SESAR Innovation Days

Key note briefing SID 2015
Challenges and opportunities for innovation

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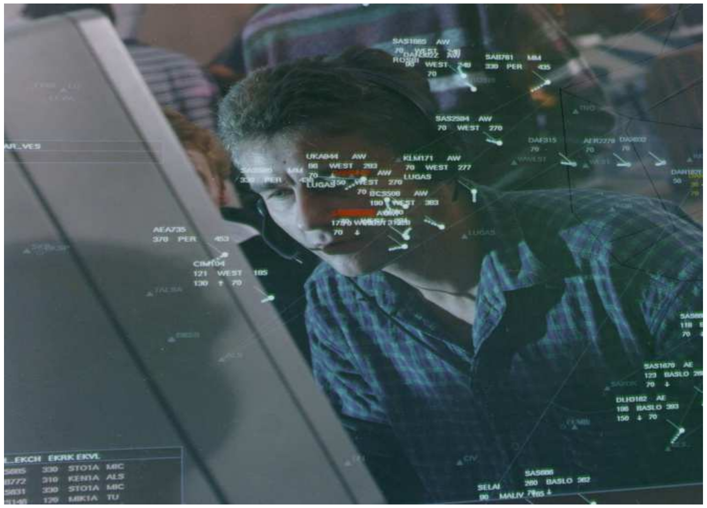
Topics

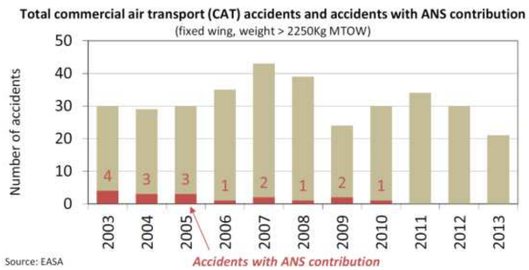
- A bit of history
- What is the current situation?
- Why do we need to act?
- Key challenges and opportunities for innovation
- Final word



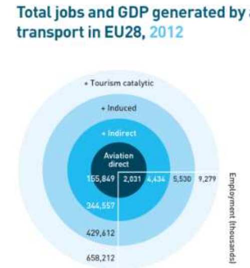
Some innovations in ATC

- Surveillance
  - 30's-40's: Radar, identification (IFF)
    - Accidents, safety requirements (Normandie liner, 1935)
    - MIL requirements: WW II
  - 70's: Digitalisation, radar processing
    - Technology opportunities (computers, signal processing)
      - NAS, CAUTRA III in 70's
- TCAS
  - Developed in US after collision (Grand Canyon, 1956)
  - Standardised in ICAO
  - Mandated in US from 1/1/1993 after collision (San Diego, 1978)
- Central Flow Management
  - Implemented in US after US controllers' dismissal (1981)
  - CFMU implemented (1995) following delay crisis at end of 80's

ANS in the European aviation context (1/2)



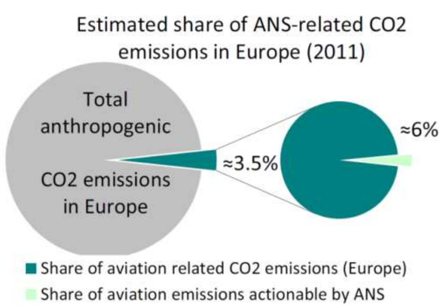
Safety
No accident with ANS contribution since 2011
Reported incidents in 0.3% of flights



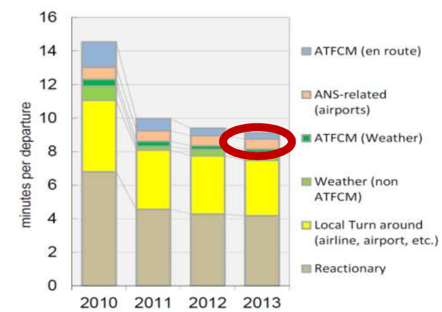
GDP from Air Transport in EU ≈ €121 B
Source: ATAG

Air Navigation Services ≈ €7.5 B

≈ 6% of Airline operating costs (Europe)
Source: AEA



≈ 6% of aviation related CO_2 emissions (0.2% of total emissions)



Air transport delay (2013)
All ≈ 9 min. per flight
ANS-related ≈1 min. per flight

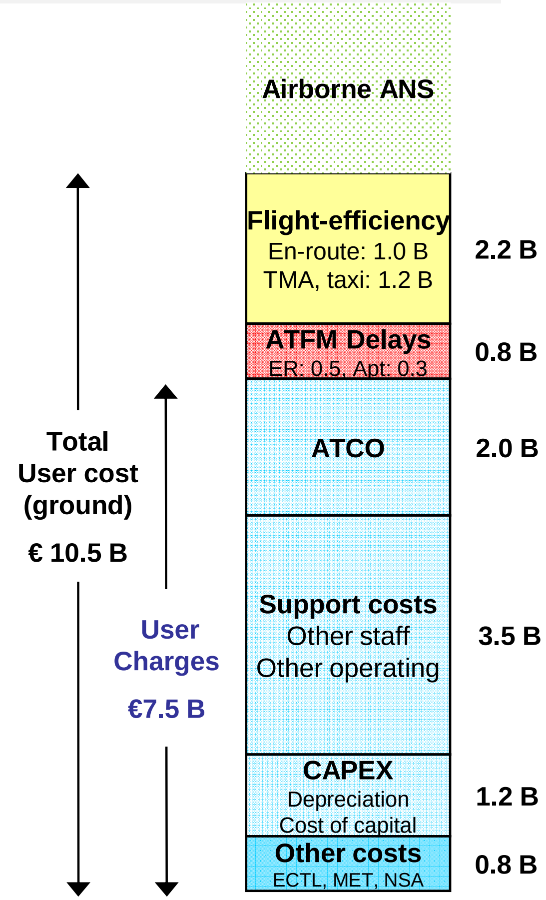
Although ANS is comparatively small in aviation context….

ANS in the European aviation context (2/2)

… but the stakes are still high!

