ATM-Airport Simulation and Development Environment
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Airport – Bottleneck or Booster for Future ATM
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
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
ACARE SRA1/2

National & Local Programmes

FP6
- EMMA
- SPADE
- OPTIMAL
- C-ATM
- ........

FP7

SESAME
- Definition
- Implementation

>>>>> Challenges for Validation
(METHODS, INFRASTRUCTURE)
Airport CDM: Common Objectives

- Improve predictability
- Improve on-time performance
- Reduce ground movement costs
- Optimize/enhance use of ground handling resources
- Optimize/enhance use of stands, gates and terminals
- Optimize the use of the airport infrastructure and reduce congestion
- Reduce wastage of ATFM slots
- Flexible predeparture planning
- Reduce apron and taxiway congestion
Product life cycle (1/3)

Research and Development

Assessment (Tools, Methods)
The product life cycle (2/3)

How validation/verification fits into the product life cycle
The product life cycle (3/3)

Detail Level View

- OCD
- Conops
- OSED
- Logical architecture
- Physical architecture
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)

**Complexity**
- Interoperability, collaborative decisions

**Performance**
- Expanded bandwidth of performance areas

**Time Horizon**
- Strategic to tactical and execution

**ATM – Airport Concept / System / Procedure / Component**

**Validation Task**
- Expanded bandwidth of performance areas

**Interoperability, collaborative decisions**
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 compliance (E-OCVM)
What exists and what is missing (2/7)

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.
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Fast-Time / Models

Fast-Time

Macro Model

Modelling

HIL
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 ?