

Future Freighter Aircraft

Converted Passenger Aircraft
or
Dedicated Freighters?

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Lecture for RAeS, DGLR, VDI at HAW Hamburg
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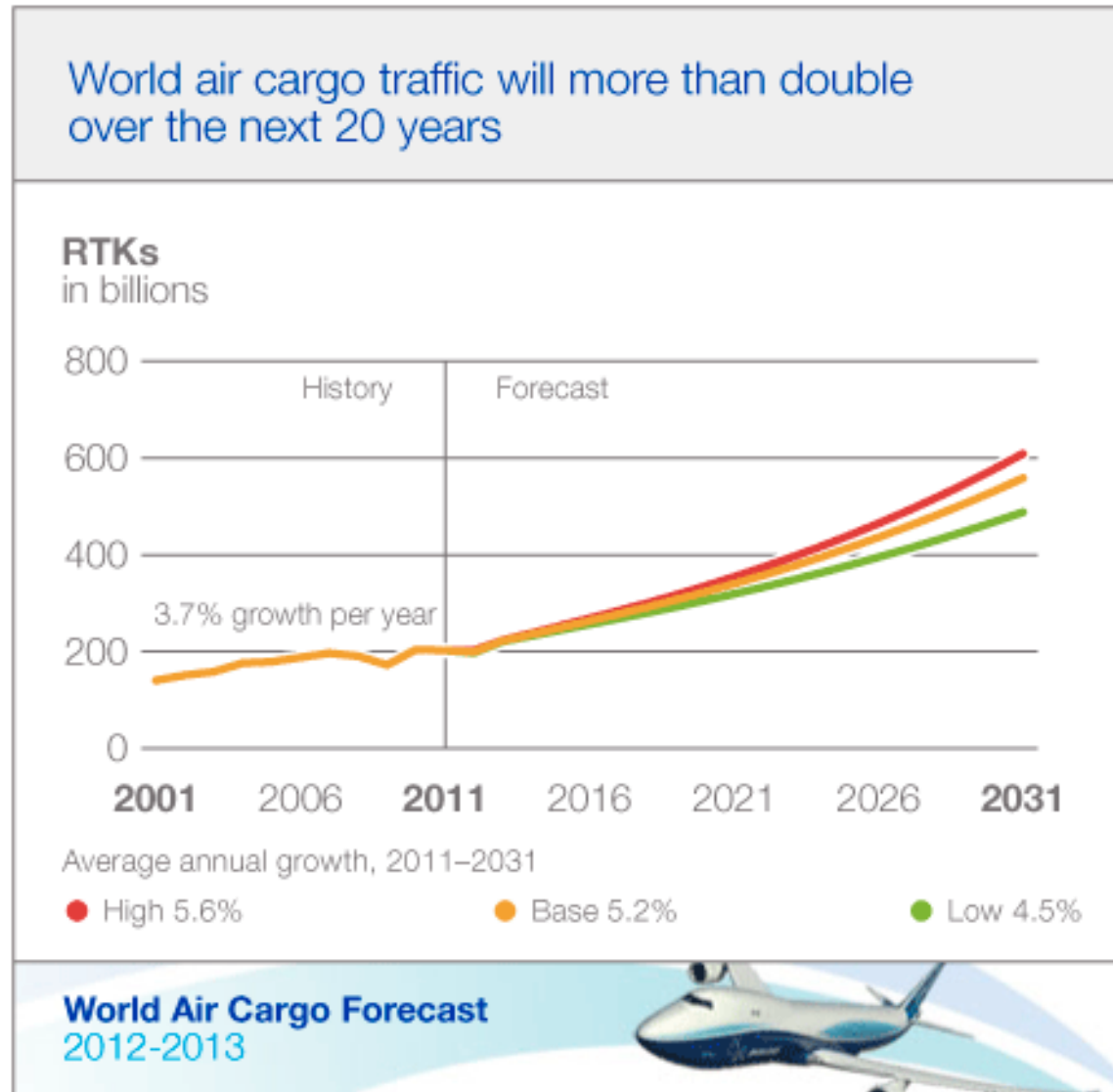


Converted Passenger Aircraft or Dedicated Freighters?

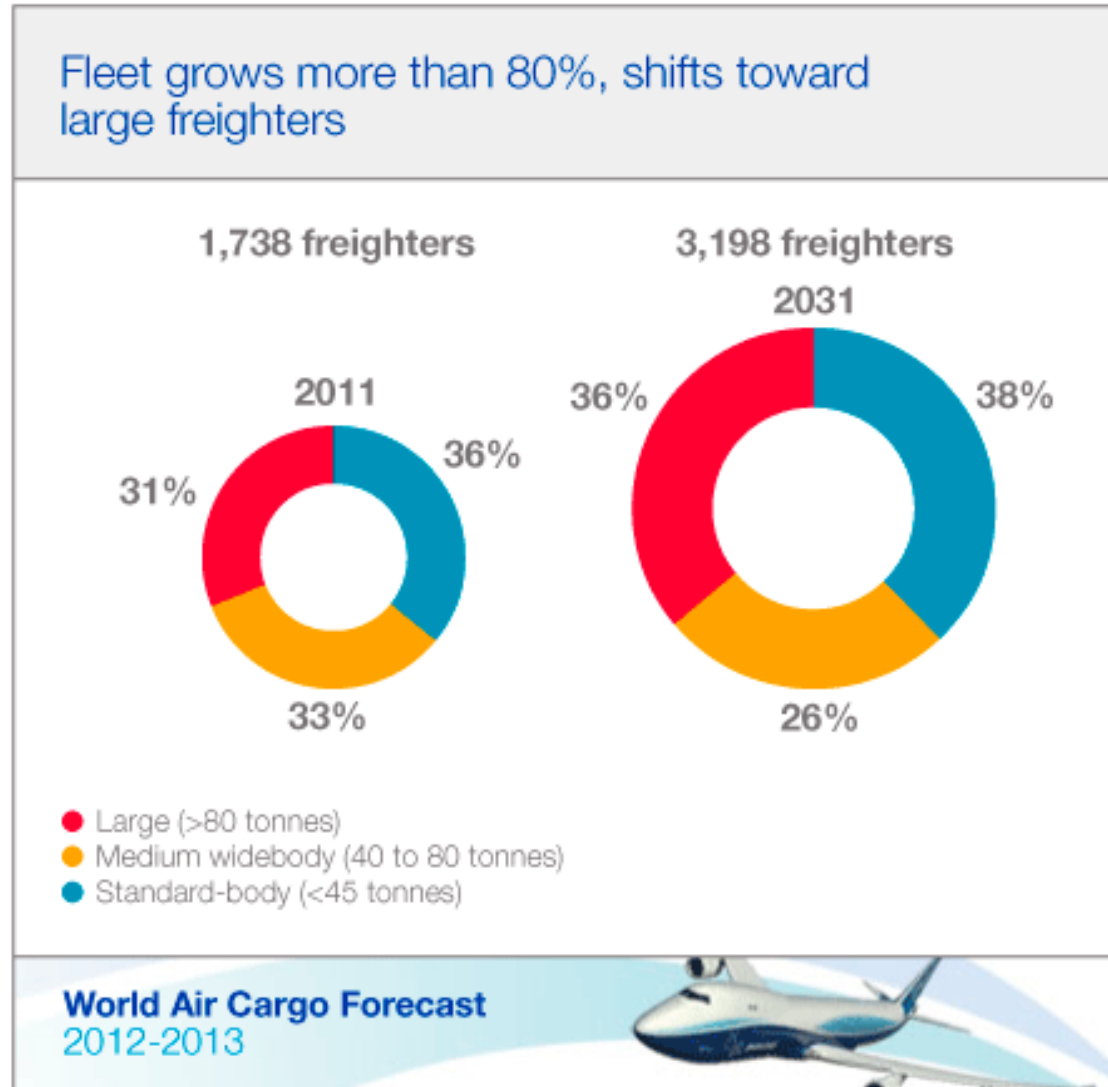
The presentation looks at the market forecast for freighters, as seen by the large A/C manufacturers. A short discussion about advantages and disadvantages for modified passenger aircraft follows. A study by three European universities was done in the year 2000 and defined a big freighter transport aircraft named „ECOLIFTER“. This Ecolifter concept was based on a set of requirements, which had been discussed with Lufthansa Cargo and some freight forwarders. Results of this study are given. Unfortunately the big industry had no interest, as the A380 F was planned, but has found no positive market interest, which was predictable! Recent studies show still an interesting niche market for a dedicated freighter aircraft, not only for very big aircraft sizes but also for small aircraft sizes.



