Common Vision Workshop

SAT Vision and Roadmap
A new transport mode in future ATS

Brussels, September 28, 2011
9.20-10.00 hours

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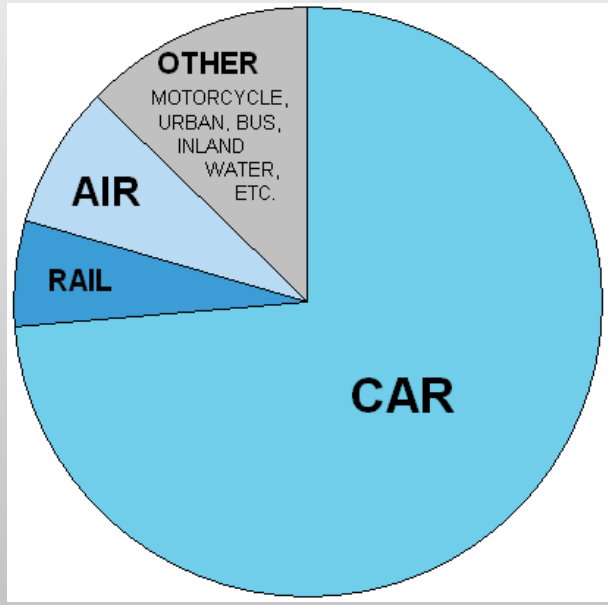
Mobility in EU 27
Volume of passenger-kilometers: 2009 and growth in last 10 years

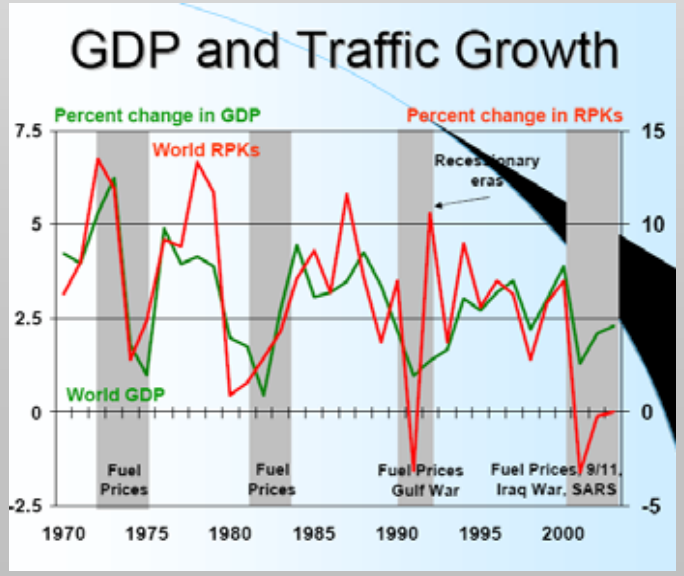
- ***Road transport (4,78 trillions pkm; dynamics: +11% pa)***
- ***Train transport (0,40 trillions pkm; dynamics: +10% pa)***
- ***Air transport (0,52 trillions pkm; share: dynamics: +14% pa)***

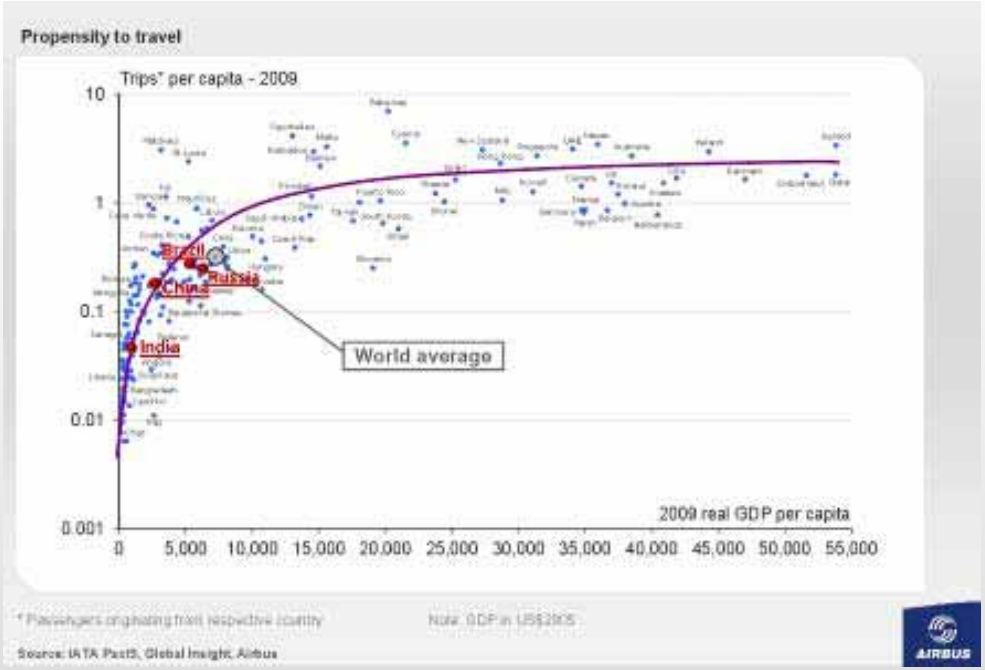


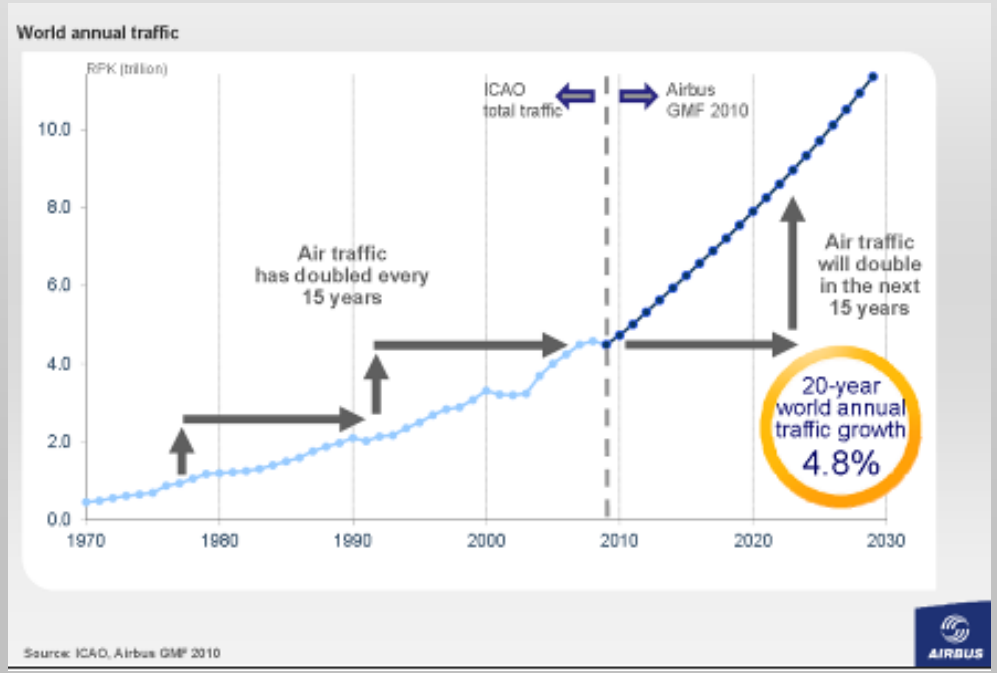
2009 data

Worldwide Air Transport grows

- The demand for air transport is related to the growth of **GDP**(jobs and leisure), **air fares** and **frequency**.
- There is a positive relationship between **GDP** and air travel demand.



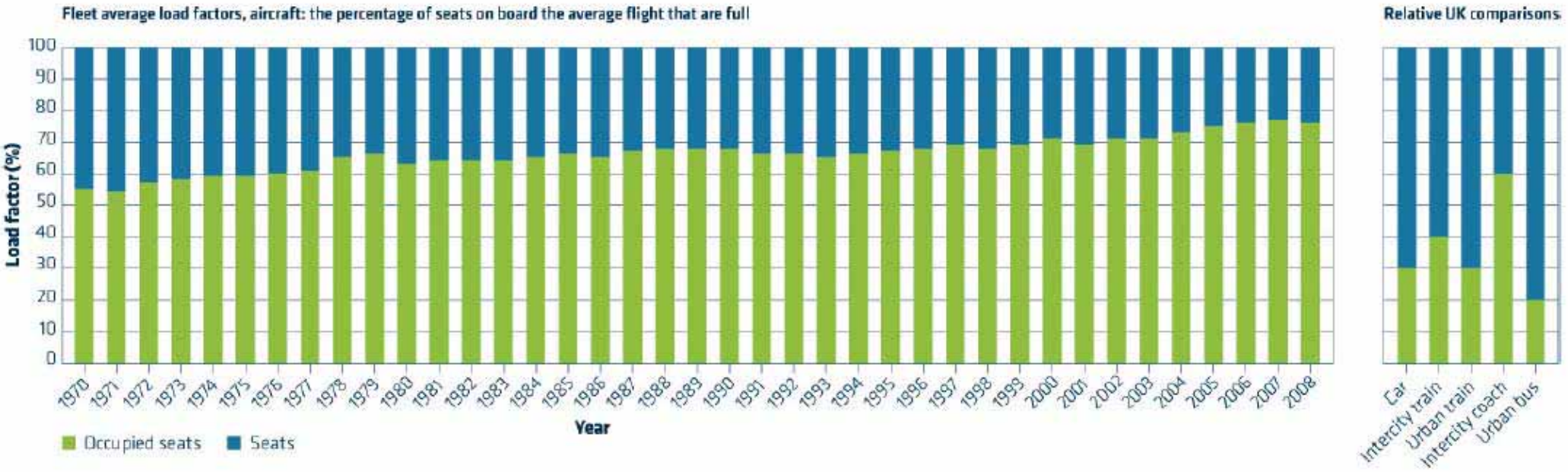




Air transport pricing

- **Air fares** have been dropping by 60% over the last 40 years despite increasing fuel cost: thanks to high load factors, high productivity and new business models.

Note: today load factor in Europe is 78%



Air transport productivity

Increase of productivity: Example speed x capacity (seatmiles/hour) leads to lower seatmile cost

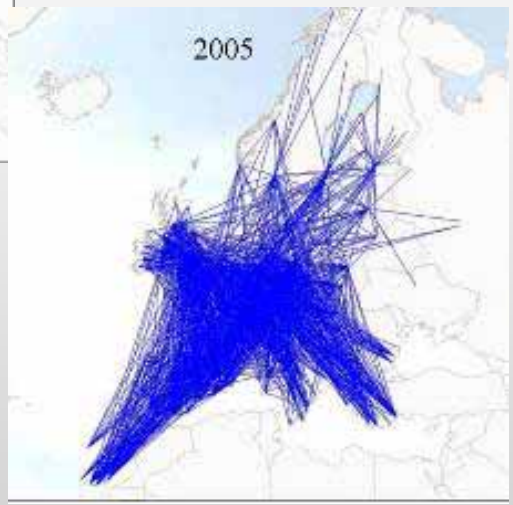
DC-7: 20.000

B-707/320: 125.000

A-380: 390.000

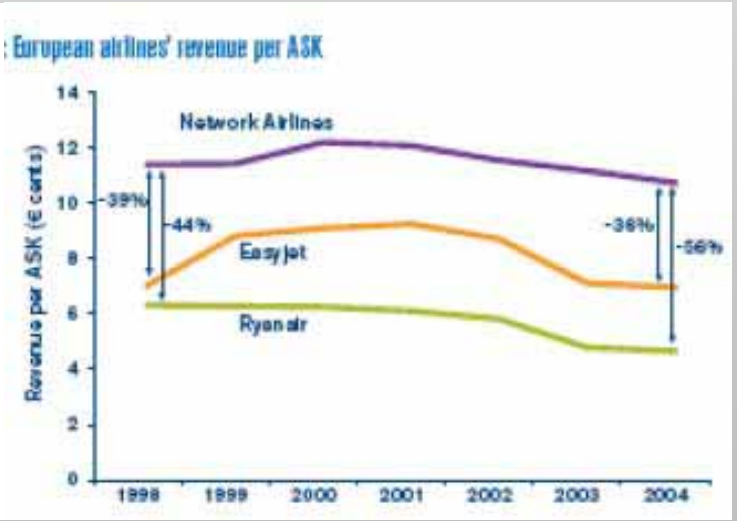
New business models: new demand

- New **business models** were developed like Low Cost Carriers that serve thick routes in Europe.



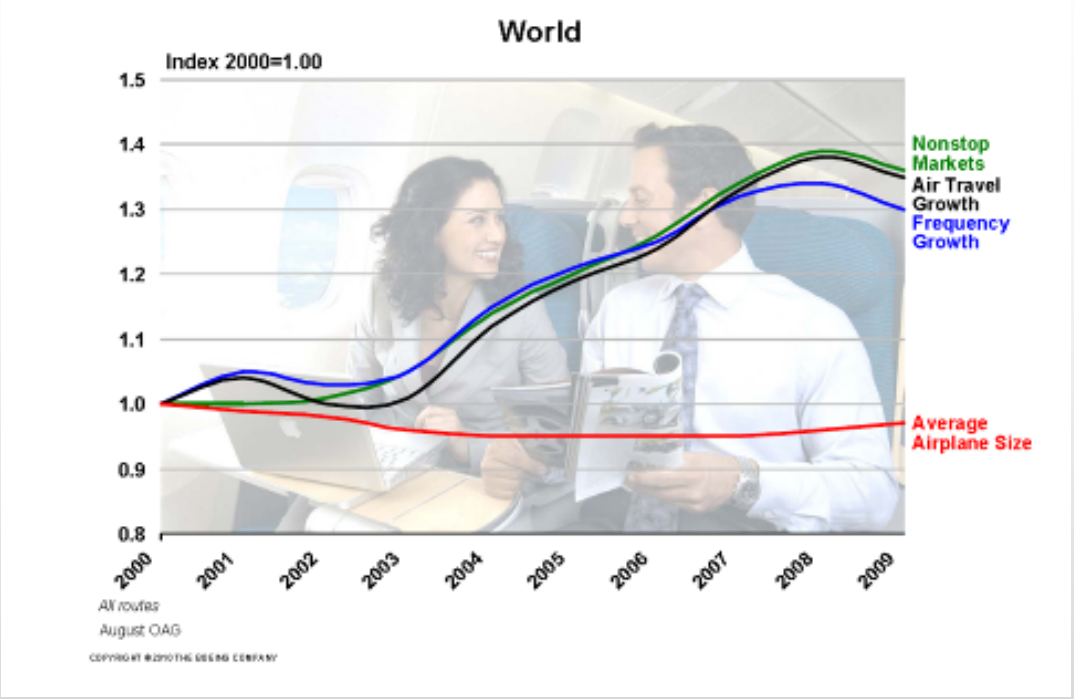
New entrants used:

- New distribution outlets (internet)
- Higher asset utilisation (fleet, staff)
- Lower costs- airports, aircraft, distribution
- Ancillary revenues (add ons, specific charges, partnerships)
- Stimulate new traffic from lower fares
- **Simplicity!**

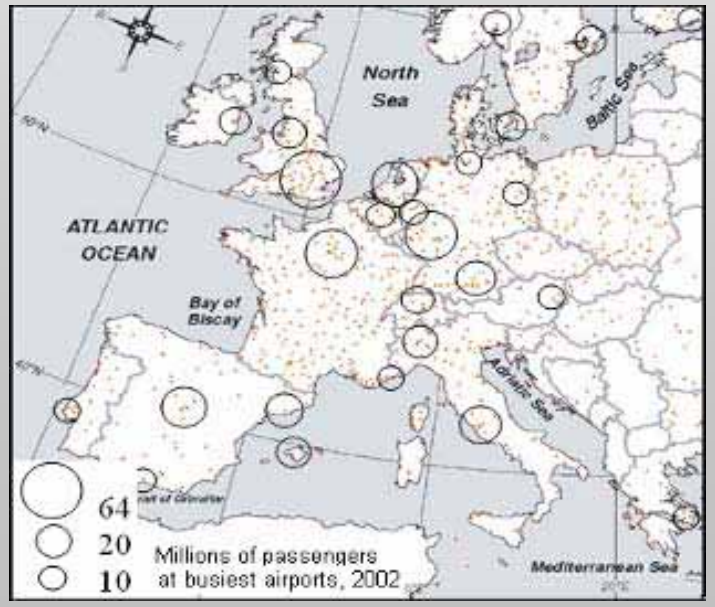


Air transport and airports

- The air transport sector translates increased demand into higher frequencies leading to more air movements and saturation of current airport capacities.