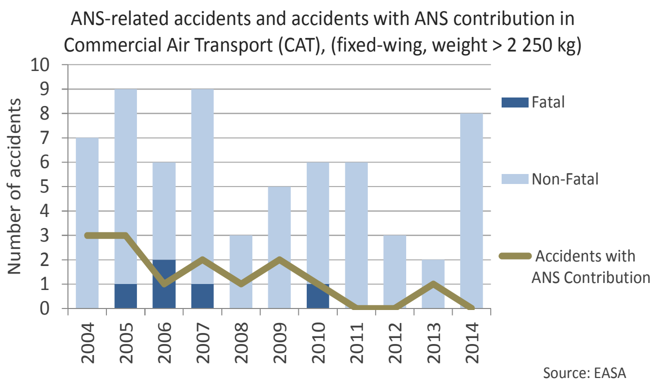
ANS generates….

- Value…..
  - Aviation Safety
  - Efficient flow of air traffic
- Environmental impact
  - Emissions, noise
- Costs ….
  - Ground economic cost ≈ € 10.5 B
    - Direct ANS provision costs (user charges)
    - Indirect service quality related costs
  - Airborne ANS costs (€2.5B p.a. for 10 years?)
- High penalties to economy if disrupted
  - Daily loss of some €1.5B per day (volcano)

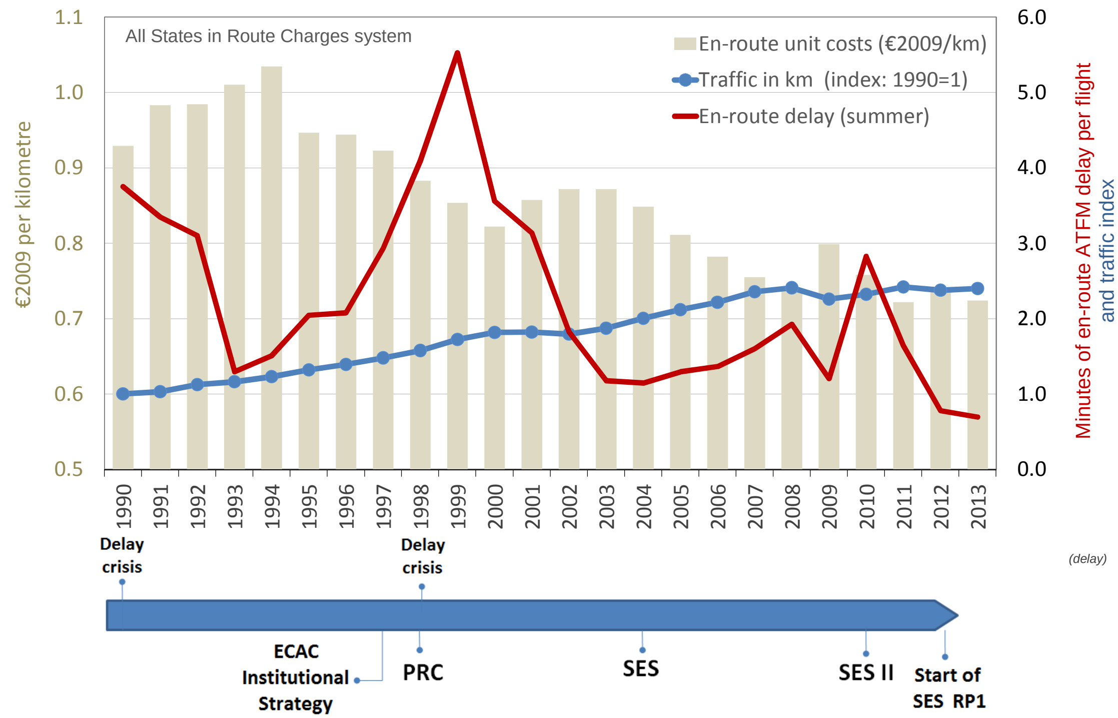


Estimated TEC 2012 (SES)

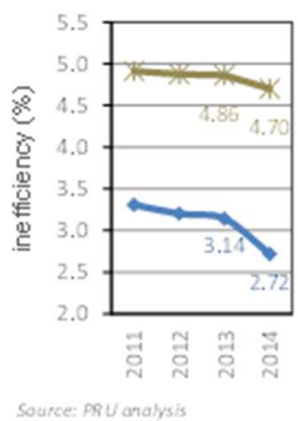
Performance improvements



No fatal ANS-related accidents since 2011



Improvements in both unit costs and delays
Further improvements driven by SES



KEP (Flight Plan)

KEA (Actual route)

Flight-efficiency improving faster than traffic (carbon neutrality)

European policies bring improvements in 3 KPAs while maintaining safety at acceptable levels

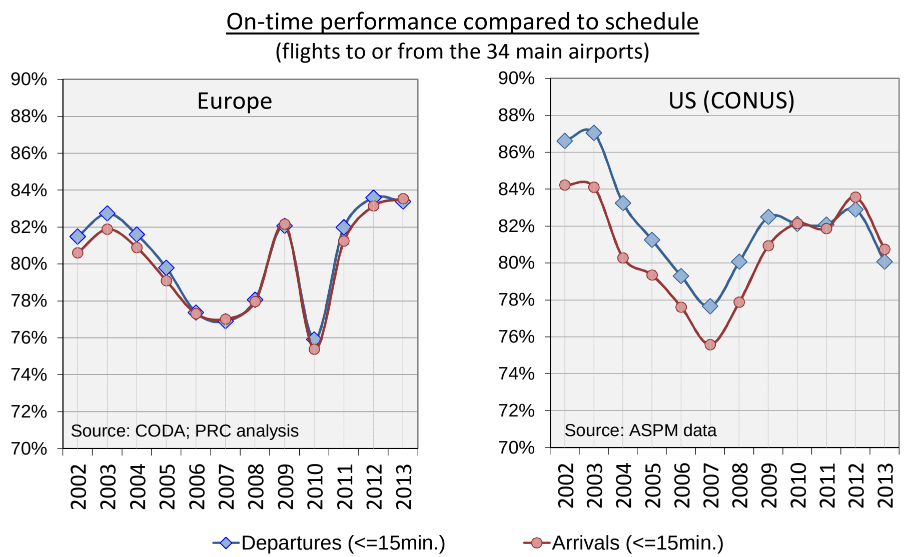
How does European ANS system compare?