- **Introduction**
- **World Air Cargo Market Forecast**
- **ECOLIFTER Study**
- **Lessons Learnt from the ECOLIFTER Study**
- **A380 Freighter**
- **Optimal Freighter Concepts**
- **Box Wing Studies**
- **Eastern Europe Initiative**
- **Conclusions**



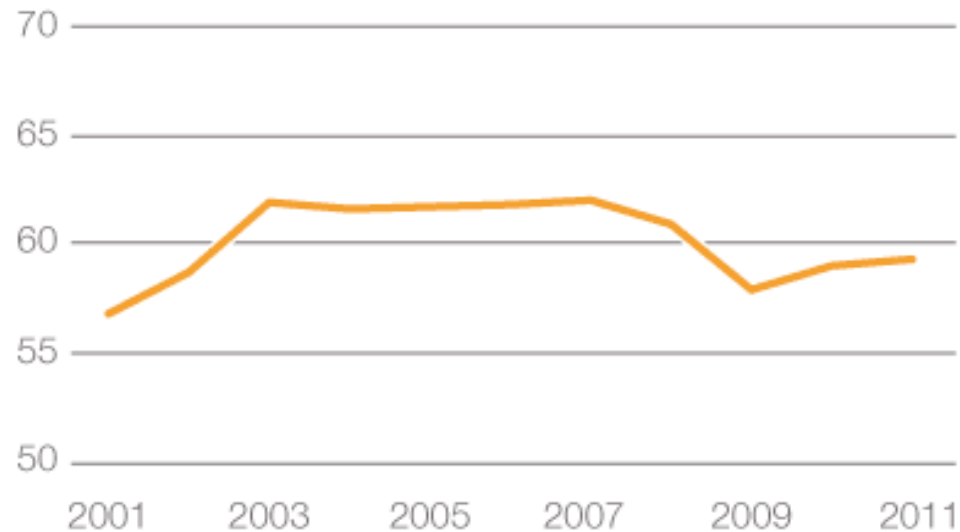
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Nearly 60% of world air cargo traffic is carried on freighters

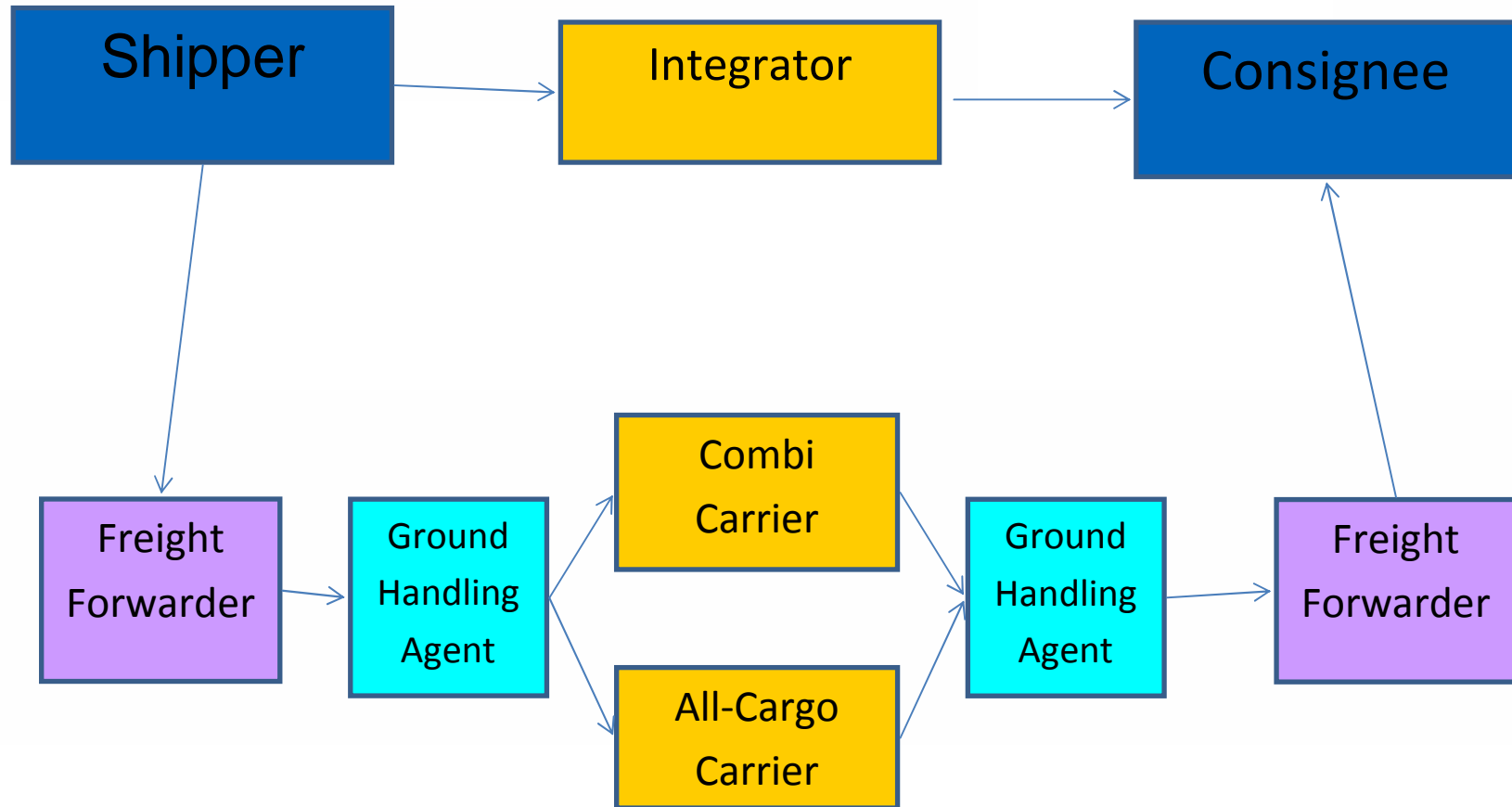
World RTKs carried on freighters, percentage