In Europe 85% of air traffic concentrated at 43 larger airports



Congested airports

- Continuous growth leads to severe runway capacity shortage and crowded terminals.

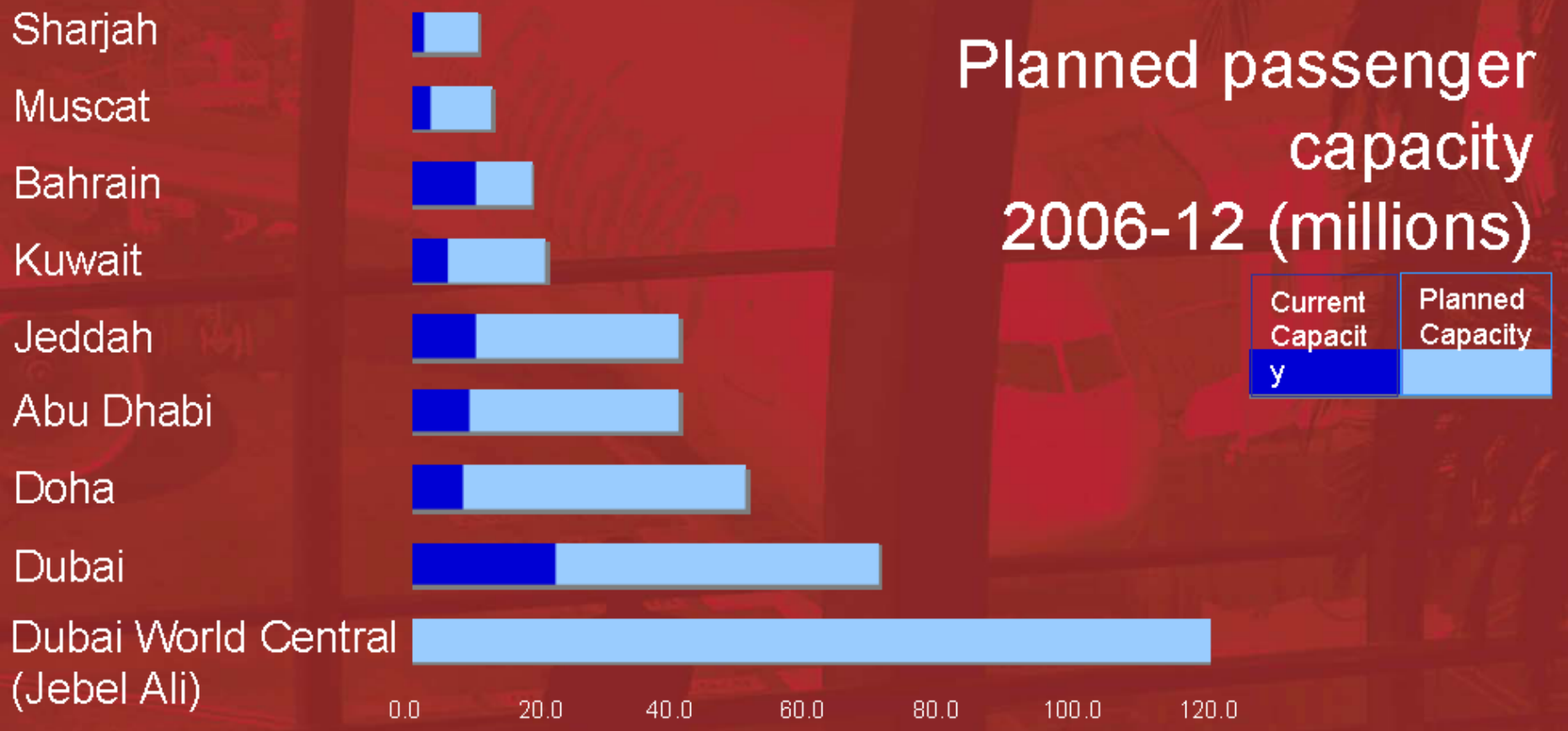
. Flights lost to airport capacity constraints

	Unaccommodated IFR Movements (million)			Unaccommodated demand (%)		
	2020	2025	2030	2020	2025	2030
A: Global Growth	0.7	2.1	5.0	4%	10%	19%

- Strict security measures are an inconvenience for the passenger (even those travelling business class).

New Hubs in the Middle East may require more longer range regional aircraft to Europe and mini HUBs

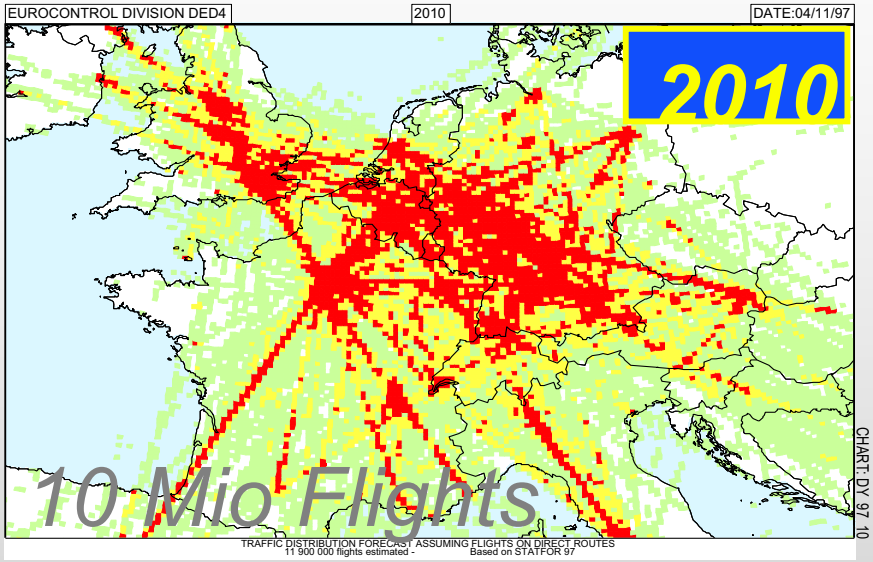
The Middle East: airports investing in capacity expansion

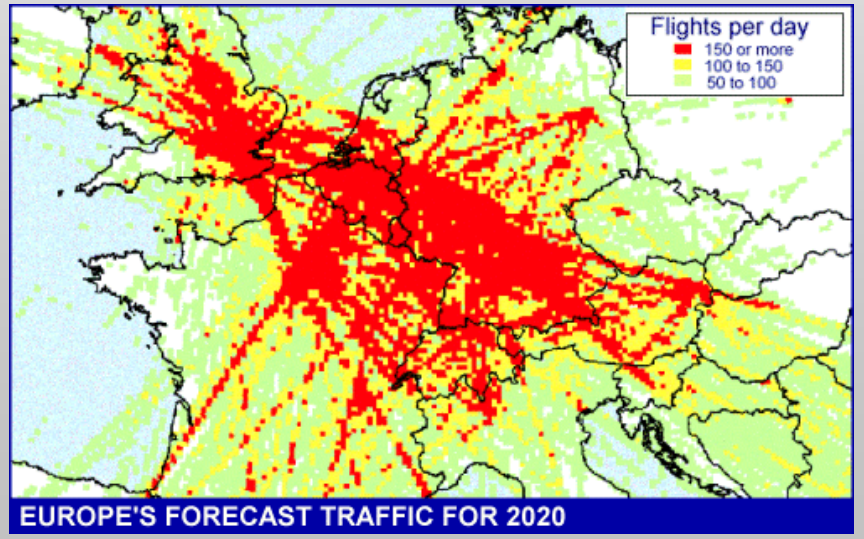


Source: Centre for Asia Pacific Aviation

Where they fly

- Airline operations in Europe are concentrated over Western Europe.
- There are about 10 million IFR flight per year.
- Main airways get saturated leading to delays.





Sensitive to small changes

- The air transport system is very sensitive to small changes.
- This illustrates that the air transport system has little inherent redundancy.
- With SESAR the flexibility of airlines may even be reduced further.
- Due to delays the predictability of airline connections may deteriorate again.

Growth in air transport

- Air transport has become mass transport resulting in queuing, delays and discomfort.

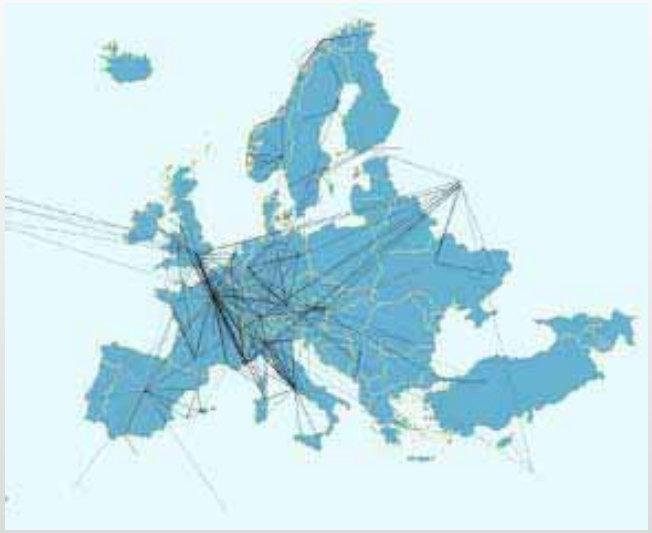
- For **business people** and those who can afford it, alternative **on demand** air transport solutions will satisfy their needs.

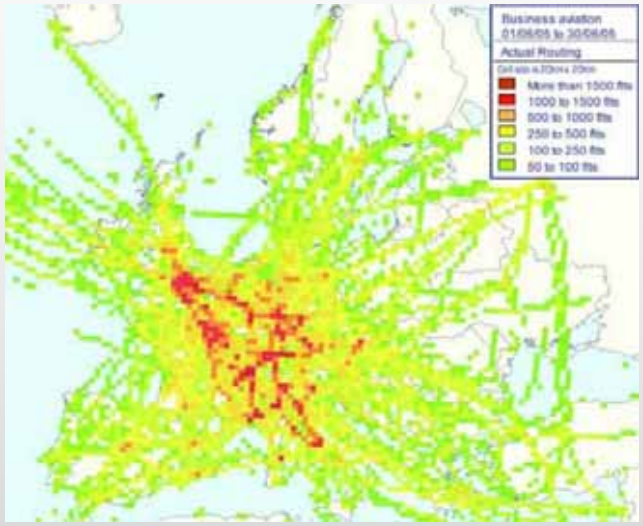
For business customers time, safety and quality are most important

- For business people travelling is tiresome.
- They want to **travel fast door to door** while using as few different transport modes as possible.
- They want to spend as little time as possible on an airport or in transit (not to queue)
- They would like to use the travelling time to work
- They care about safety

Business and corporate air transport provide limited and expensive solutions

- Business aviation is very expensive.
- Business aviation is focused on a limited number of airports only.
- As a consequence ordinary business people often take the car to reach their destination.





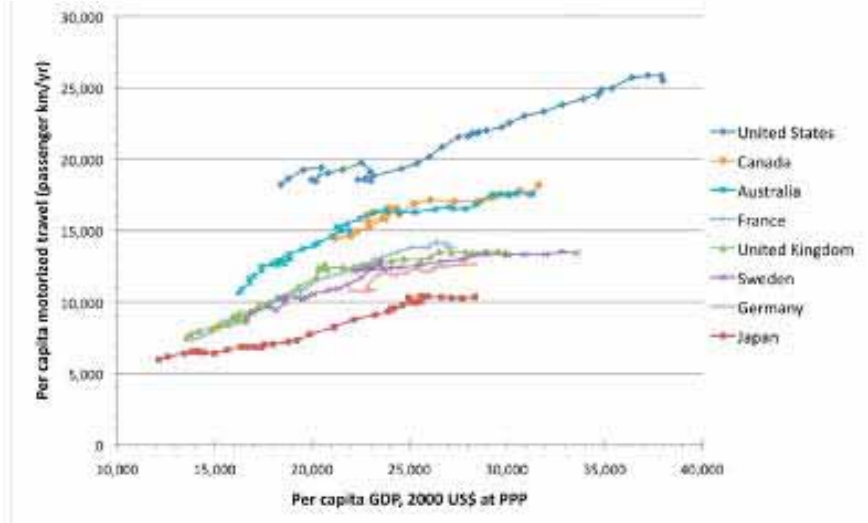
Observation 1

- Due to the growth in demand for air transport, airport capacity is stretched to the limits. This results **in long transit times and crowded access to airports.**
- Capacity of currently used airports will **not be sufficient** to accommodate the additional traffic expected.
- Business travellers want **fast door to door seamless connections**, using as few transport modes as possible. ***Time is money***.