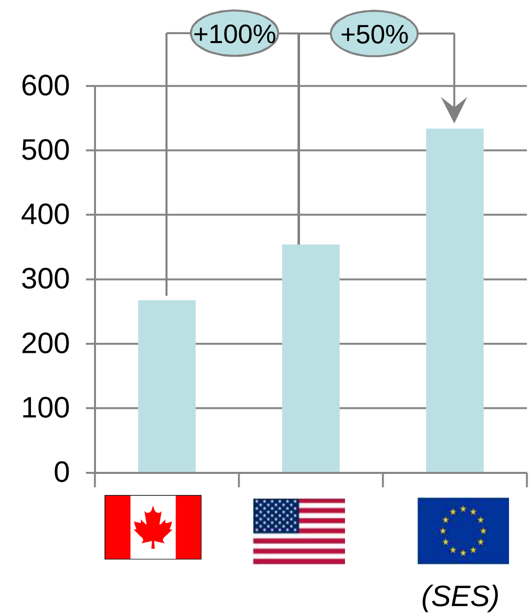
Acceptable Safety levels on both sides of Atlantic

Similar environmental impact

Similar Punctuality

High unit costs





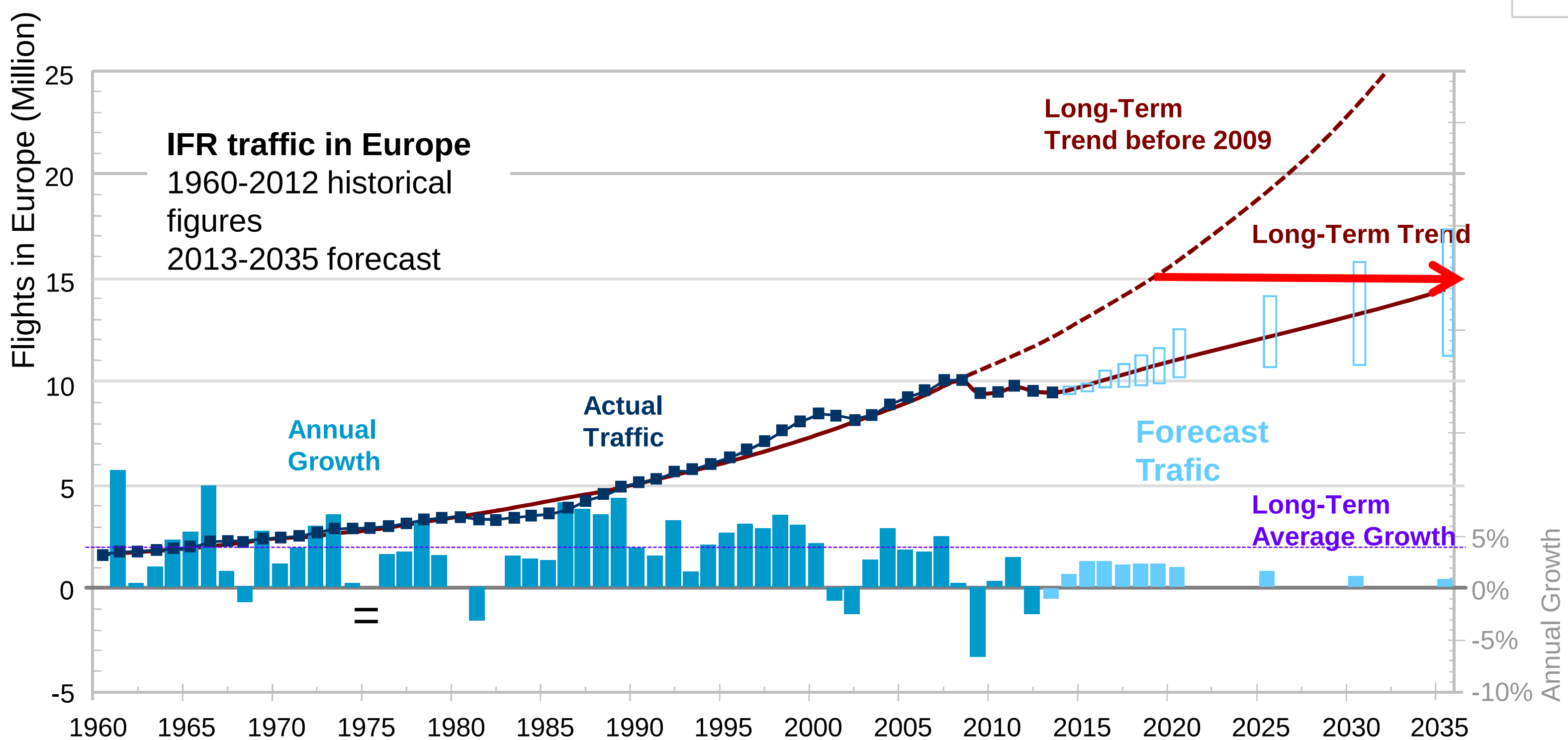
2011 ATM/CNS provision costs (€/flight hour)

Increasing focus on economic efficiency

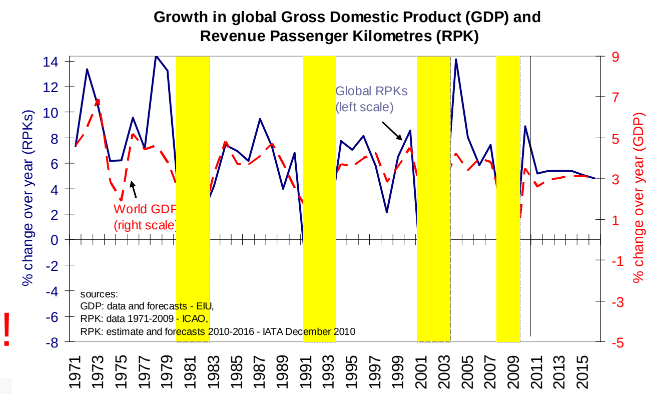
Why do we need to act?