World Air Cargo Forecast
2012-2013



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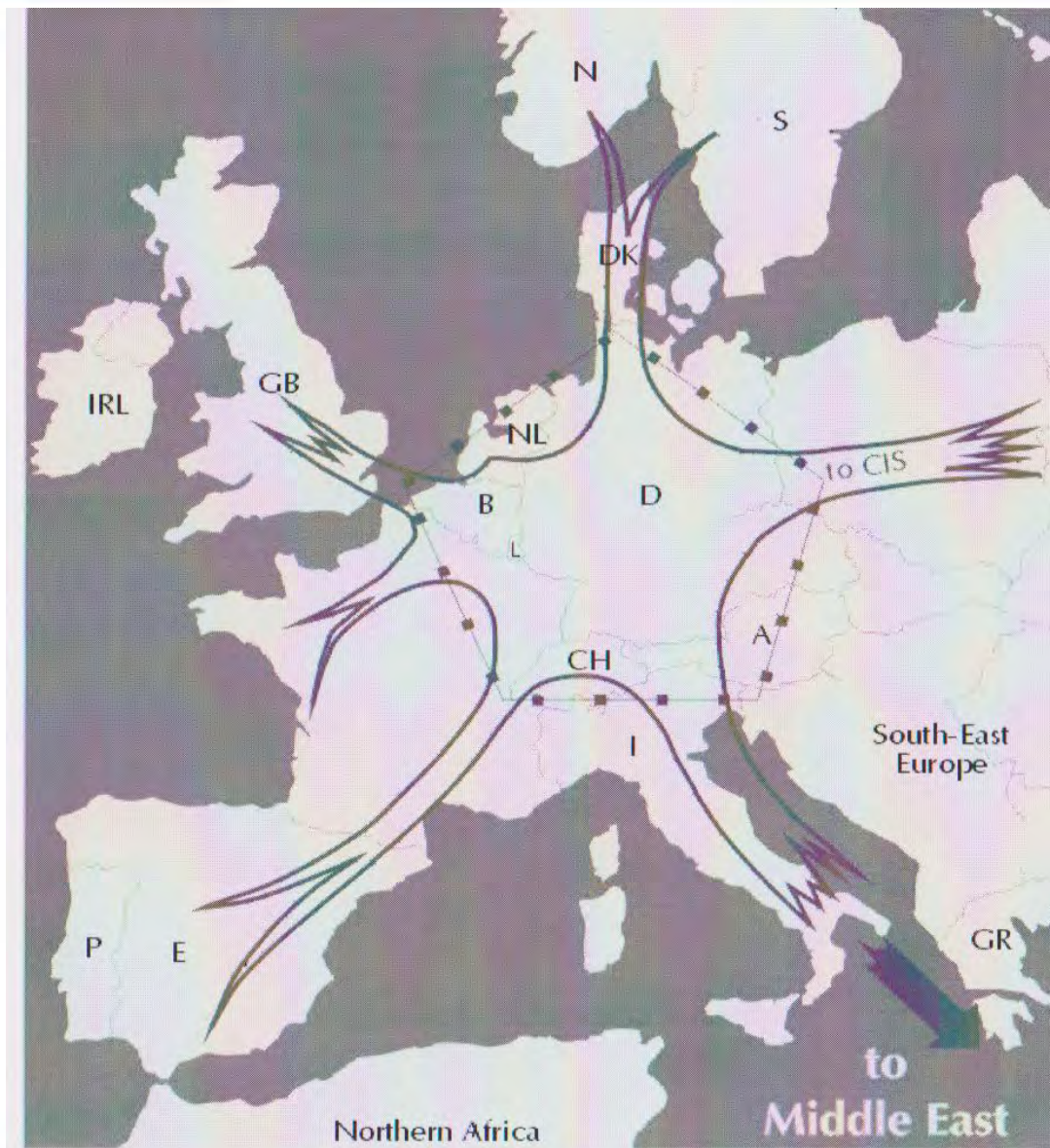


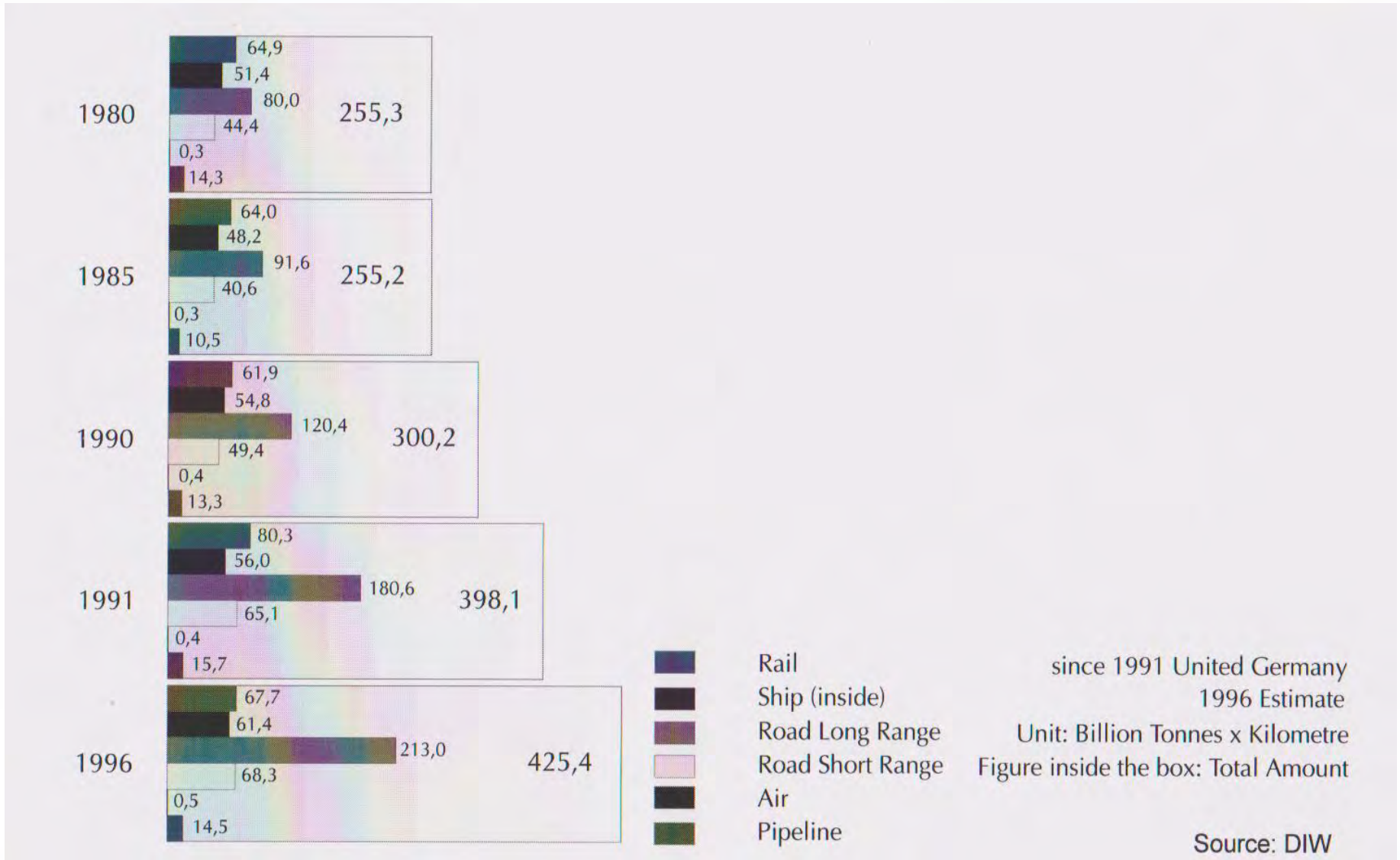
Till today the following marketing trends are visible:

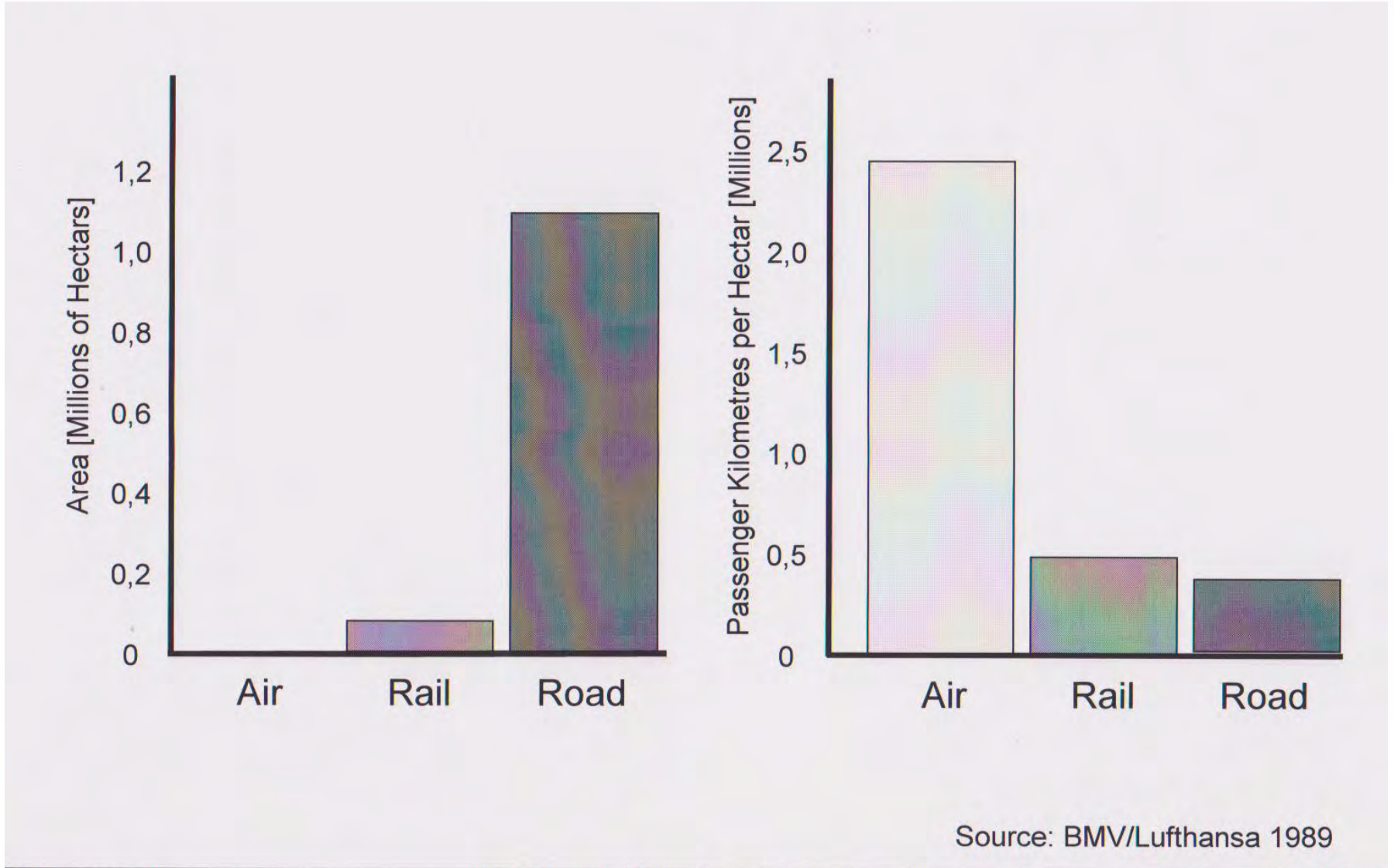
- High maximum range
- Very high cruise speed!
- $Ma \geq 0,78$ für SR; $Ma = 0.85$ für LR
- Family Concept is dominating the A/C Design
- Noise is an issue, but no design criteria for optimisation!
- Emissions are treated by economic trend to reduce fuel, but this is no specific design criteria!
- Constant evolution, no step changes in order to reduce the development risk.
- **Freighters are not worth a specific development. They are very important as a conversion from elder passenger aircraft!**