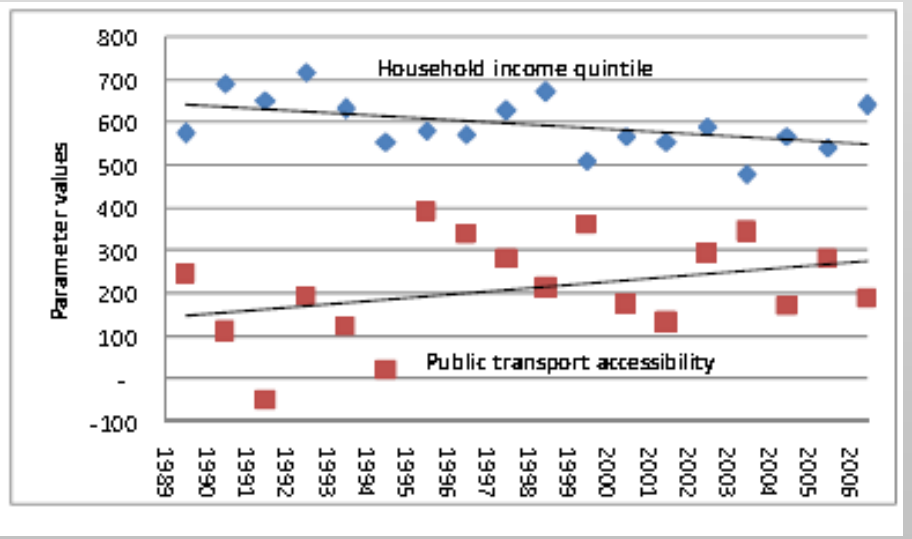
- Some business areas in Europe are difficult to reach. As a consequence business people often **use their cars** to travel.

Road travel

- The increase in car travel in Europe has been paramount...



- The use of cars is especially evident in those places where public transport is difficult to access. (UK example)



Roads in Europe

- ***236.147.000 cars in EU27***

- ***+3 million cars/year***

- ***1.977.000km of paved roads***
- ***65.100km of motorways***

- ***+1.500 km/years***

2007 data

- 80,5% of EU27 traffic is passenger cars
- 8.8% is bus and coaches
- 7.0% is railways
- 1.5% is tram and metro

Congestion

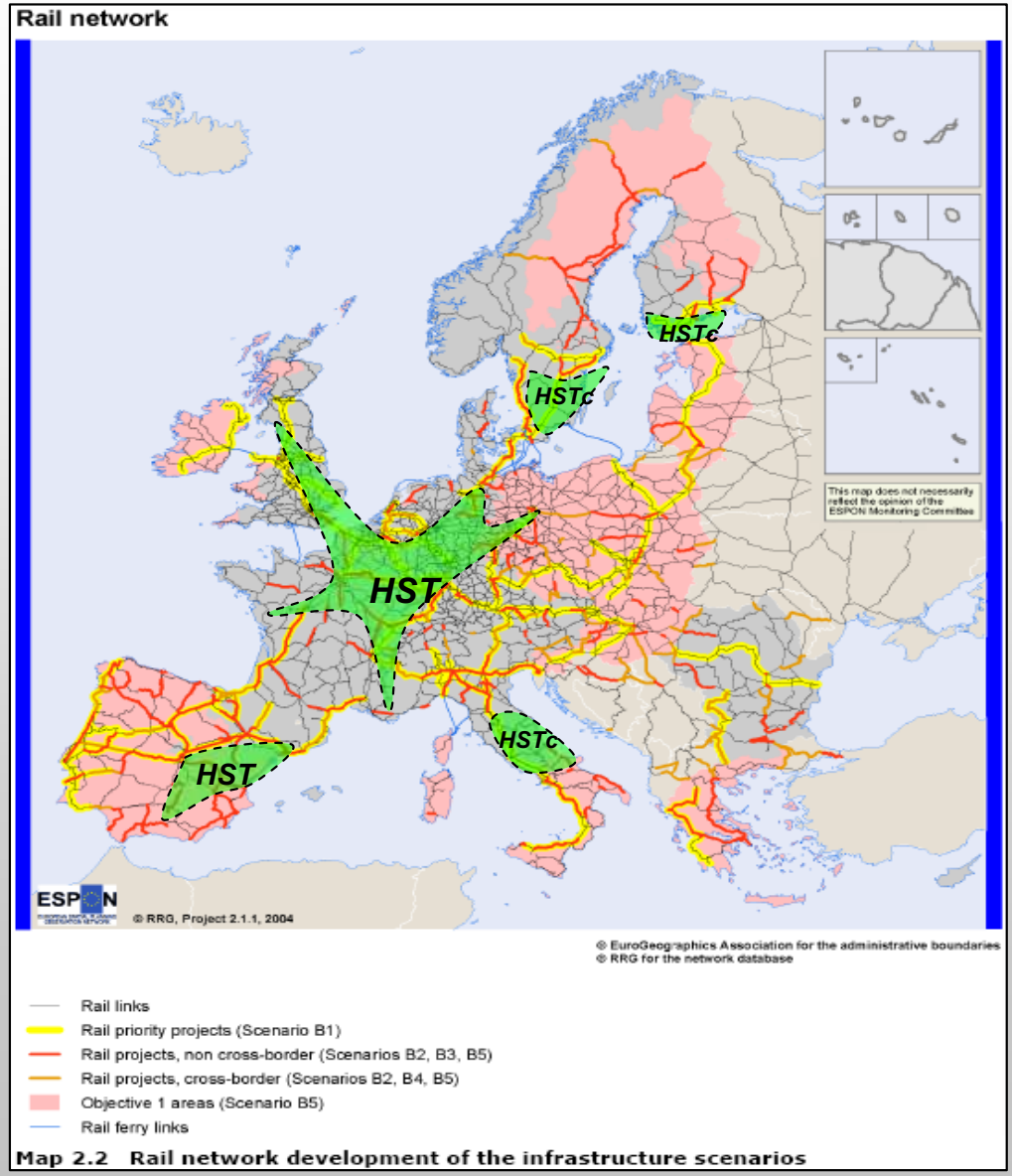
Roads in Europe

- Roads are not only used for passenger cars.
- Trucks, lorries and vans constitute an increasing portion of the road traffic. (236 million passenger cars and 34 million goods vehicles)

- If freight traffic can no longer be accommodated, the economy will stop.

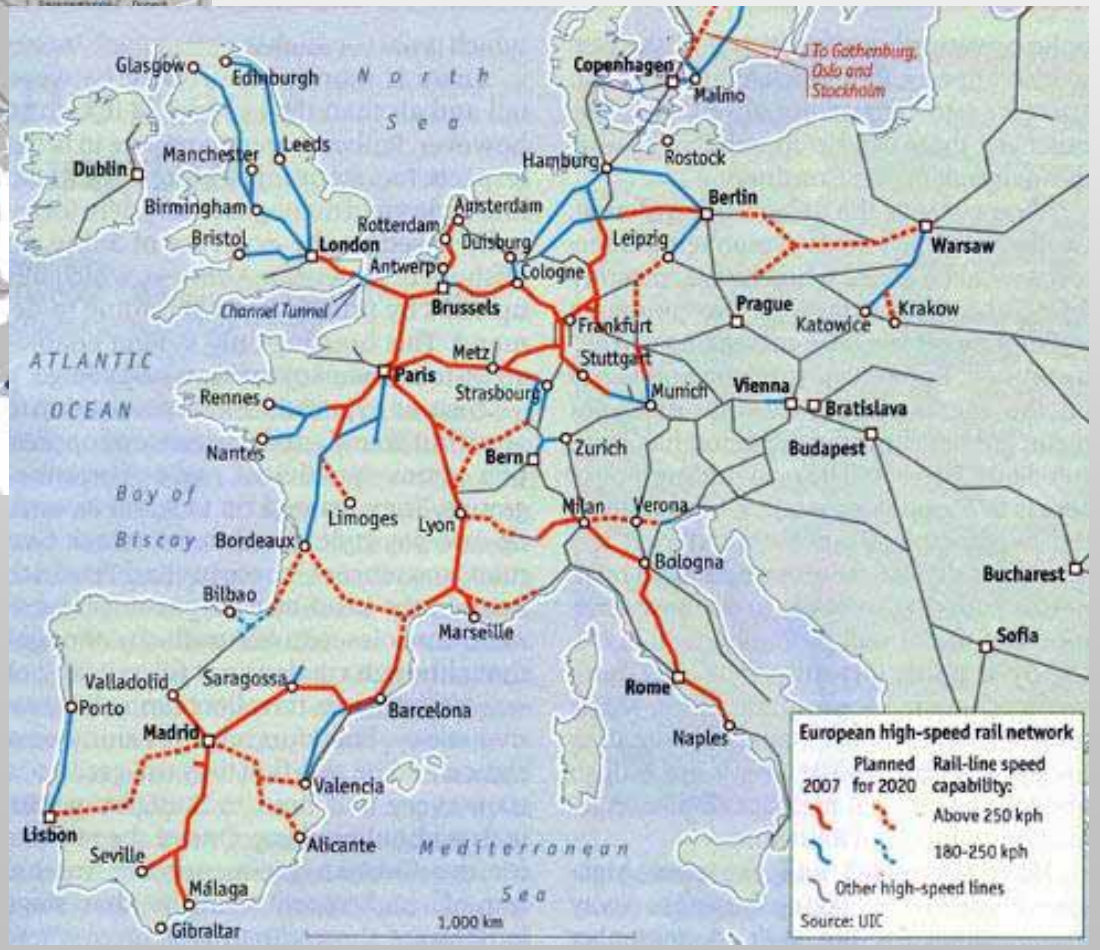
Concern EU Commission

- In its **White Paper** on Transport the European Commission has advocated the **substitution of car travel to rail travel**.
- TEN-T funding is available to create more high speed rail connections.
- However High Speed rail infrastructure is expensive: about € 40 million per km.



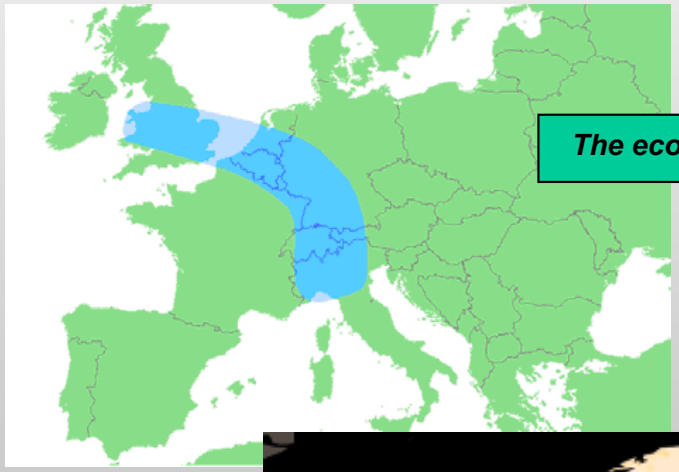
Map 2.2 Rail network development of the infrastructure scenarios

Current and planned High Speed Rail

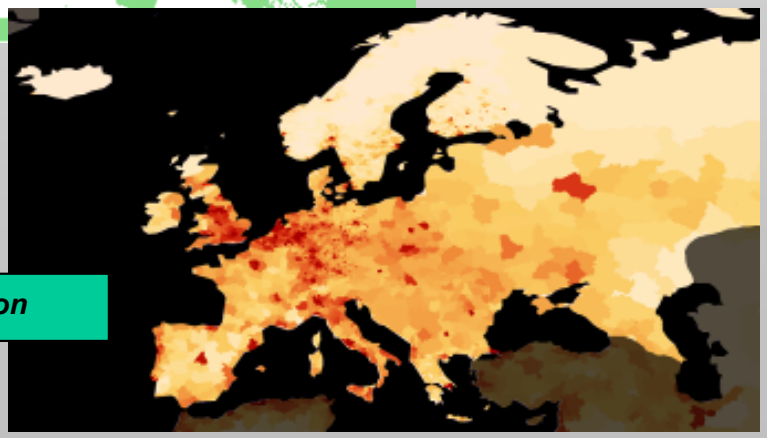


Regions of Europe

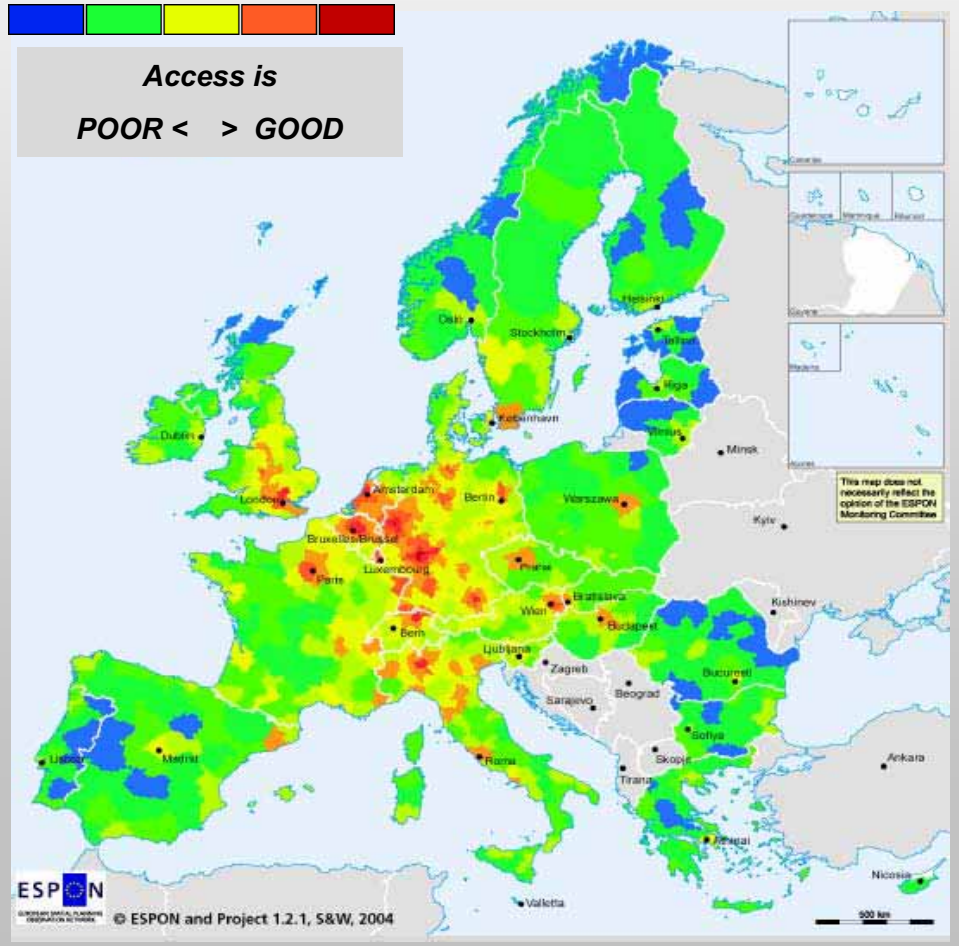
- Extended (high speed) rail connections will not help access to regions outside the European Economic Banana, to further develop their economics and welfare. These regions are mainly depending on road transport development.