- Performance is improving
- But major challenges remain in ANS…
  - Opaqueness in Safety
    - Risk measure, safety built in new concepts
  - Environmental impact of aviation
    - Emissions, noise
    - Politically sensitive, at EU, national and local levels
  - High ANS costs
    - Poor productivity of a labour intensive industry
    - Rigid service provision
    - Fragmentation of airspace, service provision, infrastructure
  - Organisational/governance issues
    - Monopolies, little competition, weaknesses in oversight
    - Human resource and social issues
    - Airspace users bear all ANS costs, have little say
    - Complex decision making
- … and new challenges are emerging
  - Volatile economy, air traffic demand
  - High demand for R/F spectrum
  - Remotely Piloted Aircraft Systems (RPAS)

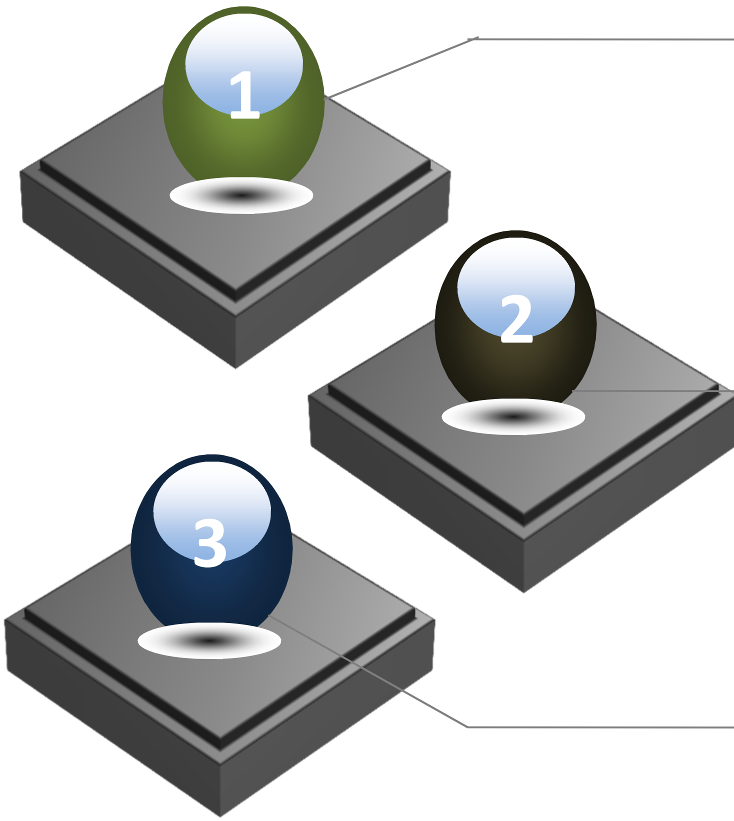
Key challenges - Air Traffic predictability



- Traffic foreseen for 2020 may happen in 2035!
- Highly volatile economic growth
- Air traffic closely linked with economic growth
- ➢ Wide uncertainties in traffic forecasts
- Flexibility to remain efficient in different scenarios!



Driving ANS Safety Performance



Compliance based

- ICAO USOAP audits
- SES targets for RP2

Risk based

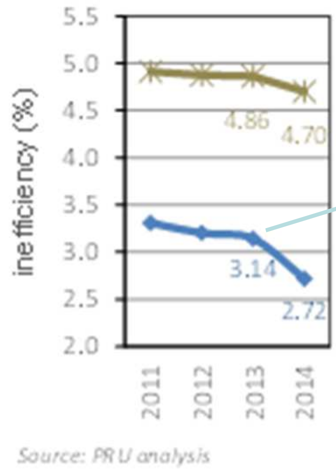
- Accidents
- Serious Incidents
- Other measures?

Behaviors

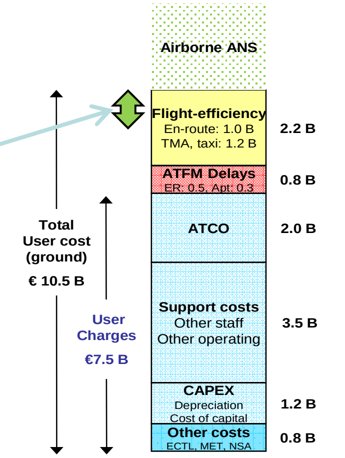
Adequate KPIs, incentives and regulations

Airspace design and management

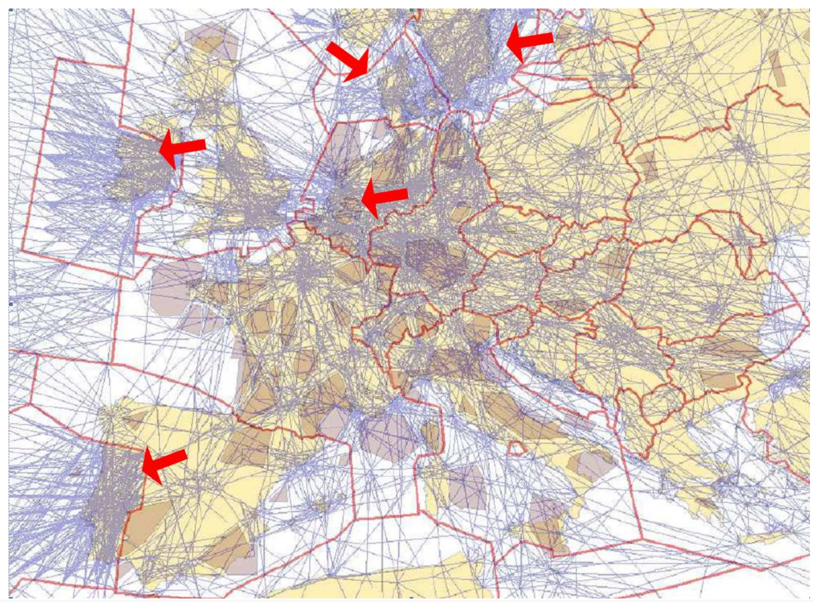
- Aviation ENV objectives
  - ACARE: emissions halved in 2050, Carbon-neutral in 2020
- Environmental impact
  - Free routes implemented in 30/65 ACCs (AF 3)
  - KEA: Improving faster than traffic
  - En-route already Carbon-neutral!
- Economic impact
  - Economic cost estimate: €2.2B
  - No heavy infrastructure required, unlike train, road
  - A key area for further improvement
- Improving performance further
  - SES-wide free routes
  - Advanced FUA
  - Sequencing and TMA (RTA, etc)
  - Key role of Network Manager
  - Innovations?