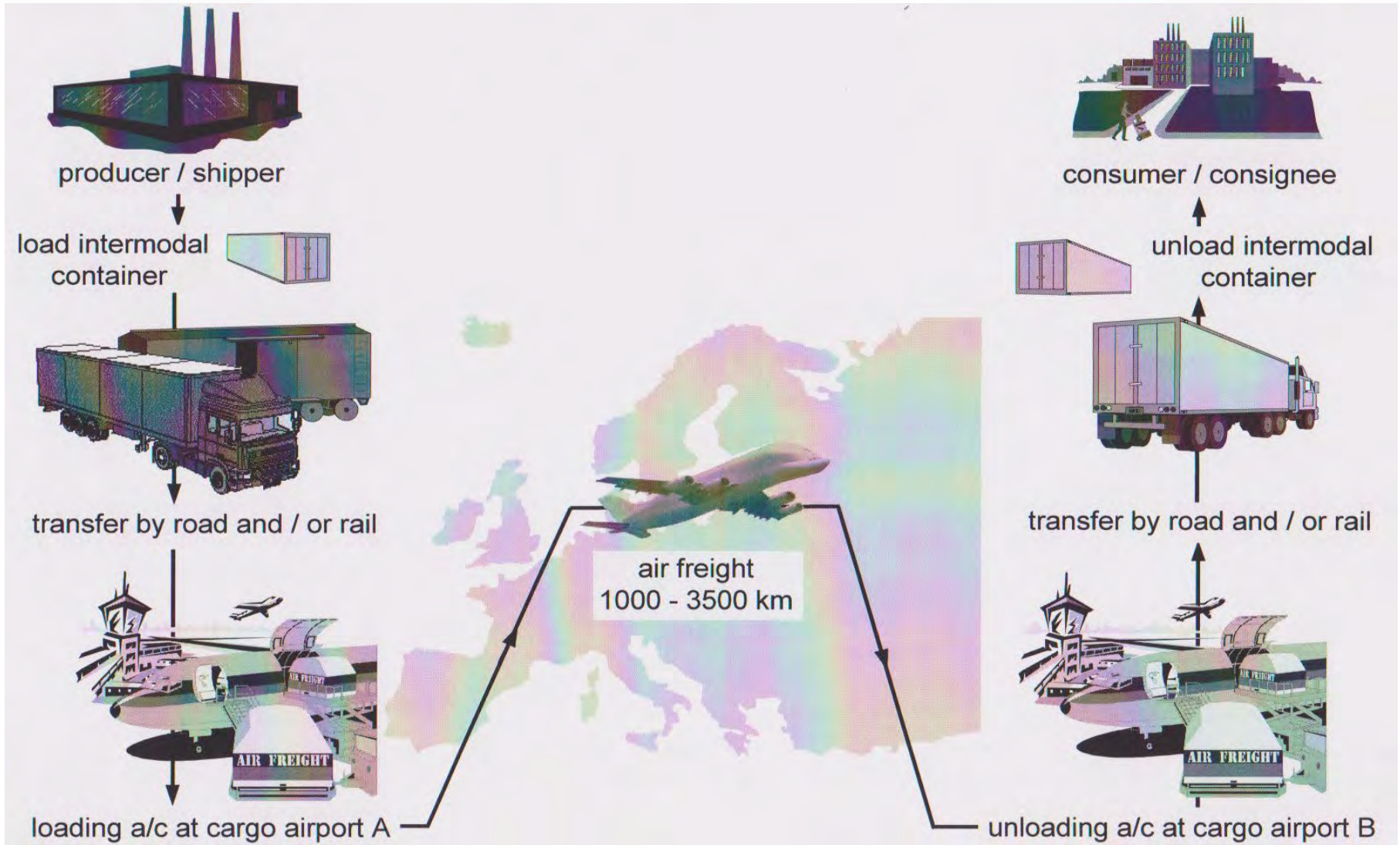


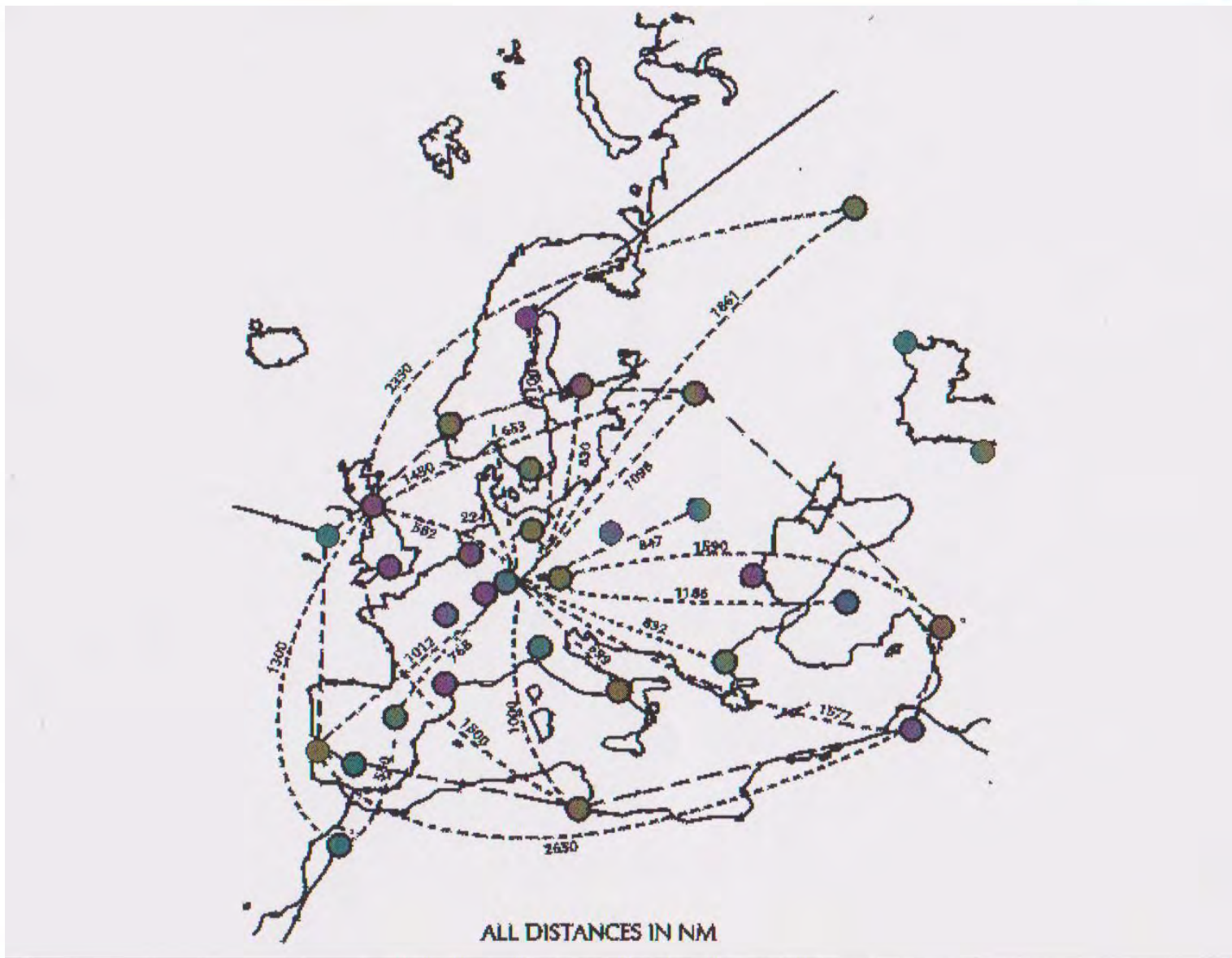
- In 1998 three Universities (Cranfield University UK; ENSAe in Toulouse and LLT in Munich) have started to develop an „Air Cargo system for Europe“, which was named „ECOLIFTER“
- Some of the outcomes of this study could be of interest for the subject, I have chosen today.