The economic banana



The population



Observation 2

- In view of the increasing road traffic, a **modal shift** is needed.
- Trains and other public transport means can alleviate the problem. However the high speed rail network is primarily focused on **areas within the main European economic centres**.
- **Remote areas** in Europe still have a bad transport infrastructure and depend on car travel. This will create barriers to their economic development.

- ***Can a step change in aviation help?***

The USA was the first to investigate

US studies

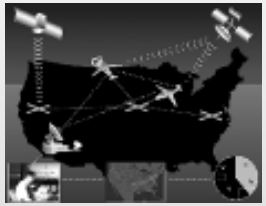
- NASA started studies on personal **on demand** air transport to see if an **air taxi business or private planes travel** would have a future in the USA.
- Large scale use of small aircraft would not only create additional door to door transport opportunities but would also **revitalize the small aircraft industry** in the USA.

NGATS

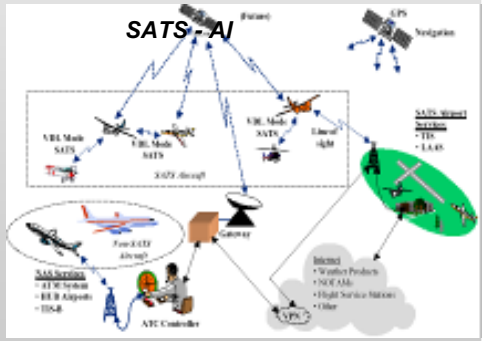
VLJ **SATS**

Affordable Alternative Transportation AGATE -- Revitalizing General Aviation

Advanced General Aviation Transport Experiments



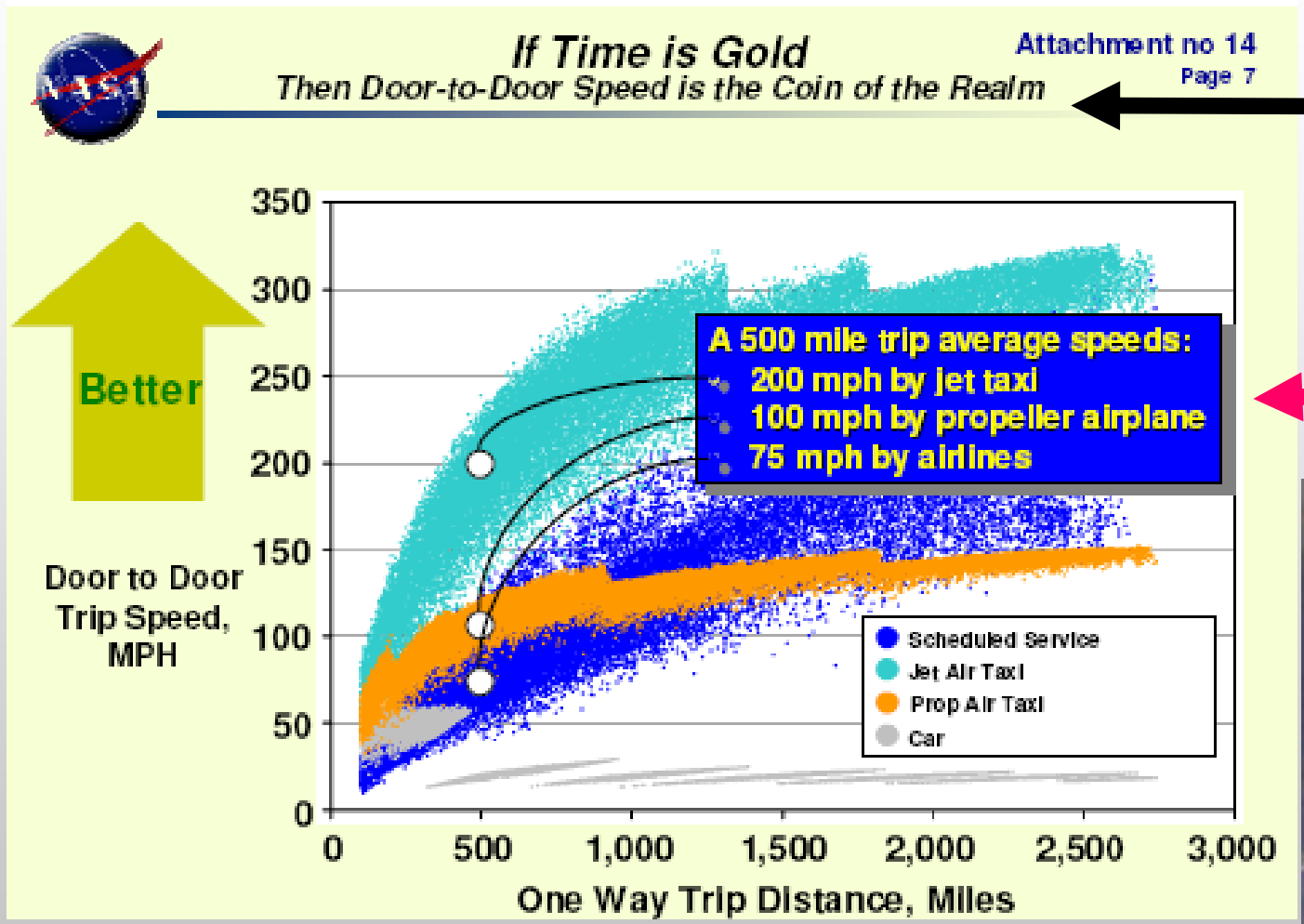
- *AGATE*
- *TAMDAR - Troposphere Airborne Meteorological Data Reporting*



*A RURAL/ REGIONAL AND INTRA-URBAN **ON-DEMAND** TRANSPORTATION SYSTEM*

NASA Vehicle SystemsPrograms (VSP): PAV - Personal Air Transportation Technologies

The NASA system approach

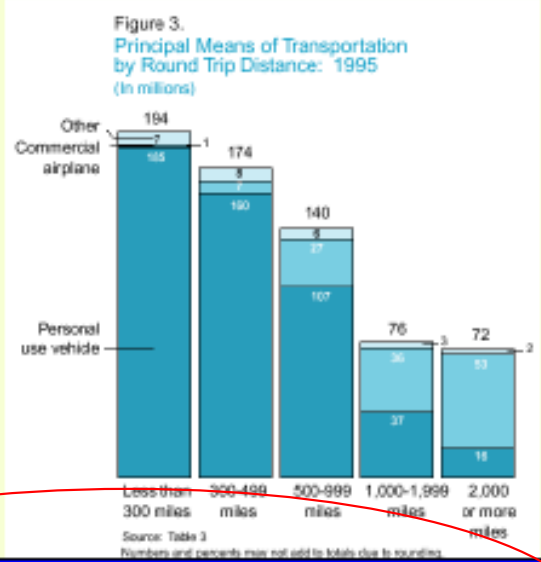


NASA conclusions

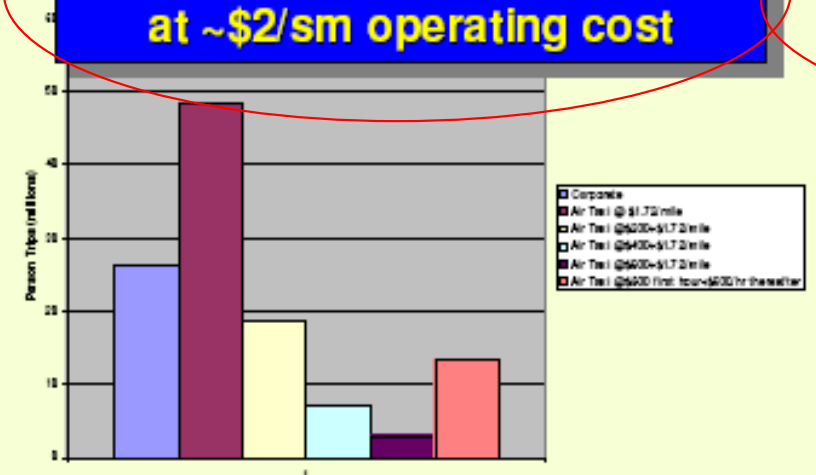
Future Aircraft Market Diverted Demand and Sensitivity Assessments

Attachment no 14
Page 11

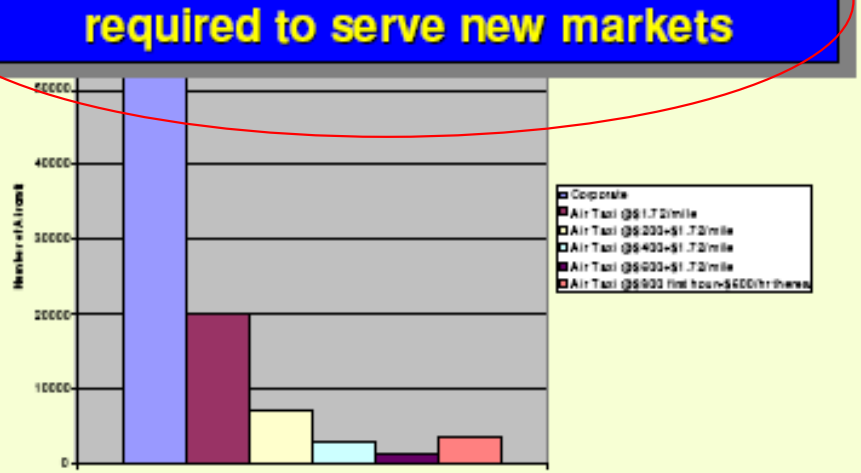
- Approach - Predict diverted mode choice at National level between automobile, scheduled air, and on-demand air travel based on the value of a traveler's time and the cost of the trip (NASA CR 2002-211927).
  - Data Source - 1995 American Travel Survey + 2000 US Census
  - Tools - Integrated Air Transportation System Evaluation Tool (IATSET), macro economic model



Between 13 and 47 million trips at ~$2/sm operating cost



Between 7,000 and 52,000 aircraft required to serve new markets



A big market was predicted for the USA.

Is such a potential market also present in **Europe** , in view of a different transport infrastructure and different geographic situation?

The EPATS study sponsored by the EU was to assess.

EPATS - SATS

Concept difference

- *low passenger volume interregional on demand and scheduled transport,*
- *access to hi-speed travel modes for remote European regions*
- *4-19-seat piston, turboprop and jet aircraft operating at small regional and local airports*
- *private, air taxi or public mode of transport (for remote areas)*

- *door-to-door travel time reduction and daily range of activity of businessmen increase*
- *4-7-seat, piston and jet aircraft, operating at small and large airports*
- *A/c mainly owned privately*
- *private or corporate mode of transport*

Aircraft

GENERAL AVIATION AIRCRAFT
CS-23

EPATS Aircraft
(Small Travel Aircraft)
JAR-23 Normal & Commuter categories
(extended to jet driven, multiengine airplane, and with supplementary requirements)

All others GA & Aerial Work Aircraft
JAR-23 all categories

- Single and multiengine Piston
- Single and multiengine Turboprop
- Single and multiengine jet

Ownership

- Private
- Fractional
- Corporate
- Public

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Operations

- Non Commercial transport Part 91
  - Individuals or corporate operations
- Commercial Transport Part 135
  - On demand passenger services - Air-Taxi
  - Scheduled passenger services - Commuter

Missions

Free Flight Travel from point to point in all weather conditions in time not more than 2 hours for the most of inter regional relations and not more than 4 hours for maximum range. Aircraft have to operate from local airports and serve all EU sub regions NUTS-3 (1150)

One day trips for individual or business travel and two flight dayly for scheduled passenger service on low density intercity traffic flow

RANGE	Short	Medium	Long	Extra Long
[km]	350	900	1500	>2000
Pistons	main	extended		
Turbo-props	main	main	extended	
Jets	extended	main	main	rare

Scheduled passenger services affordable for the most of population. Corporate and on demand taxi services profitable for business travellers,

EPATS

EPATS key elements

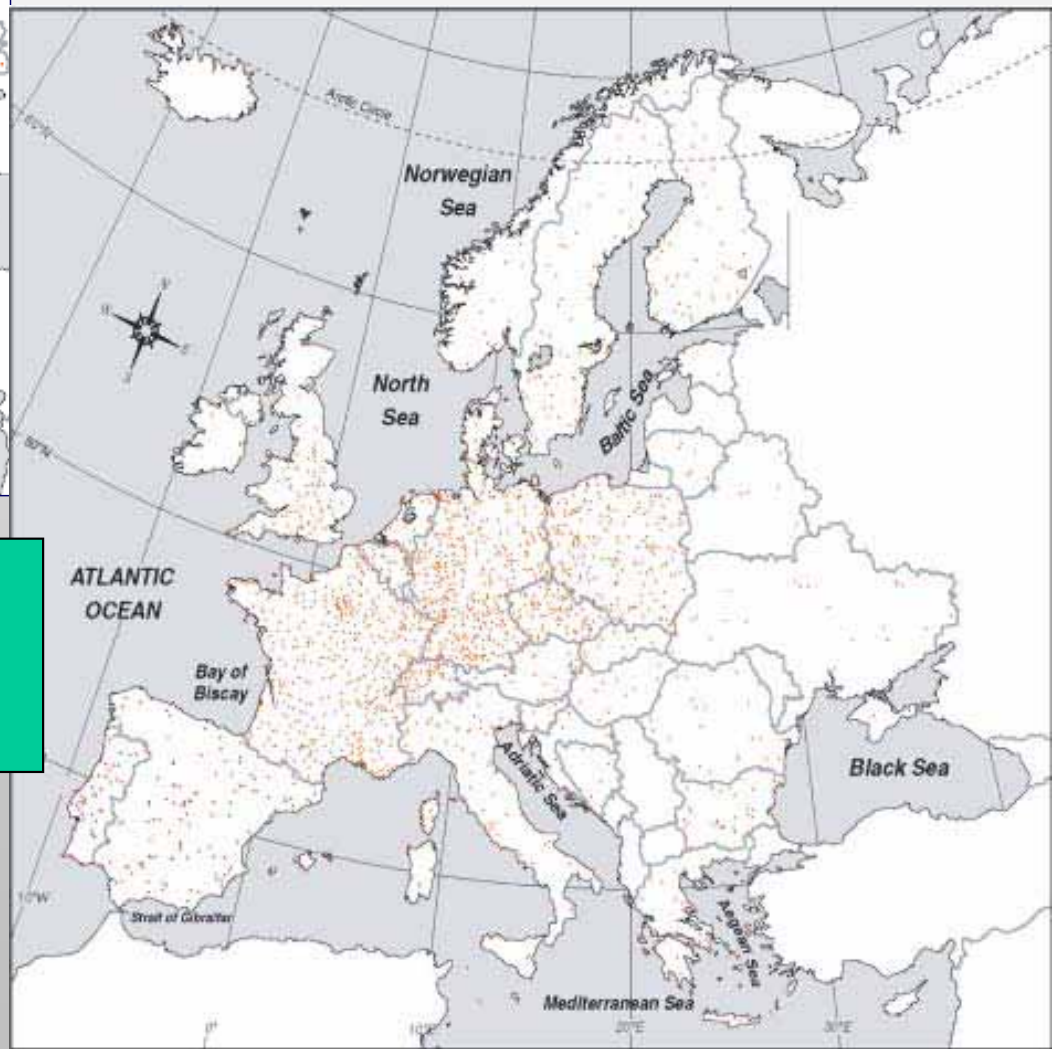
Aircraft fleet

- *Technically Advanced Aircraft fleet consisting of:*
  - *Single and twin engine piston, 4 to 6 seats*
  - *Single and twin engine turboprop, 9 to 19 seats*
  - *Single and twin engine jet, 6 to 7 seats*