Source: PRU analysis

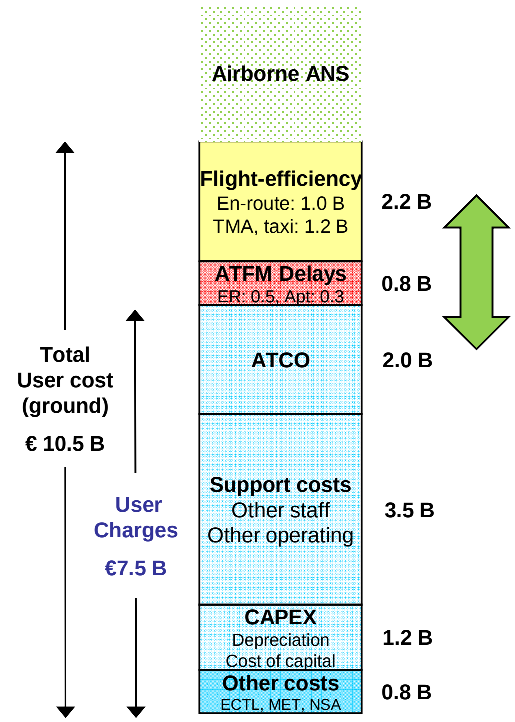


Estimated TEC 2012 (SES)



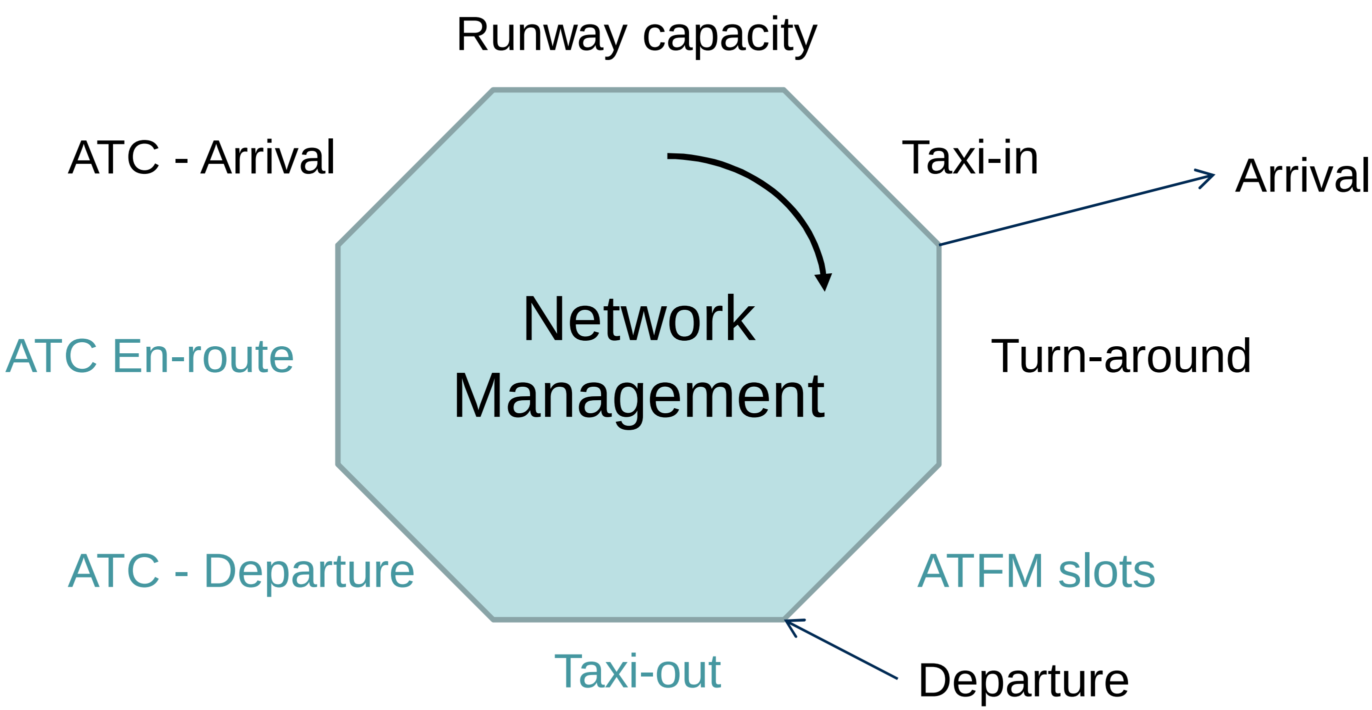
Sequencing and TMA

- Much room for improvement
  - Fuel, flight, economic efficiency
  - TMA/Runway throughput
  - Safety
- But very challenging
  - ENV constraints
  - Interactions with airport, airlines operations
  - Hundreds of very different airports
  - Weather, wake vortex, etc
- Real challenges and opportunities for innovation



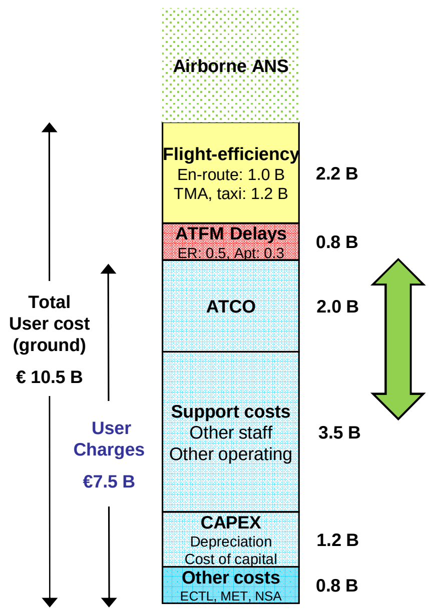
Estimated TEC 2012 (SES)

