Session 3
ATM Performance Indicators

Metrics
Measurement
Modeling

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Subjects areas of papers

	Metrics and Measurements	Models
Capacity/throughput and delays	1	2
Efficiency	3	4
Safety		

EUROCONTROL

Papers by subject

Title	Authors	Org				
Limits to NAS Growth	Frederik Wieland	CAASD/ MITRE	2		1	A
Models & Algo. for En-route ATFM	Vojin Tosic	University of Belgrade	2		4	E
Cost of ATFM Measures	Serge Manchon	CENA	2		1	E
Airport Traffic Modeling	Frits Polak	NLR	2		1	A
Workload Implications of FF	John Andrews Jerry Welch	MIT	2		1	E
Study of ATM Capacity	Jean-François Bosc	ENAC	2	1	4	E
Economic Effects of ATM Technology	Peter Kostiuk	LMI	2		1/ 3	A,E
Modeling of the other half of the flow	Steeve Bradford	FAA	4		3	
Global Review of ATM System Modernisation options	A. Haraldsdottir	BOEING	1,2	3	4	A,E
ATM Performance Indicator	J.M Pomeret S. Mahlich	EUROCONTROL	1	3	2, 4	A,E
ASC System Performance Measurement Project	William Voss Jonathan Hoffman	FAA/MITRE	3	4		A,E
ATC Economics	Jean-Claude Hustache	ENAC	1	4		E
Methodology and Initial Results for FF Transition	Anthony Warren	BOEING	2	1		E

Classification of Analytical and Fast-Time Simulation Models of Capacity and Delay

Scope of model / Level of detail (type of study)	Aprons and taxiways	Runways and final approaches	Terminal area airspace	En route airspace
Macroscopic (Policy analysis, cost-benefit studies)		· LMI Runway Capacity Model* · FAA Airfield Capacity Model* · DELAYS* · AND *+ · LMINET *+		· ASIM · SDAT* · DORATASK
Mesoscopic (Traffic flow analysis, cost-benefit analysis)		· NASPAC + · TMAC · FLOWSIM+ · ASCENT + · SHAMAN · DPAT +		
Microscopic (Detailed analysis and preliminary design)		· T A A M · SIMMOD		
Same	• The Airport Machine • HERMES		· RAMS • OPAS	

* indicates an analytical model + indicates network model

Observations on Capacity and Delay Models

- Most advanced area of ATM/airport modeling
- «Physics» well- understood
- Maturity
  - individual entities (airports, sectors) [Polak (NLR)
  - regional [Kostiuk(LMI), Wieland (Mitre), Manchon (CENA)]
- Frequent mistakes in model selection and in output interpretation
- Understand limits in applicability
- Major needs :
  - Model enhancement
  - Model integration/compatibility
  - Validation (logical, vs. other models, vs. field data)
  - Usability, training, HMI

Data Collection

- Traffic flows
  - present
  - future
- ATM Cost
  - Europe : CRCO
  - US : FAA
- Airline Costs
- Delays
  - Europe : CFMU
  - USA : ETMS et al.

Performance Metrics

- ¨Capacity and delay¨ measures alone are often insufficient [Haraldsdottir (Boeing), Pomeret and Mahlich (Eurocontrol), Voss and Hoffman (FAA/Mitre)]
- Additional indicators must be:
  - relevant to users and/or providers
  - simple and meaningful to decision-makers
  - measurable
- Objectives and cost functions of users are often complex and not known to system providers
  - predictability
  - bank preservation
  - collaborative decision-making (CDM)

Metrics of performances

- Traffic flows
- Capacity
- Delays
- Predictability
- Access
- Flexibility
- Cost
  - ATM direct cost
  - ATM indirect cost
  - Airlines/users cost
- Safety

Subjects areas for R&D

	Metrics and Measurements	Models
Capacity/throughput and delays	Metrics ✓ Measurements ↗	Advanced
Efficiency	Emerging Objective Fns ?	Emerging CBA, economic
Safety	Metrics ↗ Measurements ↗	**?**

Areas for new R&D

- **Economic analysis just begining in ATM**
  - **needs new methods (CBA analysis, economics, econometrics)**
  - **pricing policy**
  - **...**
- **Airline objectives and behaviour**
- **Safety**
  - **metrics (incidents, accidents)**
  - **modelling (CRM, ...)**

Europe - U.S.: convergence and divergence

- Close co-operation in model development and use
- Parallel develop'nt of new performance indicators
- Interest in user-oriented indicators (e.g., predictability, flexibility)
- Interest in economic quantification of ATM impacts
- Cross-checking results and exchange of ideas
- Approaches/methodologies may differ because of differences in ATM environments
- U.S. strong interest in collaborative decision-making, decentralization issues, studying carriers
- European strong interest in demand management, pricing (real-time and strategic)