  - *Certificated IFR according to enhanced JAR-23, operating under FAR 135 for commercial operation and FAR-91 for non-commercial operation*

Airports

1270 airports which have an ICAO code



1300 aerodromes in Europe that can be used for EPATS traffic

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A total overview of all European airports

1,270 airports and 1,300 landing fields

One airport per 2850 km^2

390 000 inhabitants per one airport

Europe is a special area with unique features favouring the development of regional passenger air transportation system

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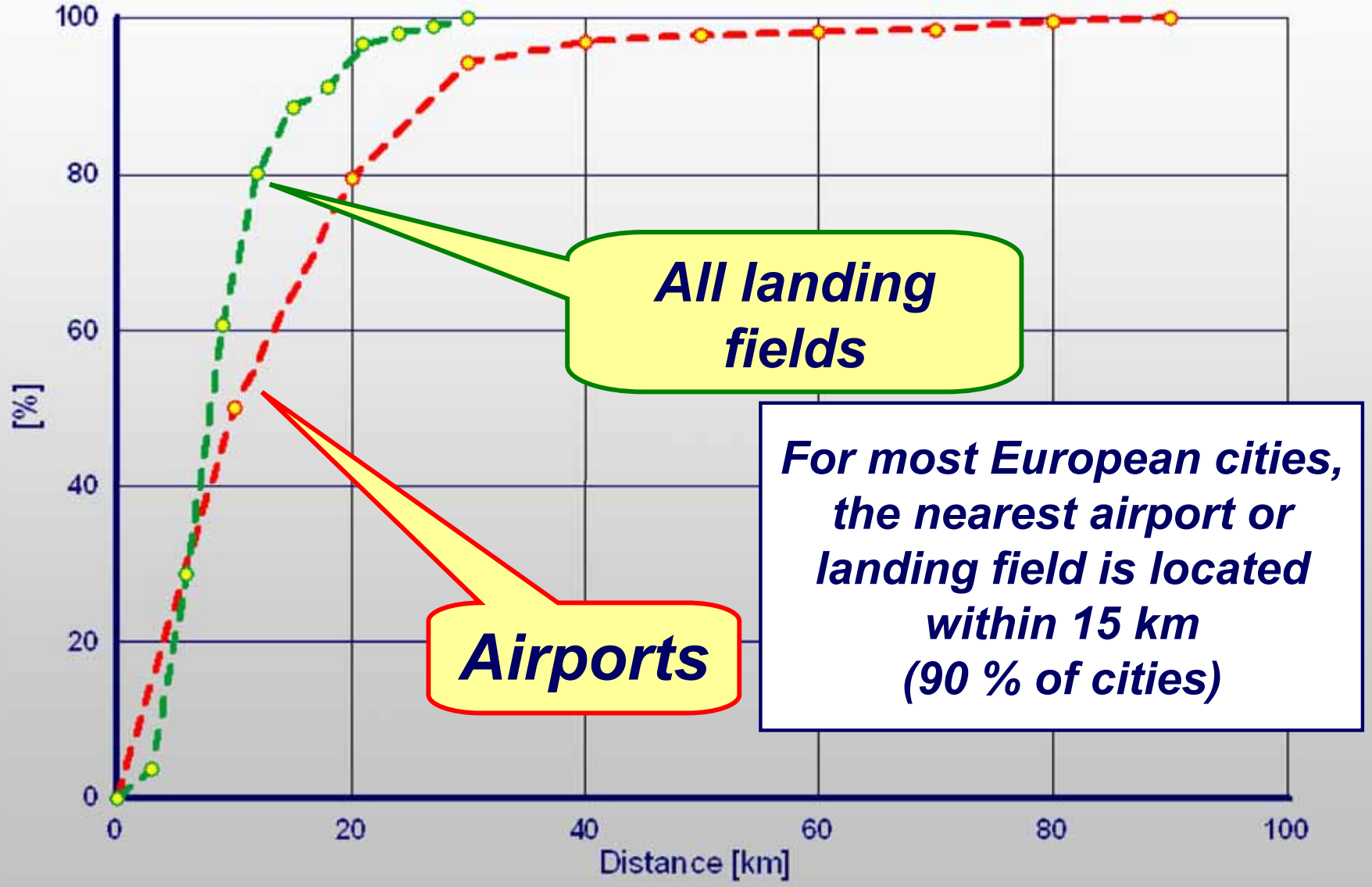
City distance to the nearest airport



For main European cities

Estimation Method for modal shift

- ***Generalized Cost method** including:*
  - *The travel cost borne by the traveler*
  - *The travel time and its associated cost value*

⇨*A traveler will choose the transport mode that minimizes his/her generalized cost*

➢ Travel Cost = monetary cost

The direct cost borne by the passenger (= Out-of-pocket cost) is composed of:

- **Access cost** C_{Access} = cost to access the terminal. This cost is fixed.

Note: It is assumed that the passenger goes to the terminal by car.

⇨ Access cost = average distance from origin point to terminal * cost per km by car

- **Egress cost** C_{Egress} = cost to leave the terminal and reach the destination. This cost is fixed.

⇨ Egress cost = average distance from terminal to destination point * cost per km by car

- **Transport cost** $C_{Transport}$: varies with the distance. It corresponds to the multiplication of a "**unit cost**" (a cost per pkm) with the distance. This unit cost is the price per km paid by a passenger to use a transport service (commercial aircraft, EPATS) or to use his personal car.

- Potential **additional cost** $C_{Additional}$ such as accommodation cost (for car when stopping in a hotel)

$$C_{Travel} = C_{Access} + \underbrace{Distance \times C_{Unit}}_{C_{Transport}} + C_{Egress} + C_{Additional}$$

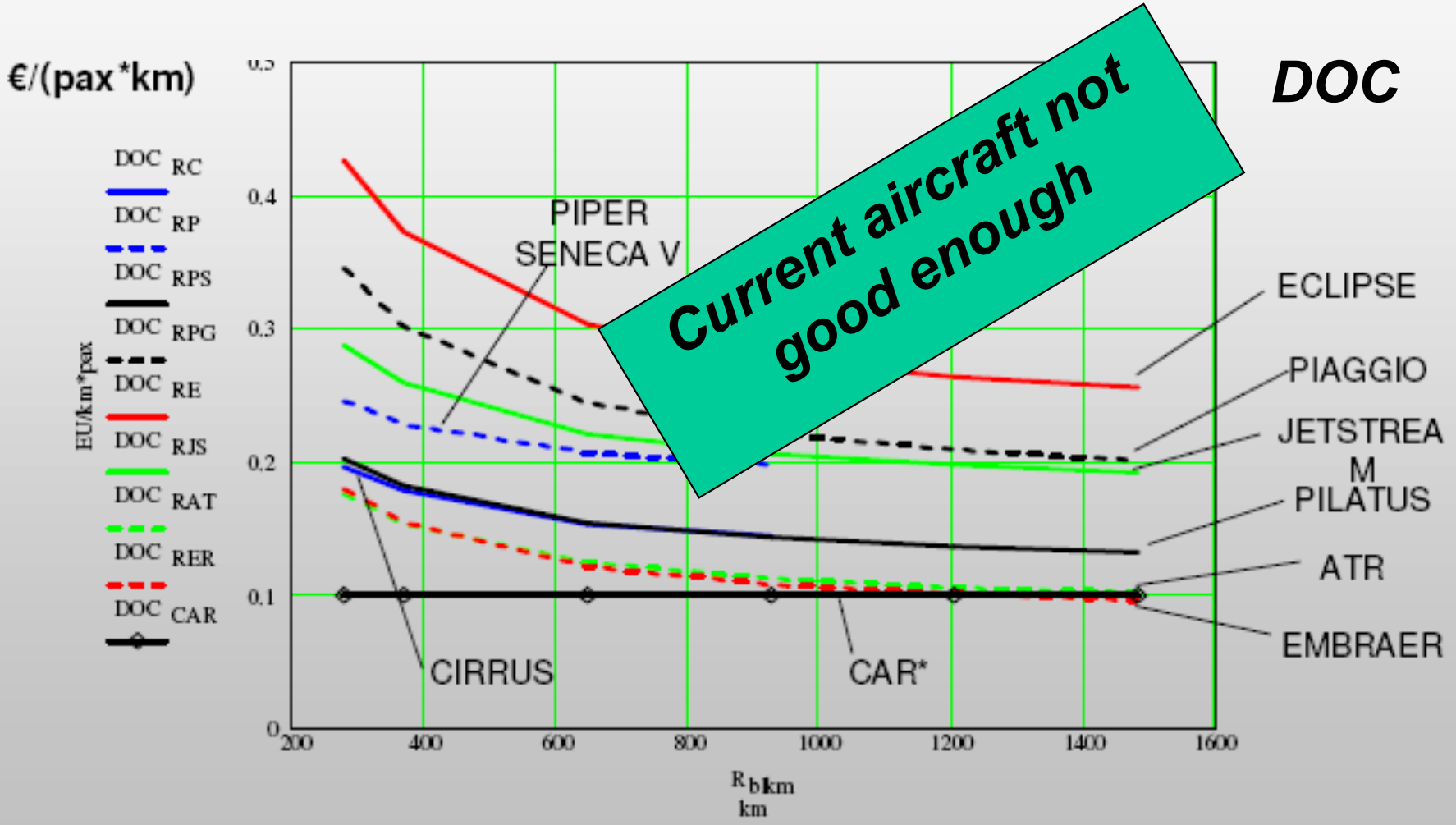
$$T_{Travel} = T_{access} + \underbrace{\frac{d}{Vm}}_{T_{Transport}} + T_{egress} + T_{additional}$$

➢ Travel Time

The travel time T_{Travel} can be separated into four distinct parts:

- **Access time** T_{access} to the transport mode = Time to go from origin point to the transport mode
  = access time to the transport terminal + time spent at the terminal for procedures (checking, waiting, boarding)
- **Egress time** T_{Egress} = Time to go from transport mode to destination mode
  = Time spent at terminal after arriving (Transfer Time, Time for picking up luggage) + Time to go from terminal to destination point
- **Transport time** $T_{journey}$ = time spent in transit only
  = Distance ÷ Average Speed
- **Additional time** $T_{additional}$ **:** this should be taken into account only in the case of car travel. It corresponds to the potential breaks the traveller can take while driving. These breaks can be short breaks, as well as stops in hotel for very long distance trips. Time used for sleeping (at hotel) is not included in additional time since it is not considered wasted time. However, time spent eating is included in travel time because for the traveller it could be time spent with his family rather than time spent in a hotel.

Transport cost versus distance



* Mercedes-Benz 350 CLASSIC AUT –Car Category E

AIRCRAFT COMPARISION: Reference vs Future to

estimate DOC

2020

PISTONS

1eng 4seat

2eng 6seat

TURBO-PROPS

2eng 8pax

2eng 19pax

JETS

2eng 8pax

Range full seats	1000 km	1.500 km	2000 km	1000 km	2000 km
Speed (bl.) km/h	Similar	+11to13%	-10 to17%	+10 to17%	Similar
DOC €/(pax*km)	-18%	-37%	-23 to 32%	-12 to15%	-24%
SFC l/(pax*km)	-20%	-26%	-11 to 28%	-16%	-21%

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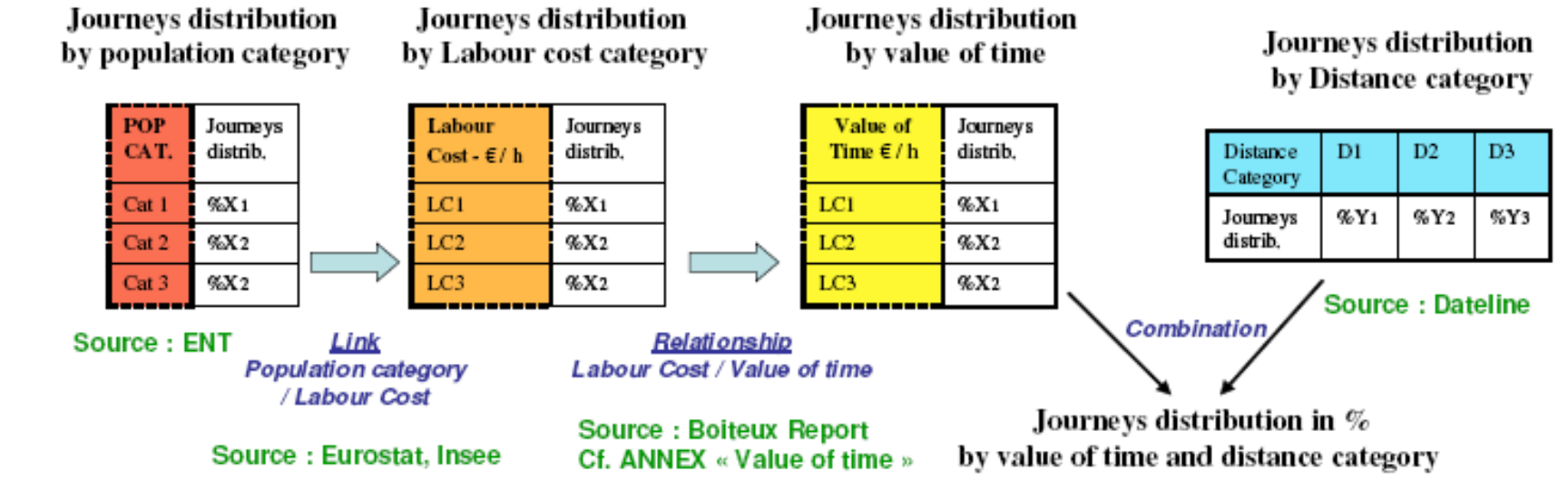
The **passenger-km distribution versus value of time and travelled distance**, for each transport mode (Aircraft / Car) is obtained as shown in Figure 3-2