Predictability of operations



- Strong links between airline, airport and ATC operations
- A tightly coupled network
- Added value of better predictability on Aviation GDP (~€120B) and passenger value of time

Human resources (5th pillar)



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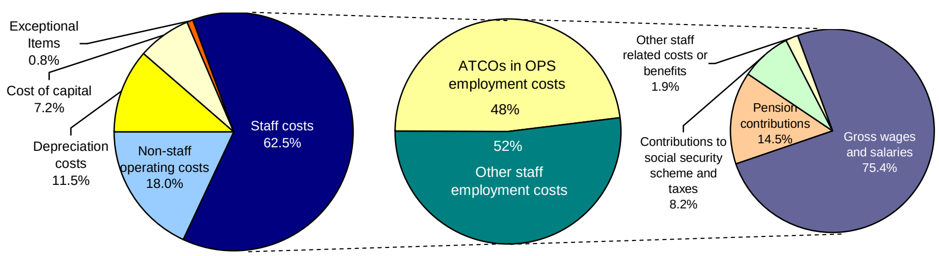
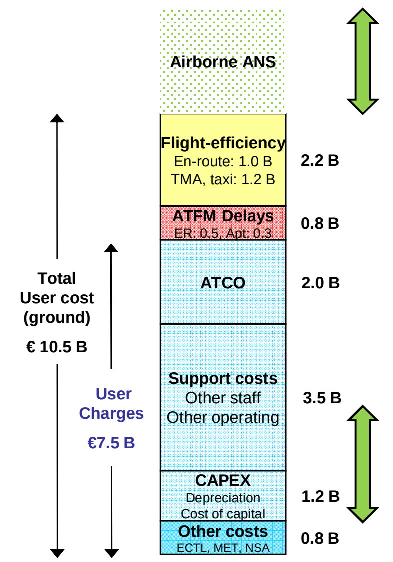


- Staff: an essential part of ATM
  - Essential role in delivery
  - 2/3 of costs (€ 4B p.a.)
  - 43 500 workers
- Research on productivity, human factors
- Shifting the labour/capital balance?

2011 data	US	SES area	US vs. SES
Flights	16.0 M	9.4 M	+70%
ATCO staff	13 300	14 300	-7%
Other staff	22 200	29 200	-24%
Total	35 500	43 500	-18%
Flight per staff	450	216	+108%

Ground infrastructure, airborne equipment

- Highly fragmented, disparate, costly ground infrastructure
  - Difficult to synchronise evolutions (e.g. data-link)
  - Blocks rapid progress
  - High capital expenditure and maintenance costs
    - Book value approx. €6B (RDPS, FDPS, CWP, etc)
    - €2-3B annual costs
- Minimising the cost of Airborne equipment
- How to ensure interoperability, synchronisation, while minimising air/ground infrastructure cost and fostering innovation?
  - Industry standards, mandates
  - Leaving room for initiative, innovation
  - Balance is needed



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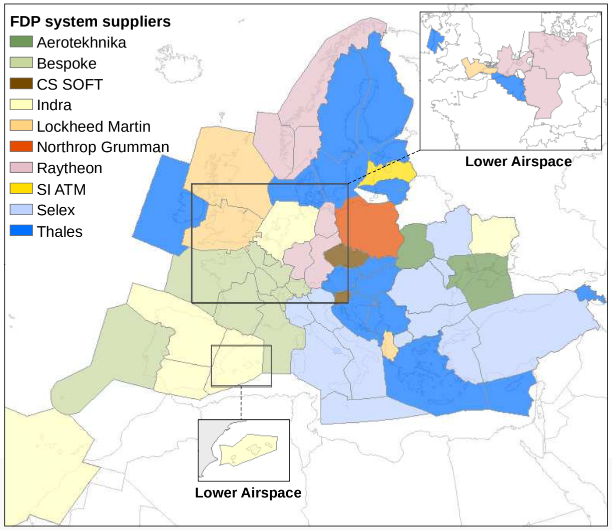
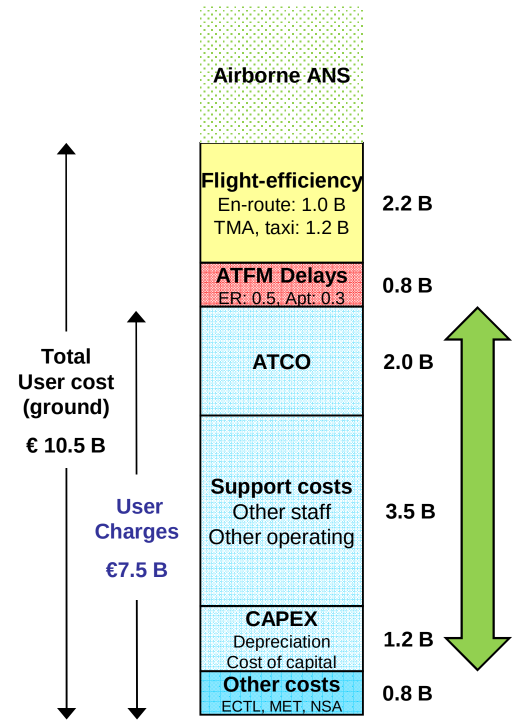


ANSP fragmentation, monopolies

- Airlines
  - Strong incentives for innovation with de-regulation
  - Learnt to minimise costs, adapt capacity to demand
- ANSPs
  - Designated by States, mostly monopolies
  - Fragmented service provision, infrastructure
  - 90% of ANS costs
  - Economic surplus: 10% in average, up to 20%
- Driving behaviours of providers, users
  - SES Performance/charging Regulations
  - Incentives, e.g. modulation of revenue?
  - Opening the market?
- Industrial organisation
  - A rich scientific corpus: Nobel prize (Jean Tirole)
  - Application to ANS



