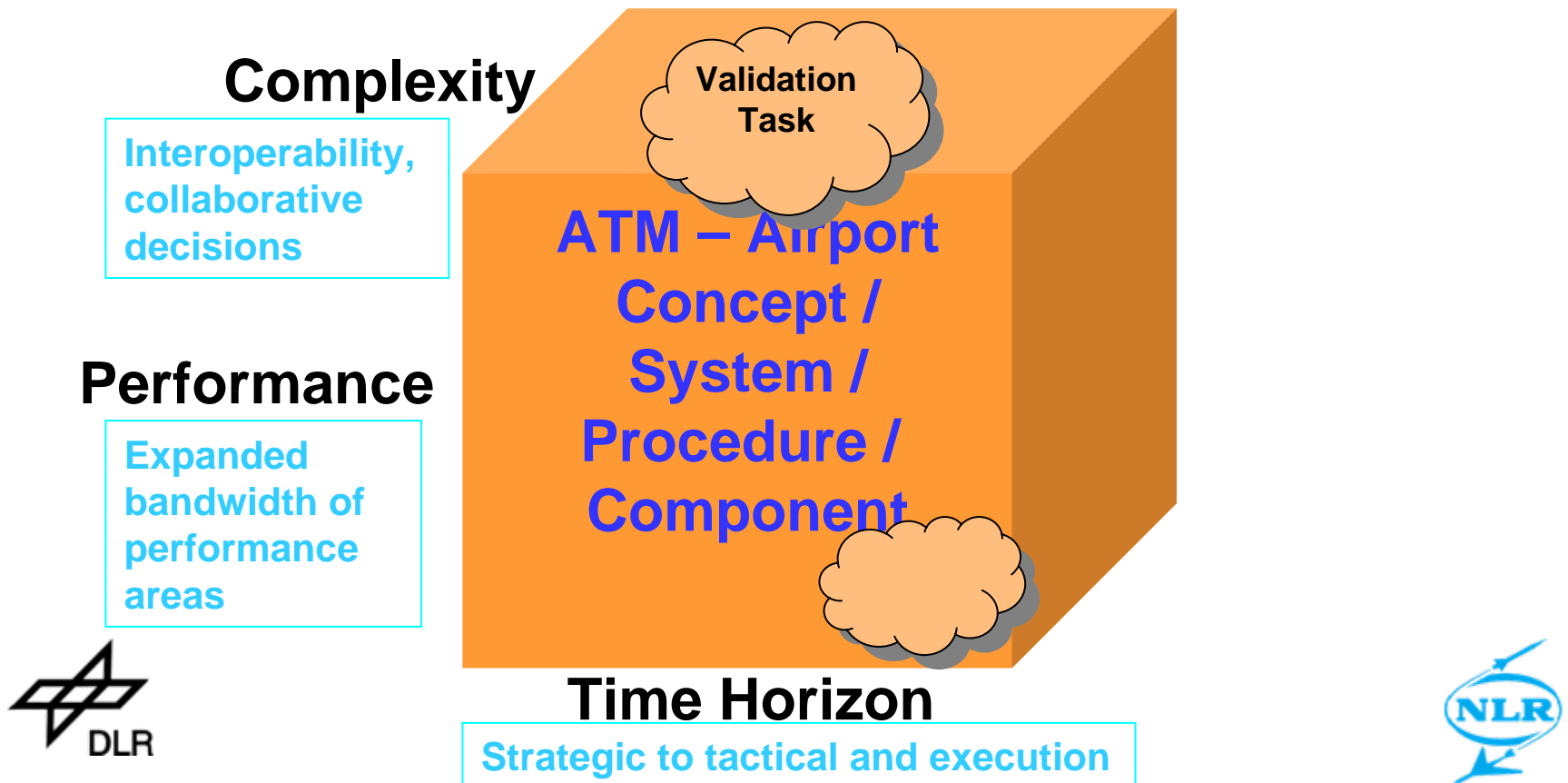


ATM Performance Areas (1/3)

Key Performance Areas (ICAO KPAs)

KPA 01 Access and Equity	Analysis and HIL
KPA 02 Capacity	Model, HIL, FTS
KPA 03 Cost Effectiveness	FTS
KPA 04 Efficiency	Model, HIL, FTS
KPA 05 Environment	Model, FTS
KPA 06 Flexibility	HIL
KPA 07 Global Interoperability	Model, HIL
KPA 08 Participation by the ATM community - ??	
KPA 09 Predictability	Model, FTS
KPA 10 Safety	Model and Analysis
KPA 11 Security	Model