EPATS
EUROPEAN PERSONAL AIR TRANSPORTATION SYSTEM

MODAL SPLIT VIA DISTANCE AND TIME VALUE

Inverse Cummulati Frequency %	Time value [Euro/h]	One way travel Great Circle Distance [km]							
		200	300	500	700	900	1100	1300	1500
80	3	Car	Car	Car	Car	Car	Car	Car	Car
60	5	Car	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1
40	8	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1
20	13	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1
10	18	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1
5	22	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1
1	33	Car	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1
0,1	64	ACP-1	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1
0,01	80	ACP-1	ACP-1	ACP-1	ACP-1	ACJ-1	ACJ-1	ACJ-1	ACJ-1

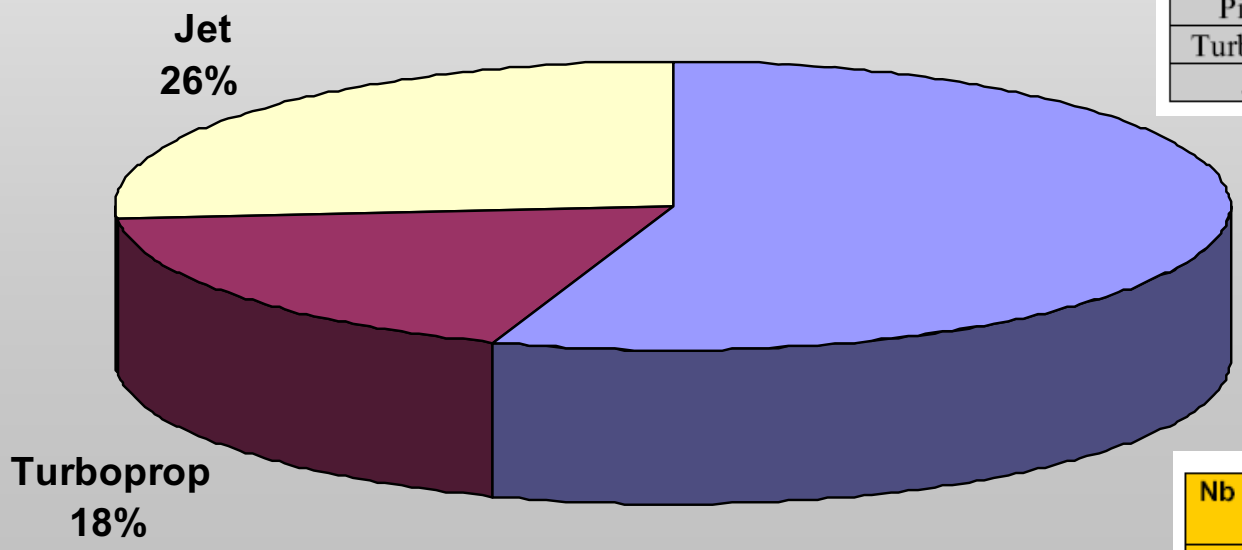
Car	Car, Average travel speed = 80 km/h, Operating Costs = 0,5 E/km
ACP-1	4 seat Piston Aircraft, Vcr = 320 km/h, Operating Costs = 350 E/h
ACJ-1	5 seats Jet Aircraft, Vcr = 700 km/h, Operating Costs = 1050 E/h

The demand

We only considered twin engined aircraft for the EPATS travel. These would be fully IFR equipped. We assumed a 70% load factor and single pilot operations.

EPATS calculated that between 90.000 and 99.000 aircraft would be needed to carry 320 million business passengers and enable 44 million flights, given the distances between the city pairs selected and the range of the different aircraft types. The split between the different aircraft categories is shown below

Aircraft types	CASE A	CASE B
Piston aircraft	200km-250km	200km-250km
Turboprop aircraft	200km-800km	200km-1000km
Jet aircraft	800km-2500km	1000km-2500km

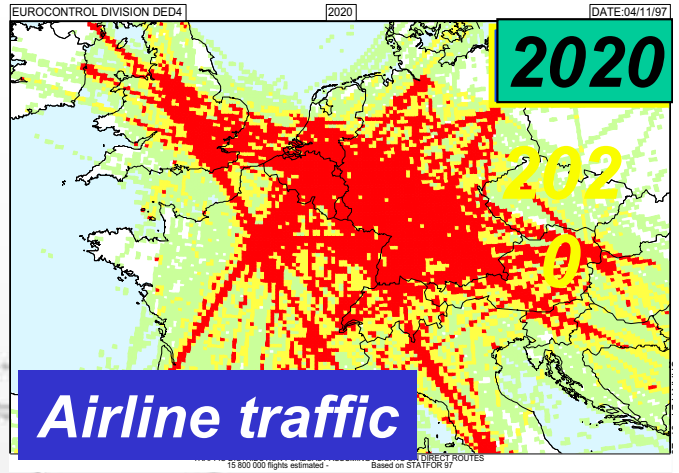


Nb of flights per aircraft type (Partial scenario)	CASE A	CASE B
ACP-2	22 910 747	22 910 747
ACT-2	14 990 357	16 313 325
ACJ-2	6 277 927	3 700 219
Total	**44 179 030**	**42 924 291**

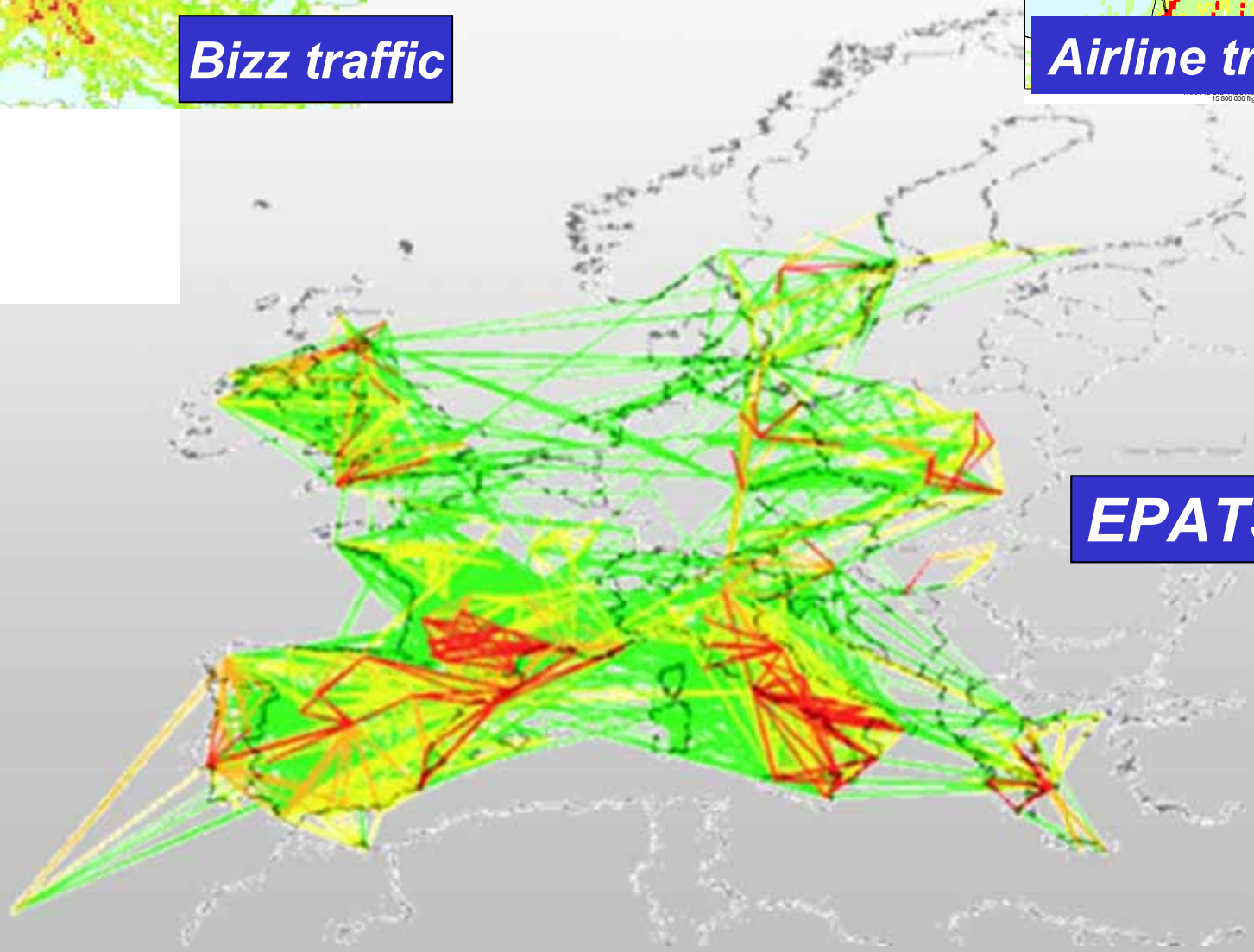
EPATS
EUROPEAN PERSONAL AIR TRANSPORTATION SYSTEM

Where they fly

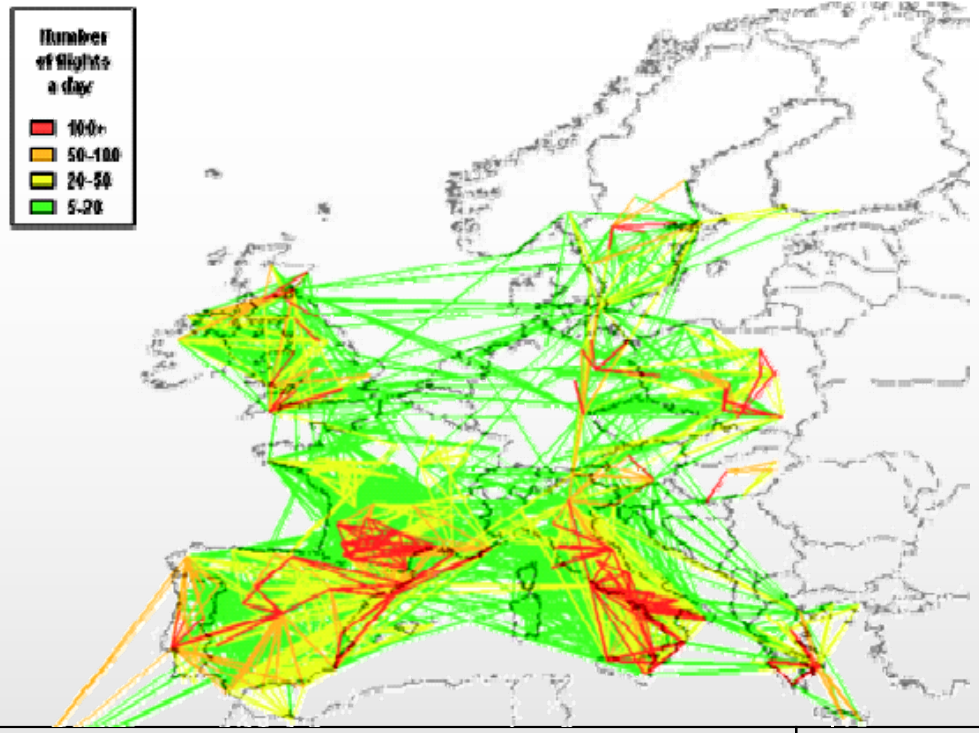
Bizz traffic



Airline traffic



EPATS traffic



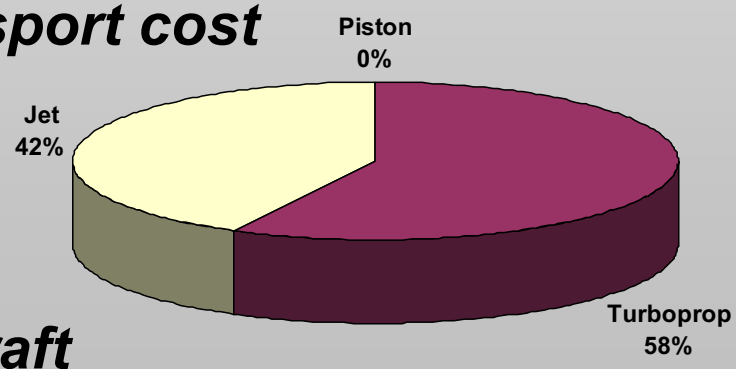
Validation

EPATS traffic and fleet in France	EPATS traffic and fleet in Poland
302 French domestic EPATS connections	70 Polish domestic EPATS connections
Estimated Traffic: 15 billion Passenger-Km 36 million passengers 4.7 million flights	Estimated Traffic: 8 billion Passenger-Km 28 million passengers 4 million flights
8400 personal aircraft: 71% piston 23% turboprop 6% jet	7000 personal aircraft: 87% piston 13% turboprop 0% jet

Sensitivity analysis

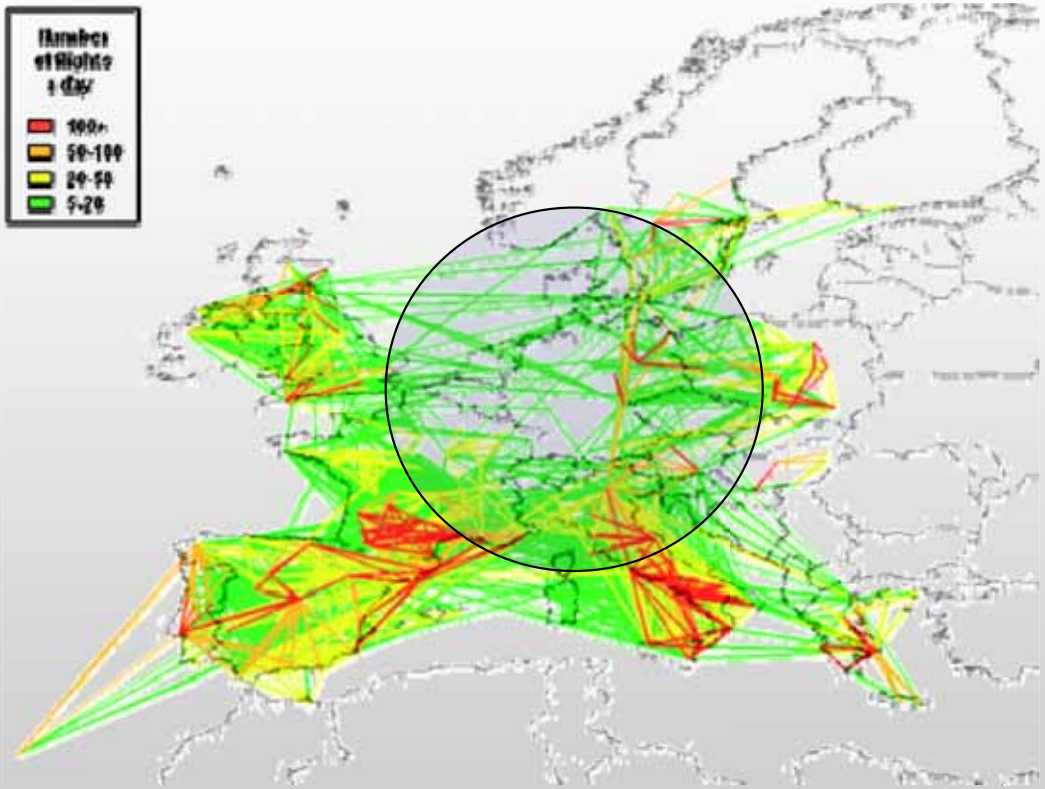
- ***Sensitivity analysis***
  - ***Operating cost may increase in the future:***
    - ***Strong fuel price increase***
    - ***New environmental taxes***
    - ***New avionics in aircraft to be compliant with SESAR***
    - ***Etc.***