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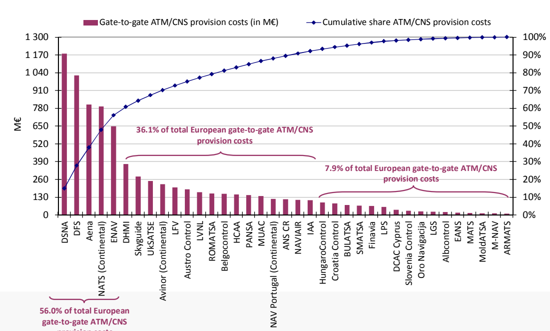
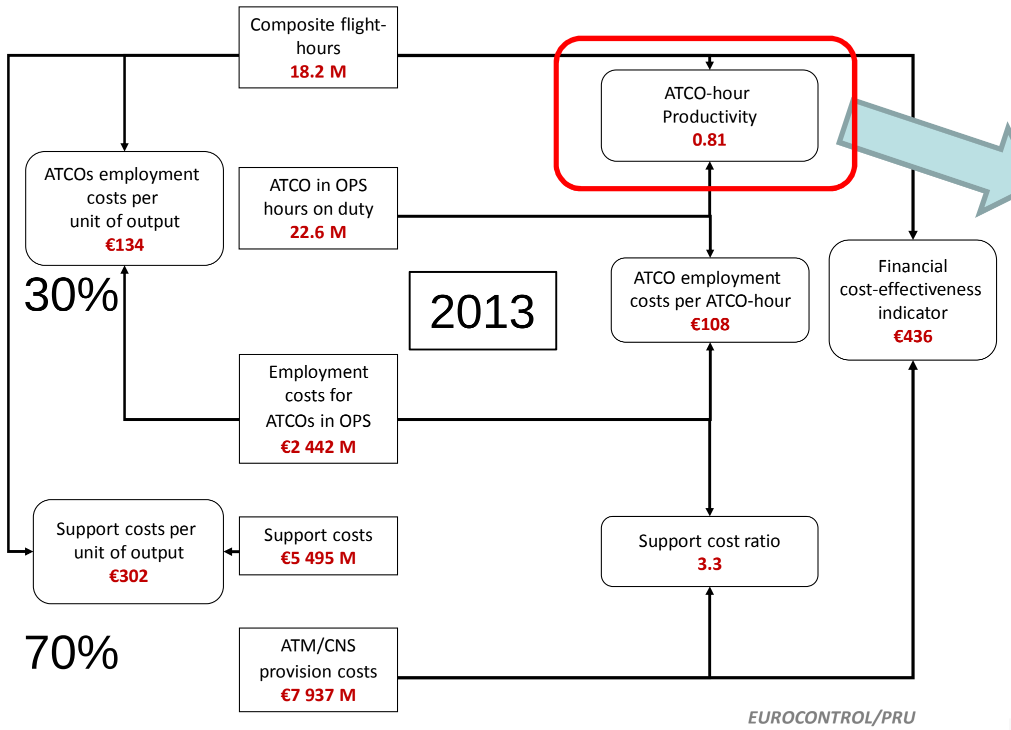
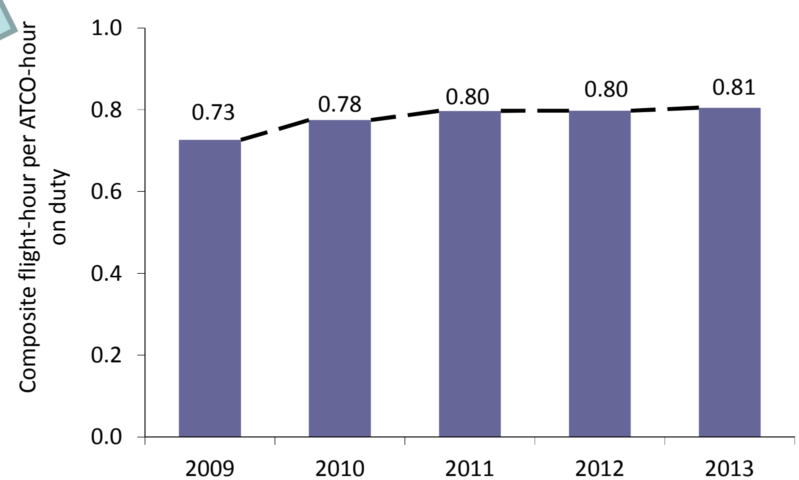


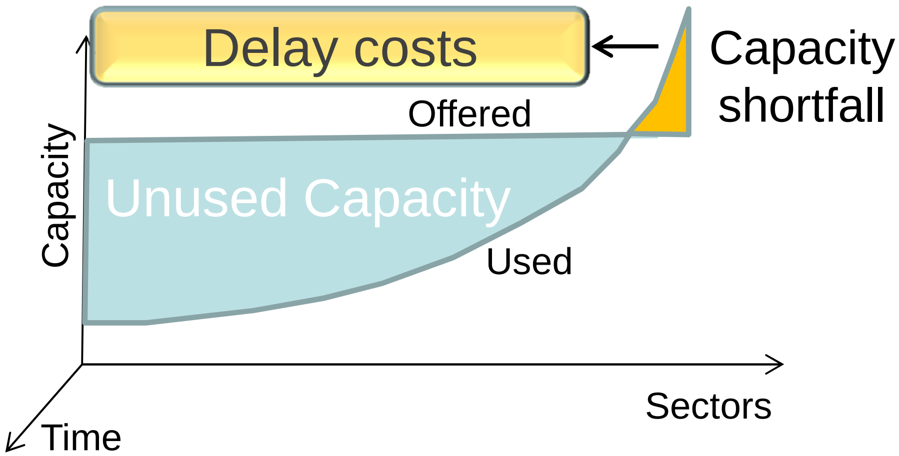
ATCO productivity

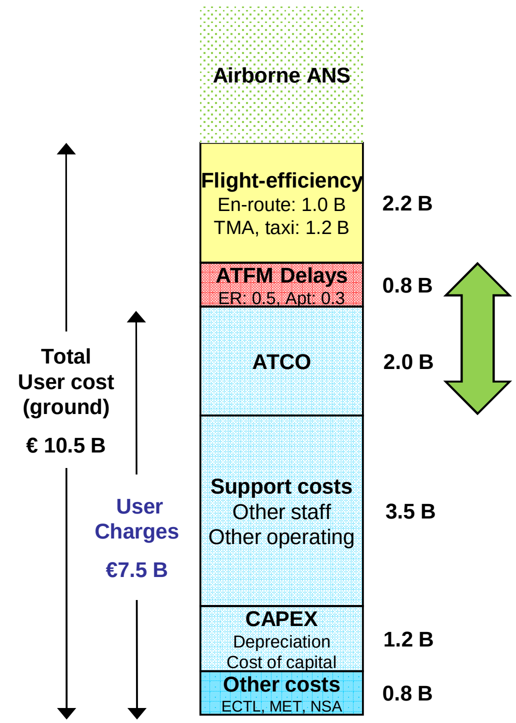
- Average productivity (flight-hours/ATCO-hours)
  - Very low (0.8), less than 1 aircraft under control per ATCO on duty!
  - Improves slowly
- Ambitious targets in SESAR 2020: Innovation required!