The Validation Cube (2/3)



ATM processes in the Cube

(3/3)

- X: What is the time horizon of the process?
 - Flow focussed: a year up to one hour
 - Flight focussed: pre-departure up to arrival, 40 min to 0 min
- Y: What aspects of the system are modelled by the process?
 - Conceptual, technical, operational, socio-economical, financial, etc.
- Z: Which geographical area is covered by the process?
 - European, region, multi centre, centre, airport (or airport pair)

Validation Infrastructure (1/3)

- Why is it needed?
 - To support validation activities
- What does it consist of?
 - Methodologies (E-OCVM)
 - Indicators
 - Tools
 - Facilities
 - Scenarios

Validation Infrastructure (2/3)

Indicators (Examples)

- Delay (per hour, per flight, ...)
- No. of movements on airport
- Controller workload
- Taxi times
- And many more



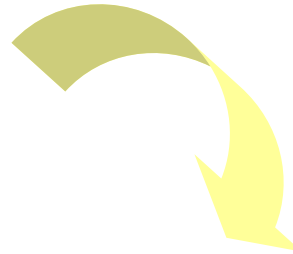
Measurement Tools

- Clocks
- Data Recordings (SMR, etc.)
- Software
- Questionnaires
- Interviews
- Etc.

Validation Infrastructure (3/3)

Facilities

- Analytical Modelling
- Fast Time Simulation
- Automatic Simulation
- Human-in-the-Loop Simulation (HiL Sim.)
- Life Experiments (Shadow Mode, life testing, flight tests)



Scenarios

- Stakeholders, Units (e.g. APP, TWR, AOC)
- Systems, Equipment
- Databases (Airports, Aircraft, ...)
- Traffic Type, Traffic Mix
- Exercises
- Etc.

What exists and what is missing (1/7)

Existing Infrastructure

- Analytical models for airspace users, airport, ATC
- Airside simulators (APP, TWR, APRON, Cockpit, ...)
- Airport processes (Turn around, ...)
- Common methodology compliancy (E-OCVM)



What exists and what is missing (2/7)

AT-One

The ATM Research Alliance

**Experimental
Cockpit**



**Command
&
Control
Simulator**



**2 Radar
Simulations**



**6 Test
Aircraft**



**4 Cockpit
Simulators**



**3 Apron &
Tower
Simulators**

HiL Simulation Infrastructure



Simulation Co-operation



What exists and what is missing (3/7)

Existing Facilities (AT-One Example)

- Apron and Tower Simulators (ATS & NARSIM)
- ACCES (Airport and Control Centre Simulator)
- Fast Time Simulators (TAAM & SIMMOD)
- Airport Traffic Monitor
- Radar Simulators (NARSIM)
- Cockpit Simulators
- Airport Field Test Equipment
- Test Aircraft

What exists and what is missing (4/7)

Expansions

- Focus on process modelling and process simulations (Horizontal & vertical dimensions)
- Integrate simulations (several stakeholders, Network interfaces)
- Integrate new tools, procedures, etc.



Range
Time

ECAC

Region

Multi-centre

Centre

Airport



-1/2 year

Macro Model *The* Gaming, Interaction models *ice*

-1/7 days

Modelling

day ops

Fast-Time / Models

-3 hours

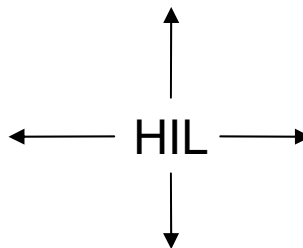
-1 hour

Fast-Time

pushback

lift-off

TMA/ETMA



En-route

ETMA/TMA

Touchdown

In-blocks



What exists and what is missing (6/7)

Challenges

- Consistent scenarios
- Build validation chain
(Results fit as pre-requisite for next validation step)
- Integrate new concepts
- New simulations
(Strategic planning, for special processes)

What exists and what is missing (7/7)

Credibility of Results

ATM community demands

- high validation quality,
- operational concept driven approach,
- laboratory independent results.

→ **European V-Standard
(Methods and Facilities)**

Conclusions

- Europe has a lot of validation experience and a large infrastructure is available (e.g. in AT-One),
- Validation task is expanding and becoming more complex
- Validation methods and means have to be harmonised and coordinated

End of presentation

Questions ?