- ***An increase of 30% in the personal air transport cost would lead to:***
  - ***40% traffic decrease: 191 million Pax***
  - ***65% flight decrease: 15 million flights***
  - ***72% fleet decrease: 25 500 personal aircraft***

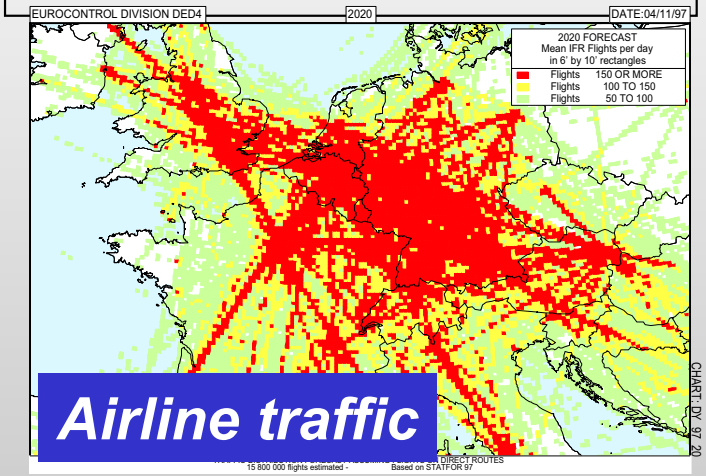


ATM impact assessment EPATS traffic integration

ATM



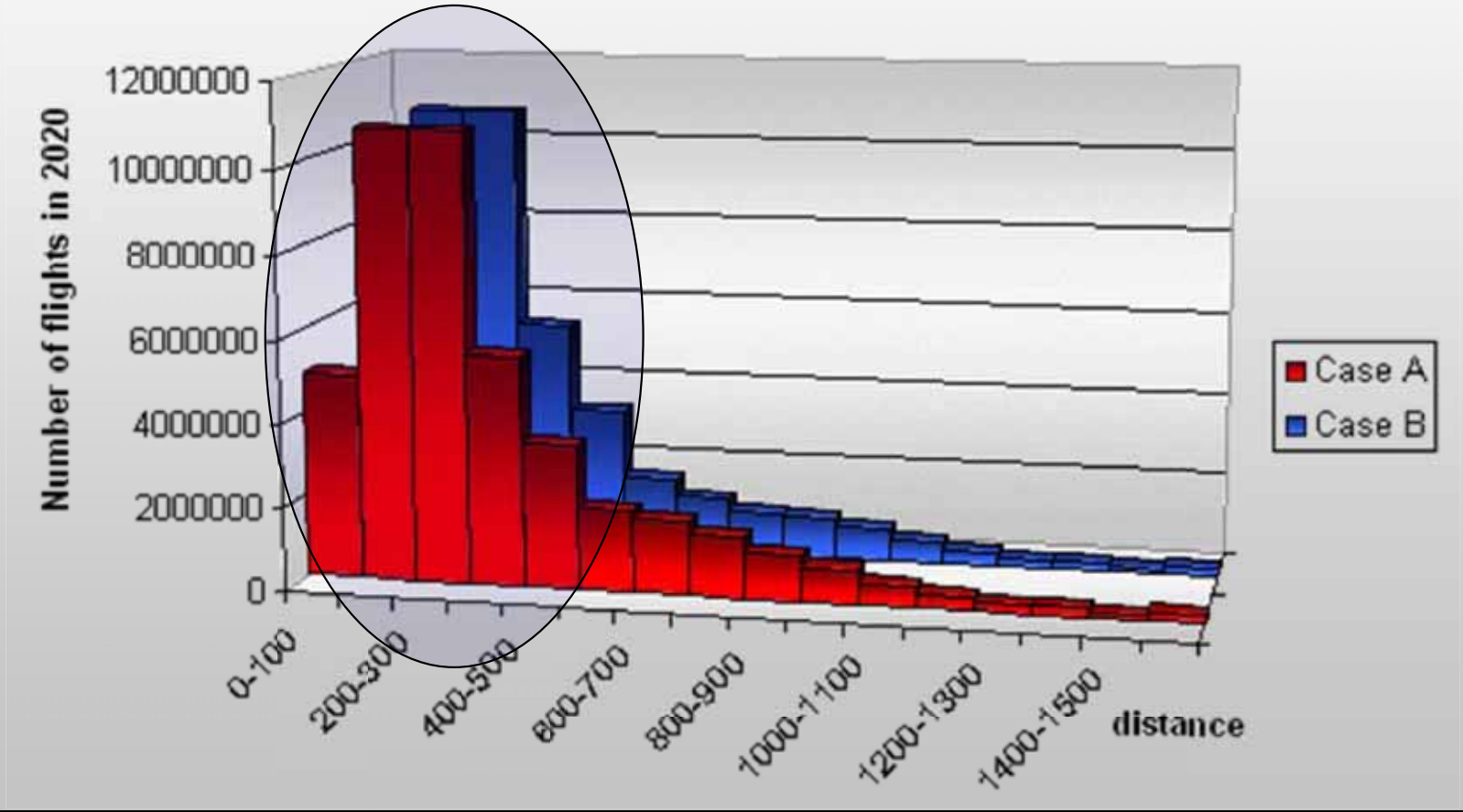
EPATS seems to be avoiding the current ECAC Core Area



EPATS may be creating new dense/congested area and airports (mainly south of Europe but also England)

Will impact the TMA, mixed traffic (traditional ones + EPATS (IFR & VFR)

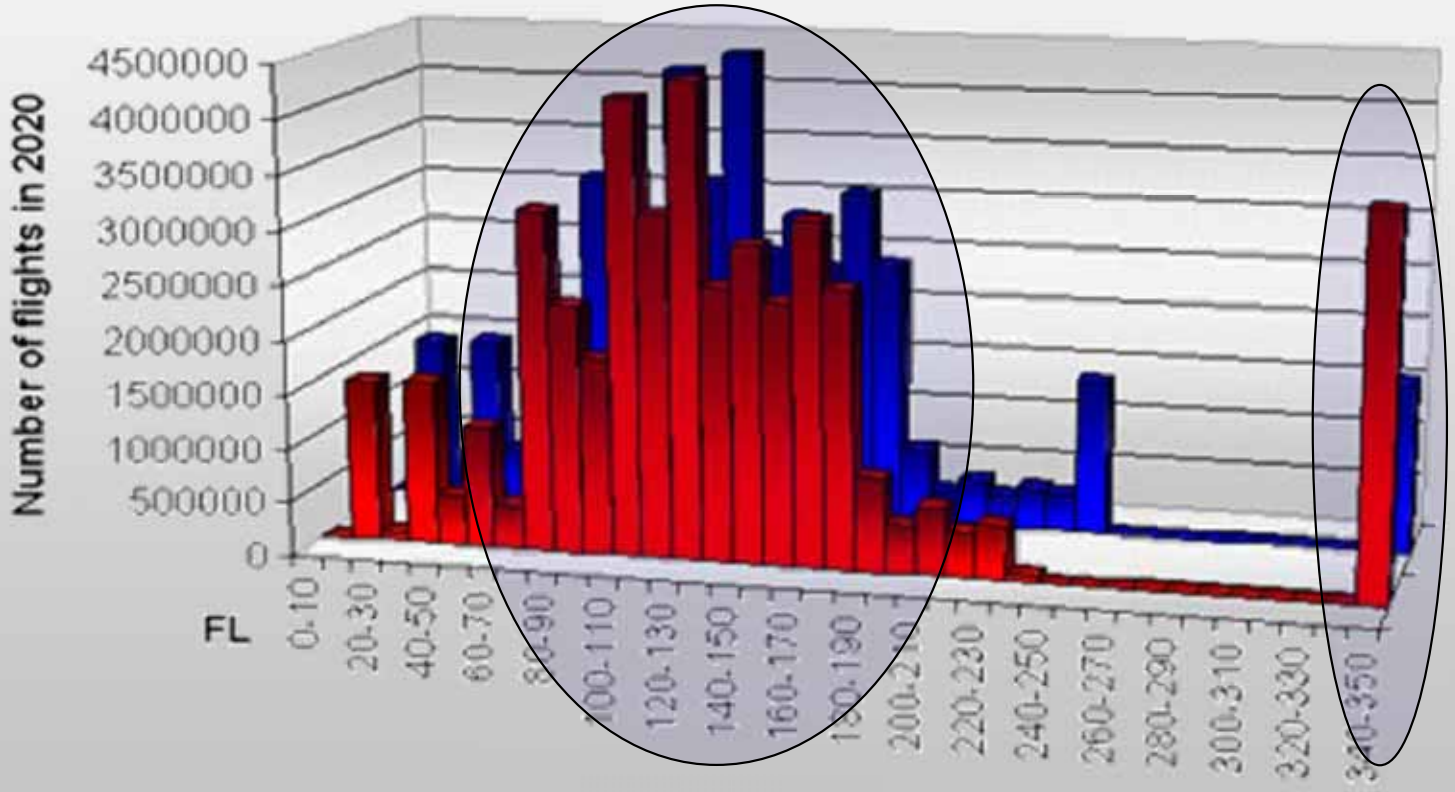
EPATS traffic distance distribution



Most of EPATS travel seems to be between 200 and 500 Kms

ATM impact assessment
EPATS traffic integration

EPATS cruising Flight Level distribution (standard distribution, not integrating ATM constraints)



Most of EPATS flying below FL190

System capacity (severe challenge for SESAR) to handle millions of additional EPATS IFR flights. SESAR Business Trajectory management for EPATS flight (IFR and VFR)?

EPATS R&D needs:

- **Single piloting** in un-managed and managed airspace (Safety - separation management and conflict avoidance - autonomous EPATS flight – Air Traffic Controller impact)
- **EPATS cockpit equipment** for supporting SESAR standard requirements
- **TMA operation** mixing EPATS and traditional flights
- **En-Route operation** mixing EPATS and traditional flights (Aircraft performances, managed airspace, Routing, separation management)

Environment and safety

The assumed 40 Million flights annually by EPATS aircraft would mean between 50 to 60 daily landings and take-offs on average for each European airport.

However these flights will not be equally distributed over all the airports and some airports may experience an increase of more than 3 in movements.

Further analysis is needed to fully understand the impact for each European airport.

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- Many local airports are ***noise*** constraint and EPATS might become a problem quickly => Socio - economic impact
- VLJs replacing regular jets reduce the noise impact
- Single and twin piston engines and turboprops give better or comparable noise characteristics during approach (comp. to VLJ)
- Future EPATS aircraft should have **better noise characteristics** than the current generation of VLJ's and will be able to use CDA approach procedures and use noise abatement routes
- Engines should become more silent, higher efficiency, new propulsion techniques

Other technology needs

- **Gust alleviation** for small aircraft should be developed.

- **Deicing** needs attention.

- **Emissions** from jet aircraft should be lowered to the levels of modern piston and turbine engine aircraft.

- **Alternative fuels** should be investigated (Fuel cells, electric etc.)

European GA manufacturers capability

PZL Mielec

Estimation of EPATS Airplanes manufacturing potential capability

of GA manufacturers in Europe

Results of the survey: European GA manufacturers capability (annual output) is limited by EASA POA (A2).

Results of rough estimation of EPATS Airplanes manufacturing potential capability of GA manufacturers in Europe:

Maximum 5300 airplanes / year,
More realistic number 3200 airplanes / year.
More airplanes per year – more employees needed.

EPATS
EUROPEAN PERSONAL AIR TRANSPORTATION SYSTEM

On demand air taxi will require ***a new business model***

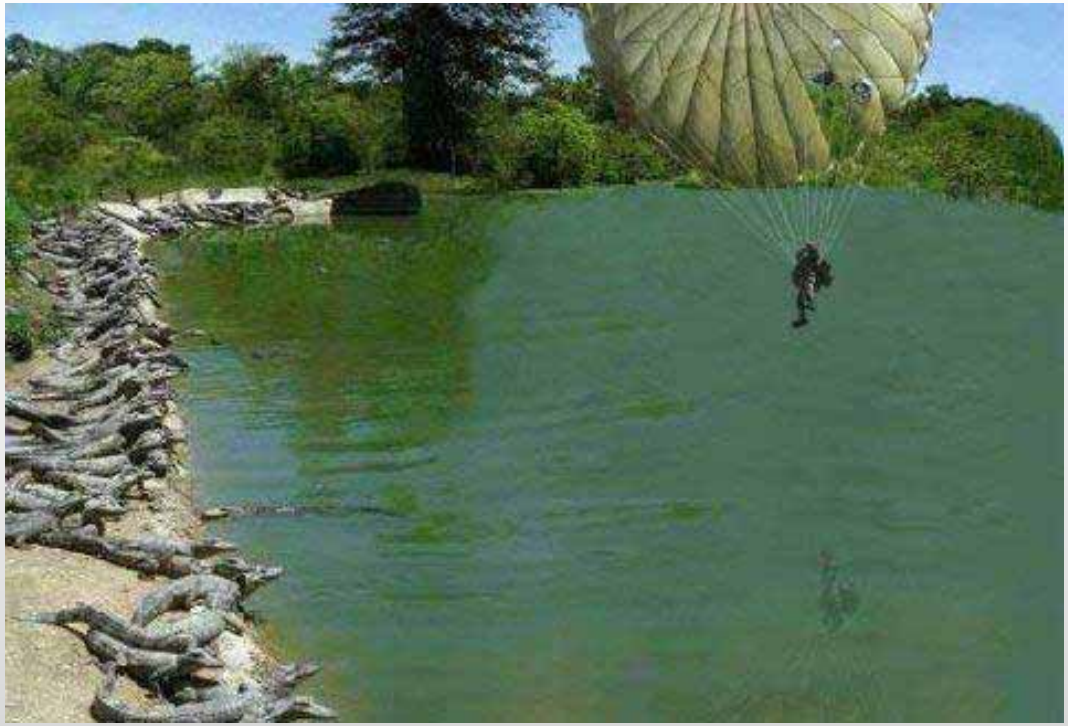
- Instant access via IT
- EPATS **transportation management** center
- On the spot **flight planning**
- **Regulatory** action
- Etc.