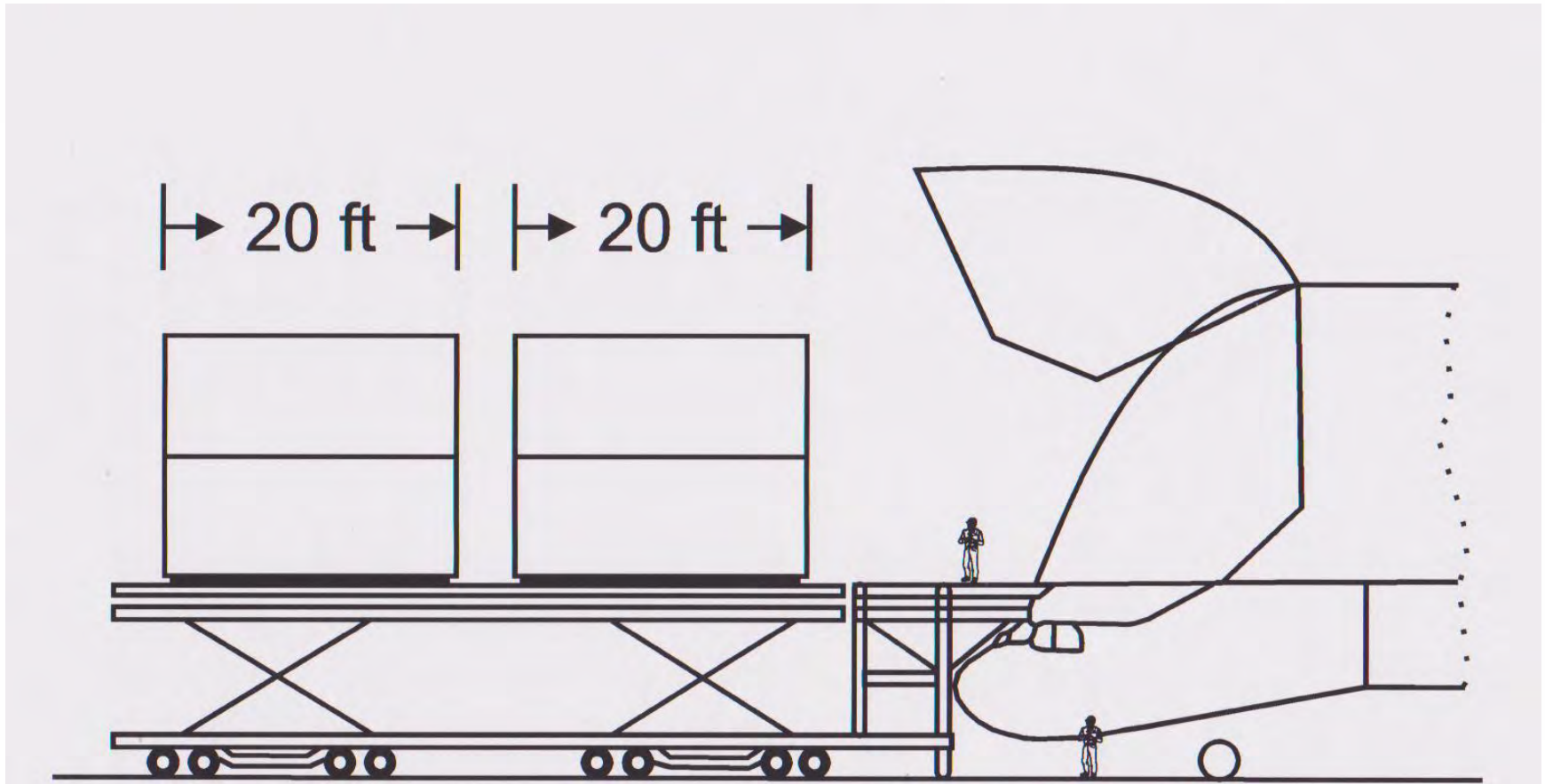


References

Chair of Aeronautical Engineering, Prof. Dr.-Ing. Dieter Schmitt

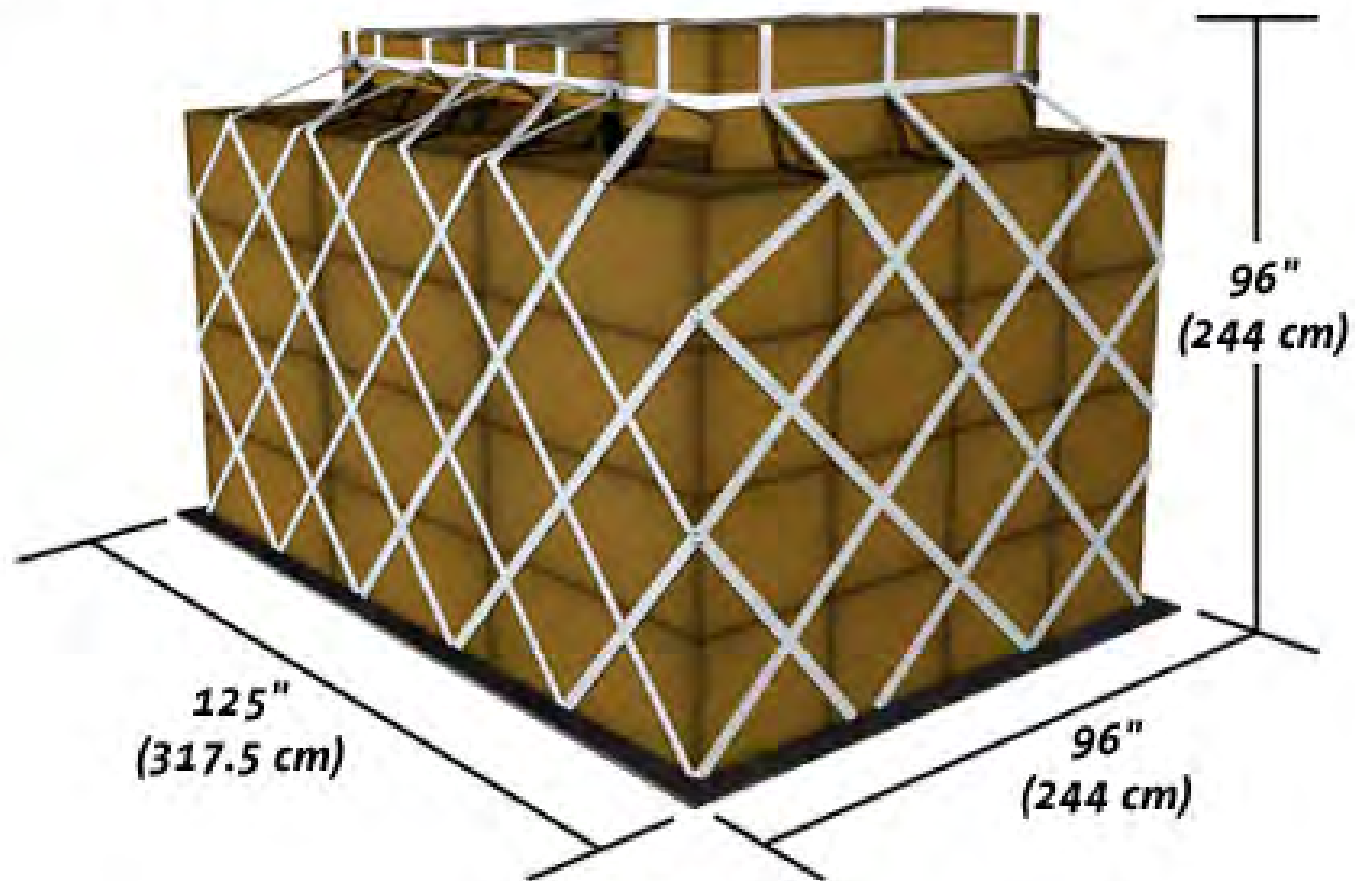
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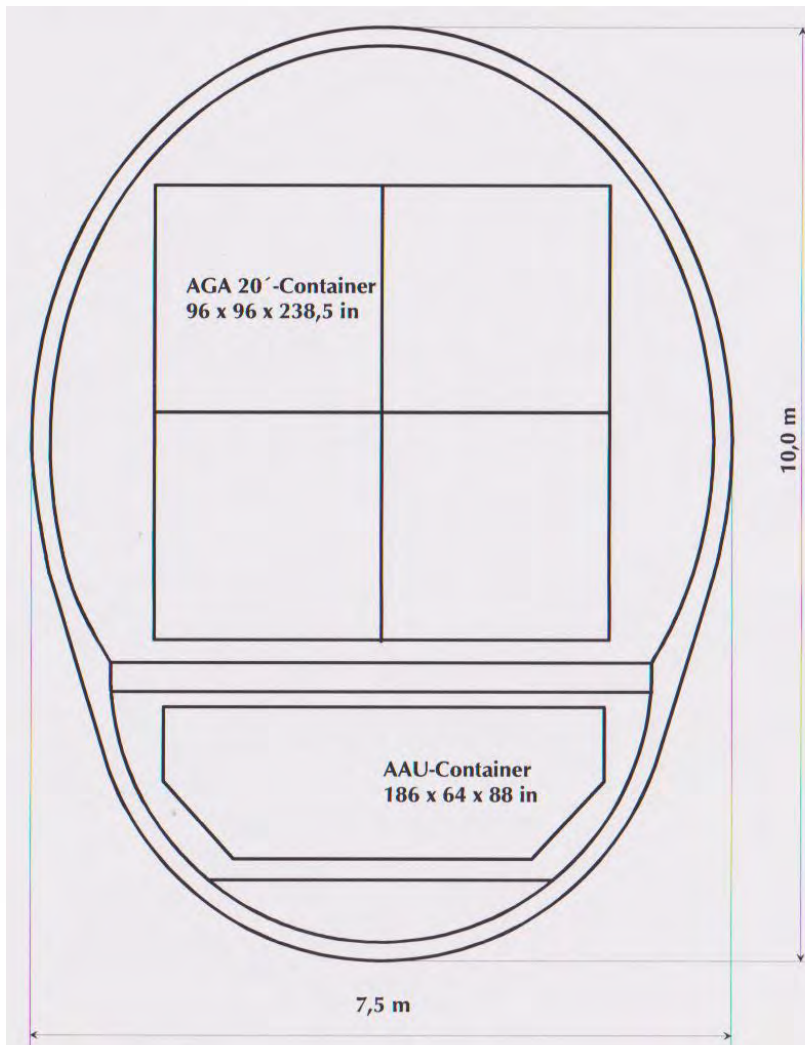