Matching en-route capacity with demand



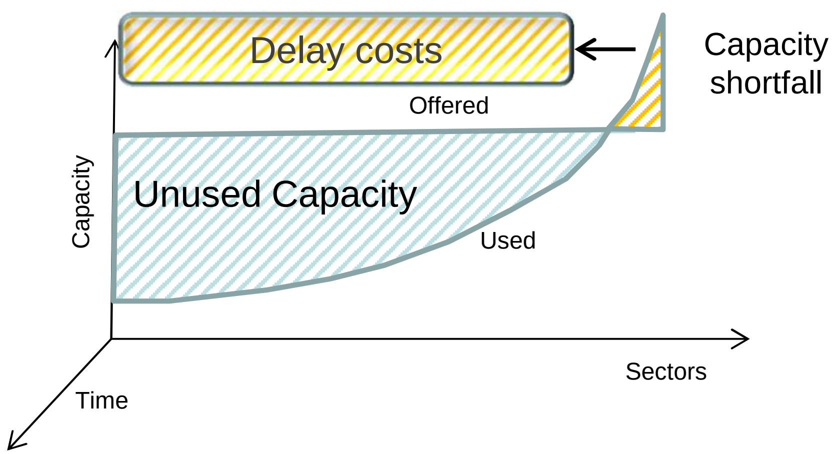


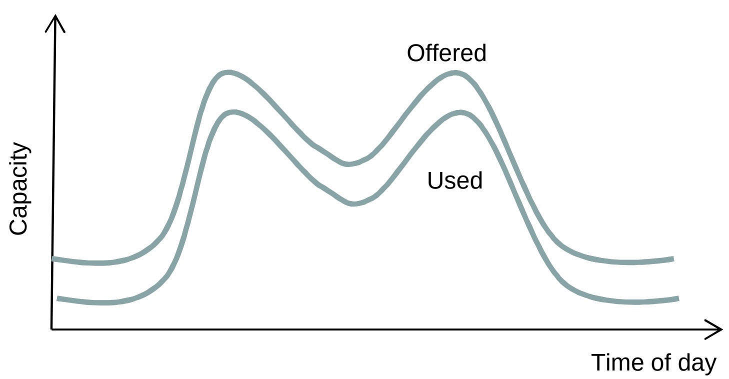
Estimated TEC 2012 (SES)

- ATC capacity tends to be very rigid
- Better matching ATC capacity with demand
  - Gaining on both capacity costs (charges) and delays
    - Impact on some €2.5B p.a.
  - Addressing traffic variability
- More flexible en-route capacity
  - Flexible rostering (e.g. Maastricht UAC)
  - Virtual centres, Industrial partnerships
  - Business drivers (e.g. modulation of user charges, ANSP revenues, SATURN)
  - Innovation: new concepts, e.g. Flight-centric ATC

New operational concepts

- Flight-centric ATC
  - Separation responsibility allocated per flight, not per sector
    - ATC load is more stable and predictable: much better use of resources
    - Capacity is much more scalable, not locked in small sector silos
  - Full use of trajectory-based concept of SESAR
    - Flight-centric is trajectory based, makes full use of 4D
    - SESAR 1 concept perpetuates weaknesses associated with sectors, does not use full 4D potential
- Other concepts: Room for innovation!





Flight-oriented view

- Flight-centric ATC
  - Both piloting and separation functions have flight-oriented view
    - Separating own aircraft against all others
- Delegated separation
  - Piloting and separation both airborne, both flight-oriented view
- RPAS
  - Piloting and separation on the ground, both flight-oriented view
- Flight-oriented view
  - Would ease productivity, integration of RPAS, delegation of separation

	Current	SESAR 1	Flight-centric	Delegated separation	RPAS
	Sectors		Flight-oriented view		
Air	P P	P P	P P	P S	
Ground	S S	S S	S	Flow, Police	P S

P: Piloting, S: Separation

RPAS

- Wide variety
  - From toys to high-end aircraft
- Big challenges and opportunities
  - Integration or segregation?
  - Mass market
  - R/F spectrum
  - etc

Efficient use of Radio Spectrum

- Aviation has significant radio spectrum allocations
  - VHF band (Voice, NAV, VDL)
  - L, S bands (Radar, DME, shared with military)
  - C band (MLS)
- High value, high demand for spectrum
  - High demand, e.g. 4G networks
  - A licence for a 5 MHz band in a large State can be worth some € 2B…
- Active spectrum management
  - Spectrum-efficient technology exists, but high retrofit costs for aviation
  - 8,33kHz, VDL2 are low efficiency, low capacity technologies
  - New Spectrum requirements, e.g. Data/Link, mainly RPAS
- Opportunity for use of new CNS technology
  - e.g. addressed COM for flight-centric

Key challenges and opportunities for innovation

- Improvements in performance, but much room for further improvements
- Opportunities from crises, technology, …
- A volatile world, high uncertainties
- Safety: measuring, controlling risk
- Enhanced environmental efficiency
- Sequencing and TMA
- Predictability of operations
- Human factors, behaviours, culture
- Deployment: Balance between standards/plans and innovation
- Industrial organisation
  - Research, Incentives, Partnerships, ANSP governance…
- Step change in productivity, flexibility
- New concepts, e.g. flight-centric ATC
- RPAS: mass market power
- Spectrum efficient CNS, technology supporting new concepts

Conclusions

- Plenty of challenges and opportunities for innovation
  - Some hints

Looking forward to SID 2015!