Experience with PATS in the US

- Several air taxi service companies were established in the USA.
- Most went **bankrupt** :
  - *Dayjet* using Eclipse (2007-2008)
  - *Point2point* using SR22 and DA42 (2005-2007)
  - *SATSair* using SR22 (2004-2009)
  - The same happened to European start-ups

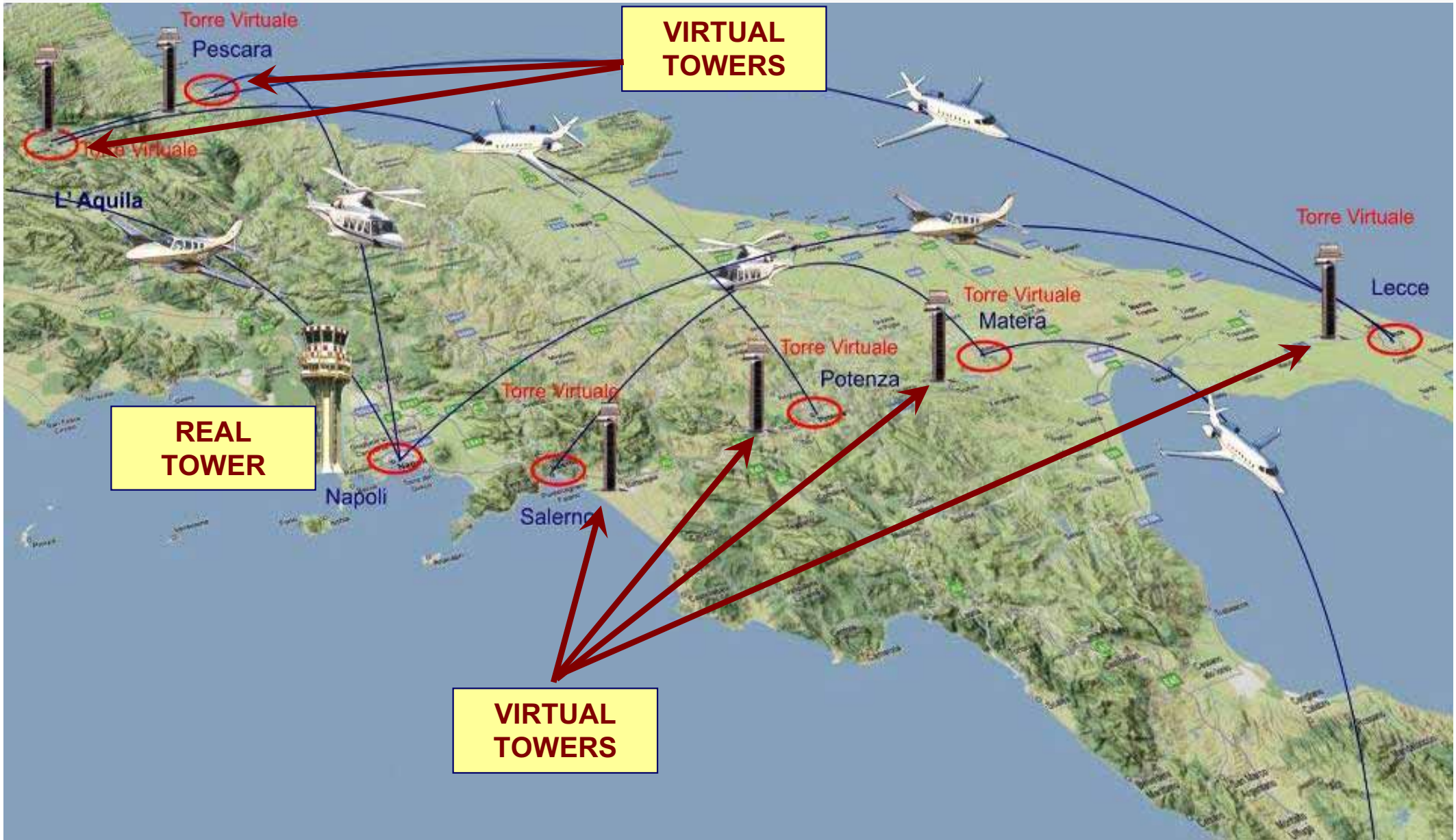
    Bankruptcy due to economic down turn, lack of money and inappropriate aircraft.

We first need an agreed vision where to go



Common Vision needed

Small Aircraft Transport System



SATroadmap priorities

- Refinement of the demand model and conclusions for SATS.
- Functional requirements for a SAT system
- The business case for SAT
- The business models
- Future aircraft concepts and certification
- A stronger industrial base for SAT aircraft production
- A RTD Roadmap for:
  - A (network centric) booking system
  - Novel aircraft technologies (configurations, engines, avionics, cabin etc.)
  - Adaptation of airports and ATM
  - Crew training

Turning SAT mode into practice

2008 Addendum to the Strategic Research Agenda

Flightpath 2050
Europe's Vision for Aviation

Report of the High Level Group on Aviation Research

Engagement

Scenario

Social Needs

Market Needs

Quality & Competitiveness

Environment & Energy Supply

ATS Efficiency

Safety

Security

SAT VISION

SAT ROADMAP

Industrial Development Master Plan

European & National R&TD

Enabling Conditions

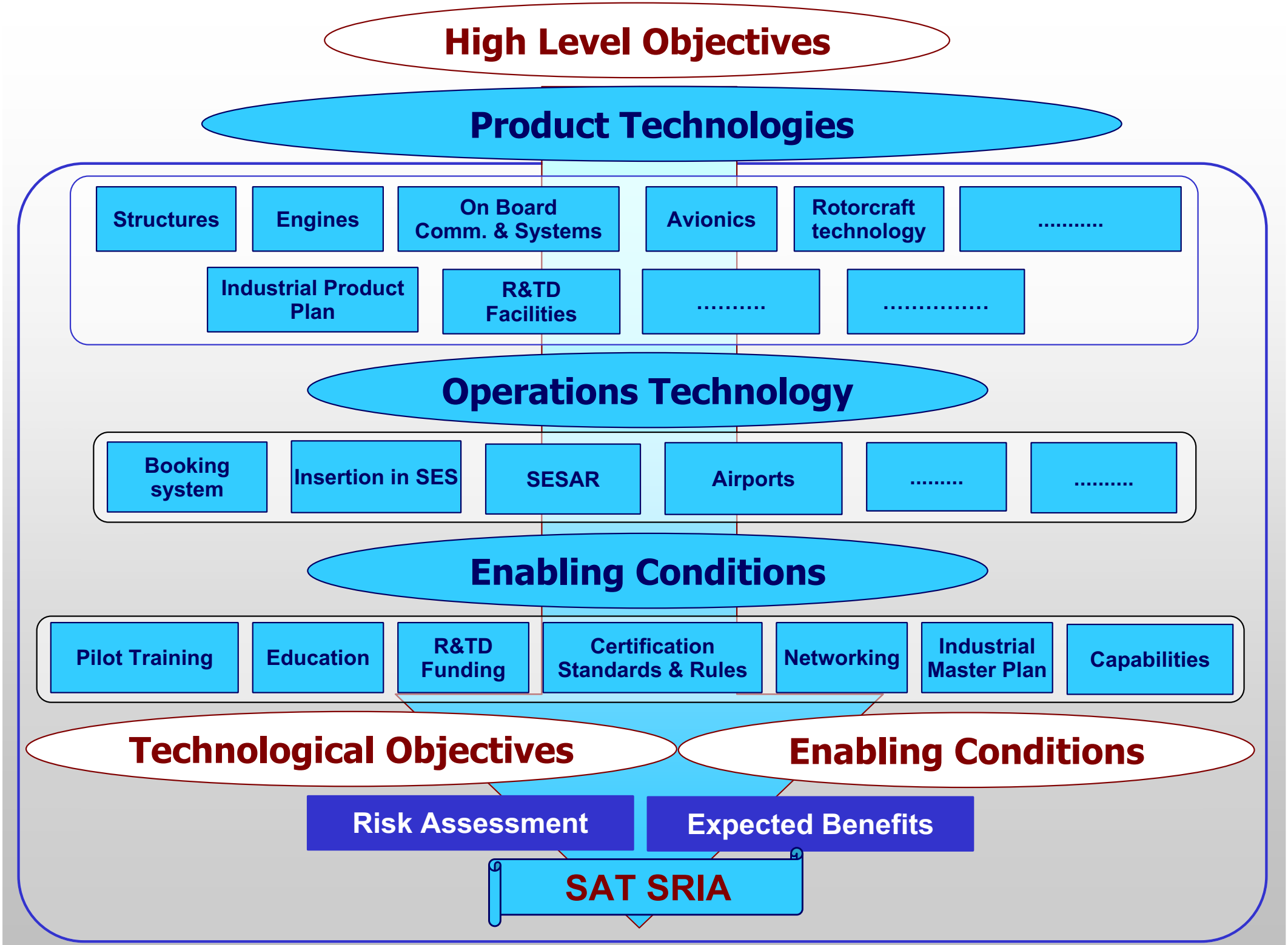
SAT SRIA

Small Air Transport Actions

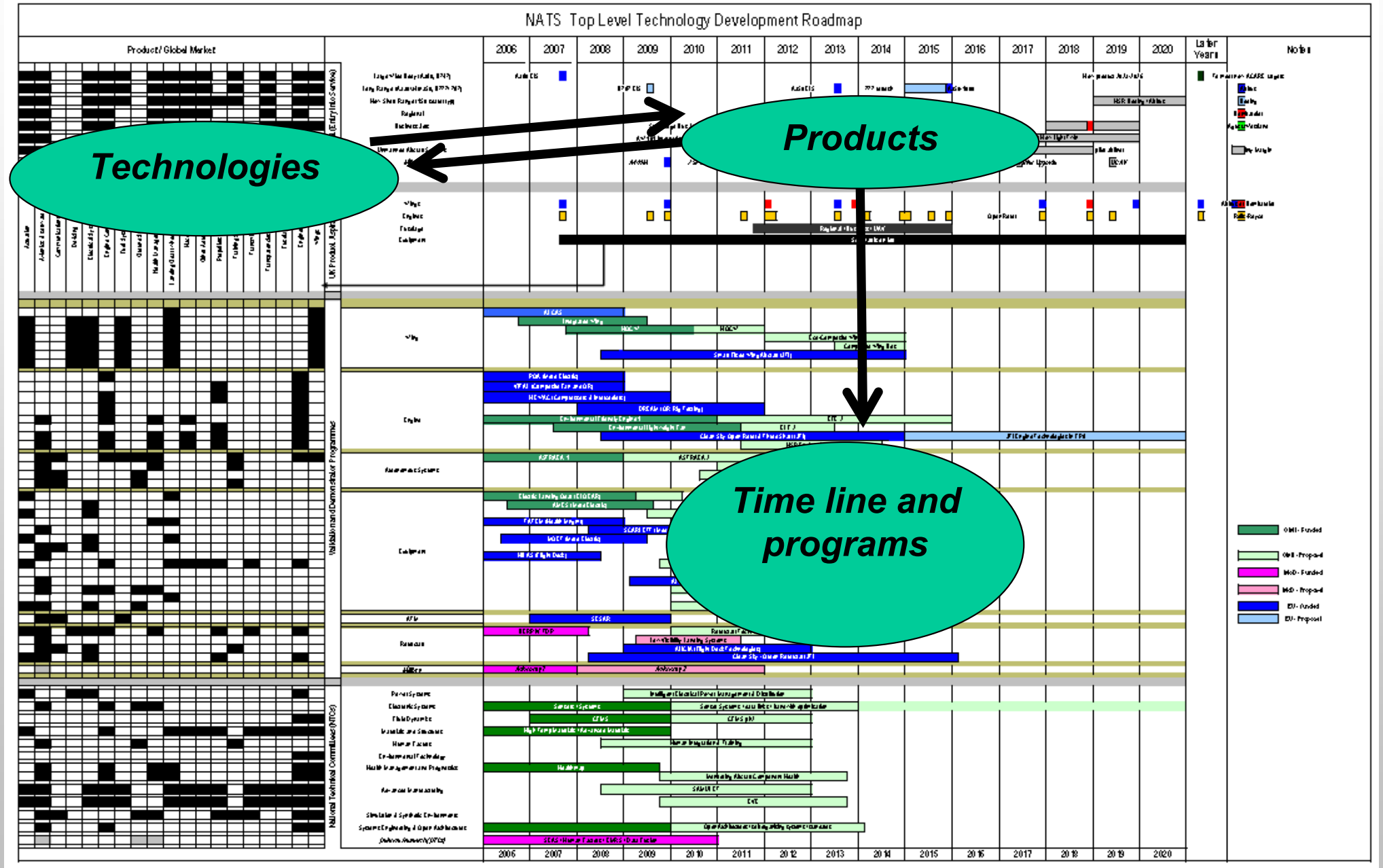
Feedback

EUROPEAN COMMISSION

ACARE


High Level Objectives
Product Technologies
Structures
Engines
On Board Comm. & Systems
Avionics
Rotorcraft technology
.....
Industrial Product Plan
R&TD Facilities
.....
.....
Operations Technology
Booking system
Insertion in SES
SESAR
Airports
.....
.....
Enabling Conditions
Pilot Training
Education
R&TD Funding
Certification Standards & Rules
Networking
Industrial Master Plan
Capabilities
Technological Objectives
Enabling Conditions
Risk Assessment
Expected Benefits
SAT SRIA

Ultimate product: Example NATS roadmap



Essential conclusions first: Vision

Question 1:

Do you agree with the following statement:

A small aircraft transportation system, based on small sized aircraft, operating on commercial scheduled or non-scheduled on demand flights from a standard airports and small airfields network, should be accepted as a component of the European (Air) transportation system

Essential conclusions first: Vision

Do you agree with the formulated goal:

The main goal of the small aircraft transportation system is to provide fast passenger transport service

- ***the needs of passengers along city pairs with low intensity traffic (also in Central Europe),***
- ***as well as the needs of remote regions with an underdeveloped transport infrastructure***
- ***for European business travel needs,***

thus enabling door to door travel between EU regions/ city pairs at a flying distance of up to 4 hours.

Essential conclusions first: Vision

Do you agree that this goal might be met by 2020 using currently existing aircraft, infrastructures and ICT mostly?

(Or to put it in an alternative way:
Do you think that aircraft, infrastructures and ICT need further development to enable a SAT system in 2020?)


Questions?