M1N PALLET

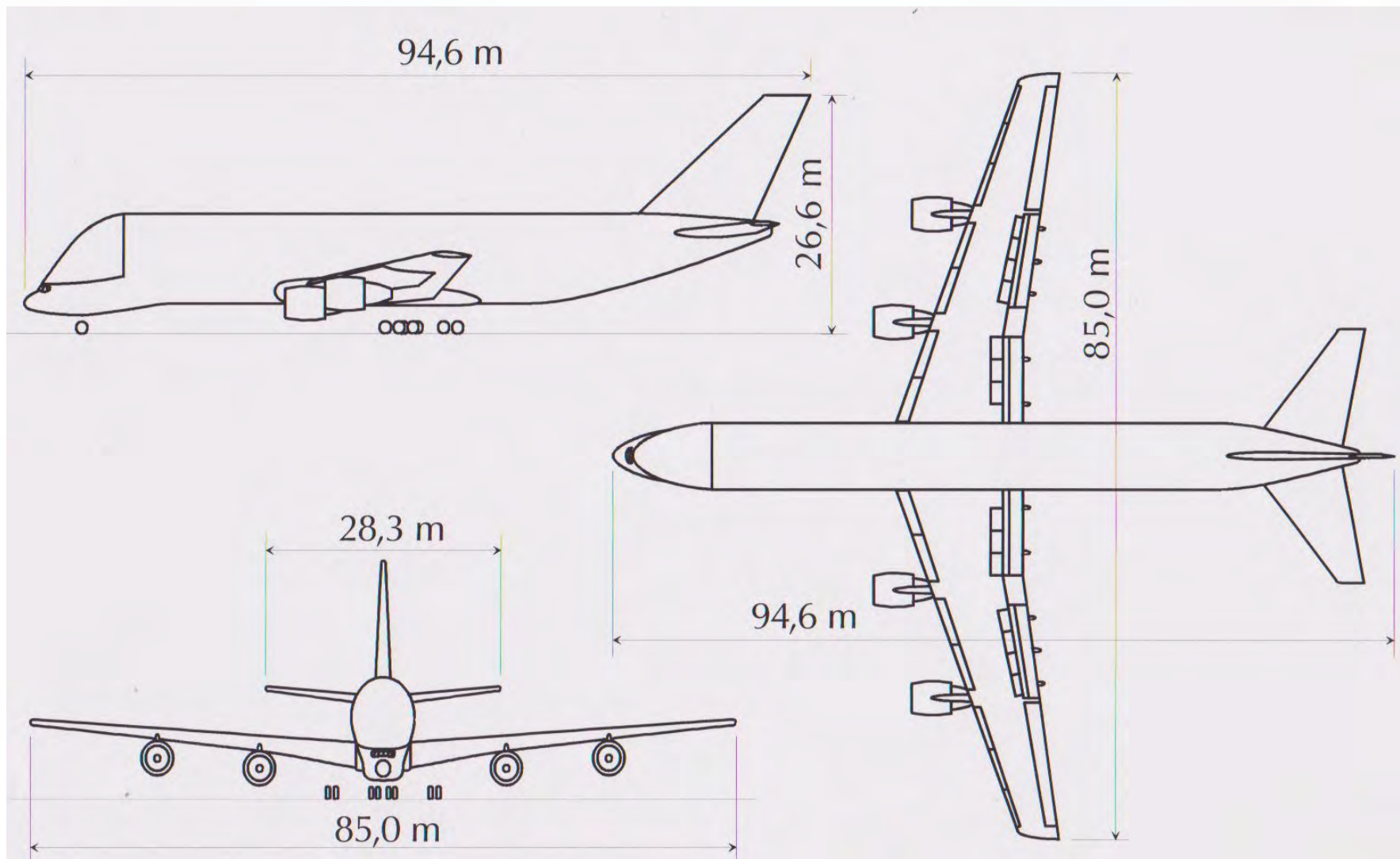


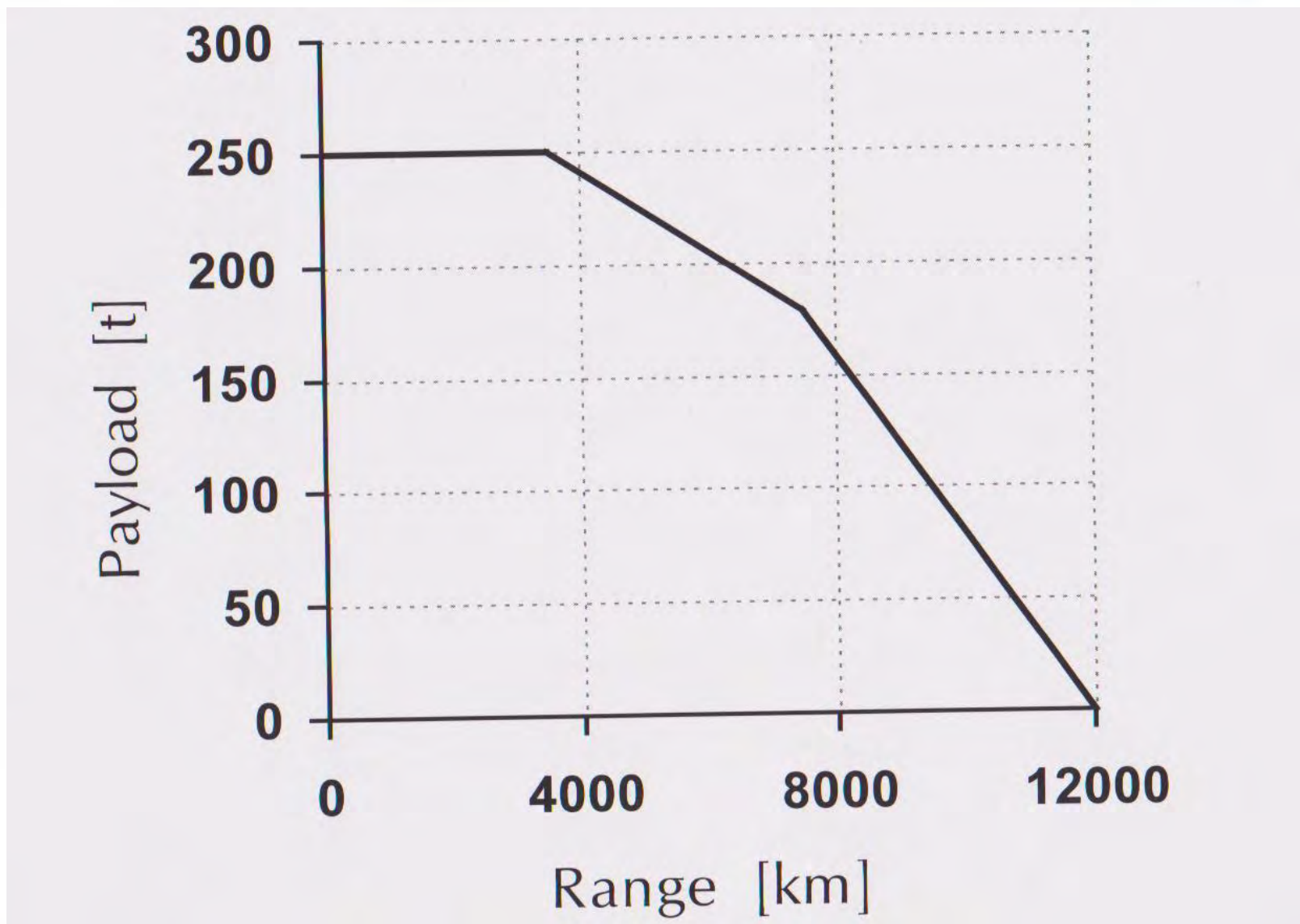
- **Cruise Speed:** $\geq M = 0,7$
- **Payload:** $\geq 250t$
- **Range:** 3500 km (Intra-Europe)
- **Airfield:** ACN < 75
- **Noise:** Reduced for 24h operations
- **Turnaround:** Quick loading / unloading; TAT < 1,5h
- **Economy:** Main driver; better than status quo!
- **Pressurisation:** Reduced / limited to cockpit section

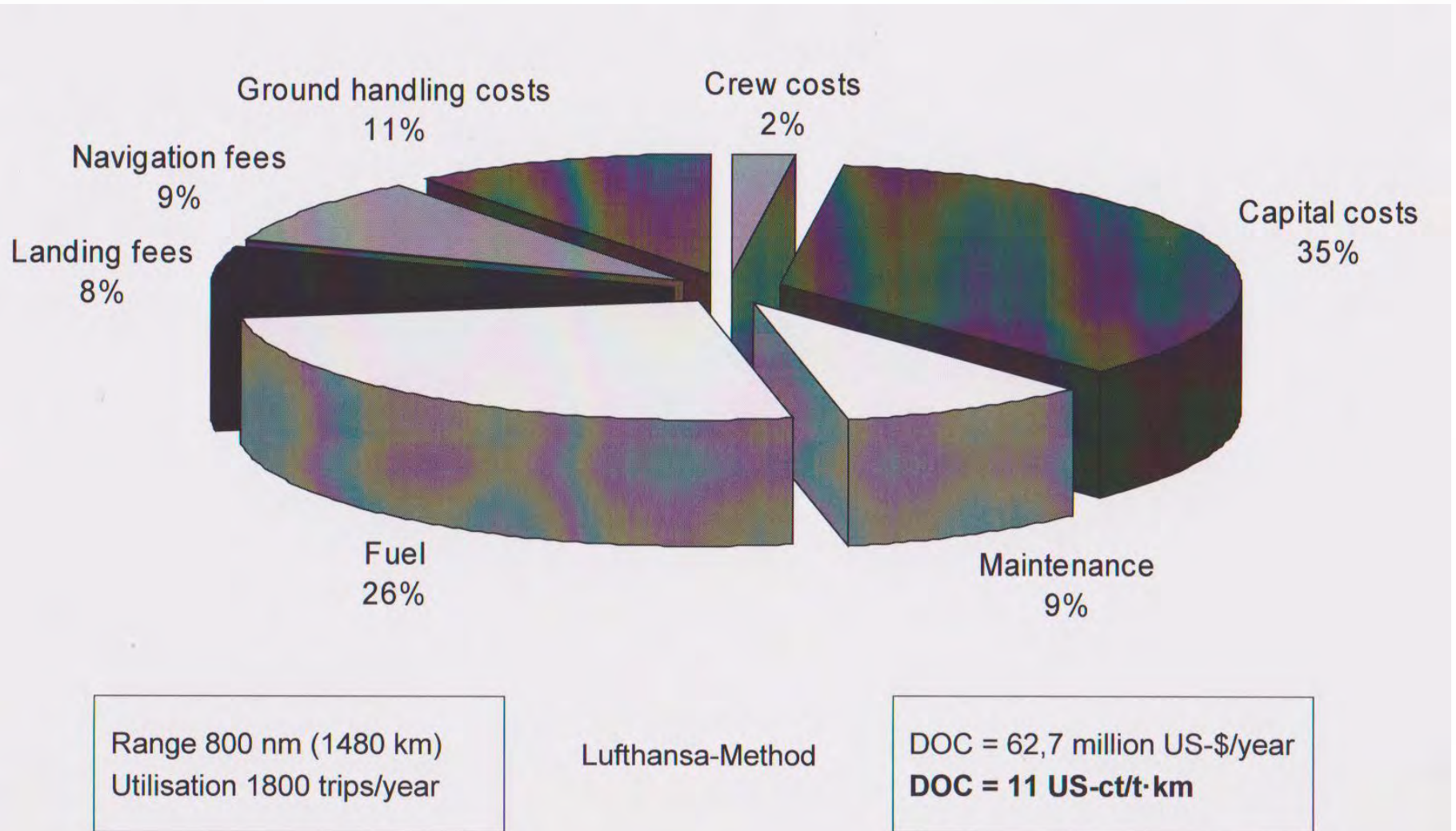
- Infrastructure
 - Dedicated Freighter Airports
 - The next airport should not be more than 200km from each major industry center
 - Ecolifter has identified in Europe ~28 old military airfield/airports, sufficient to fulfill this requirement
 - These could be transformed to freighter airports
 - In big countries like F, D, GB, E - you need max. 4 airports
 - 24h operation
 - Specific infrastructure for fast loading (nose door)
 - Turn around time: considerably less than the 3h of today



- **Cross section designed around intermodal containers (8*8*20 ft)**
- **Freight density 170 kg/m³**
- **No second cargo deck for faster turnaround**
- **Front cargo door and cockpit integration like A300-600ST Beluga**
- **Pressurised fuselage with 18000 ft pressure altitude**







- ECOLIFTER Study 1998 – 2001
 - Conclusion:
 - Cargo transport in Europe will increase considerably during the next 20 years. Political intension is to increase the cargo-rail system.
 - However, only the tunnel through the Alpes (Brenner basic tunnel) would cost 60 billion Euros! This would only solve one bottleneck for the Cargo-rail system
 - The development of an ECOLIFTER aircraft would cost 10 – 20 billion and would provide a very flexible transportation system, to be used not only for Europe. 28 airports have been considered, each only 200 km from all major economical centers.
 - No partner could be found to support the idea!

- Turn around can be improved considerably
- Needs specific equipment for airport handling
- A new aircraft (ECOLIFTER or Prandtlplane) would be ideal, but will not be available on the market
- Develop a freighter aircraft out of an A330, similar design concept like for Beluga (or A380!)
- Cockpit installation to be investigated (UAV)

- **ACARE Vision 2000 established; Update SRA2 in 2004**
- **Recent Changes have happened:**
 - New Airline Business Models ??
 - Constant Pressure on Airlines (Financial crisis ??)
 - Fuel prices ?? What will be the limit?
 - Many Airlines (esp. in USA) have financial problems:
 - Reduction/Concentration of number of Airlines/Alliances
 - Retirement of old aircraft
 - Cancellation of air routes?

A380: 21st Century Flagship

ARTS-DS

AIR FRANCE

中国南方航空(集团)公司
CHINA SOUTHERN AIRLINES (GROUP)

Emirates

الاتحاد
ETIHAD

FedEx
Federal Express

ILFC

KINGFISHER

Lufthansa



QATAR AIRWAYS القطرية



SINGAPORE AIRLINES



THAI



virgin atlantic



560t

555 seats

8000 nm

EIS 2006



590t

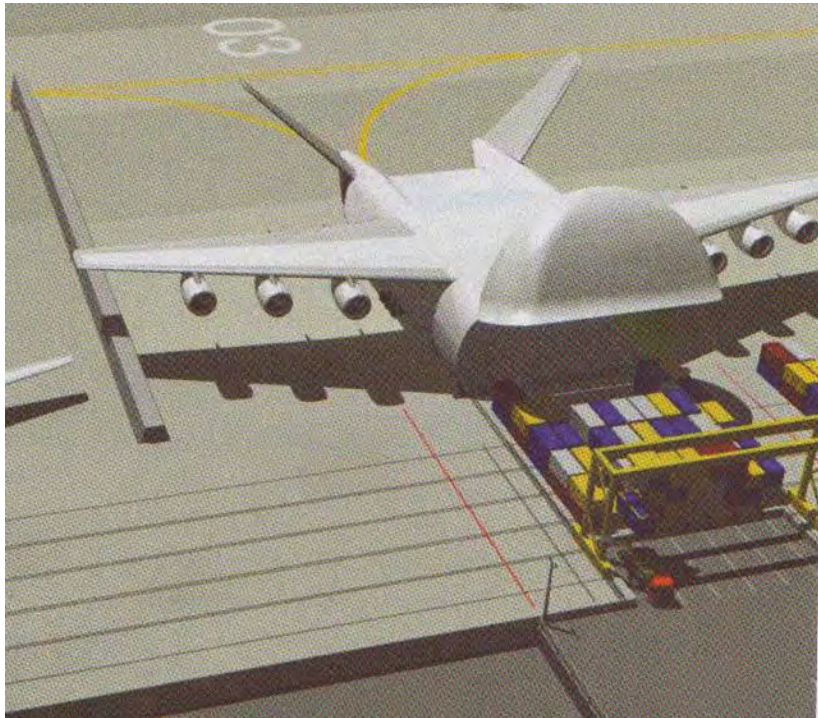
150 t

5620 nm

EIS 2008



Freighters



Prandtl's Best Wing System, analysed by Prof. A. Frediani from Univ. Pisa

Fig. 1: Lift distribution in the Prandtl's Best Wing System (BWS).

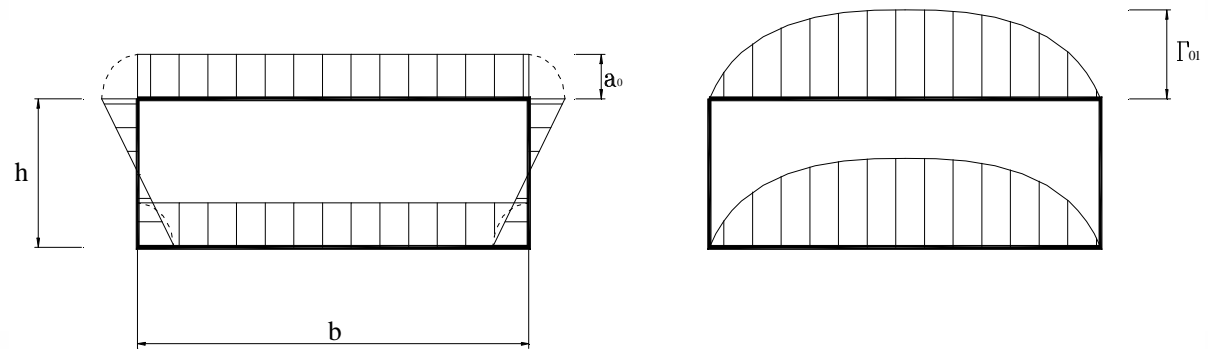
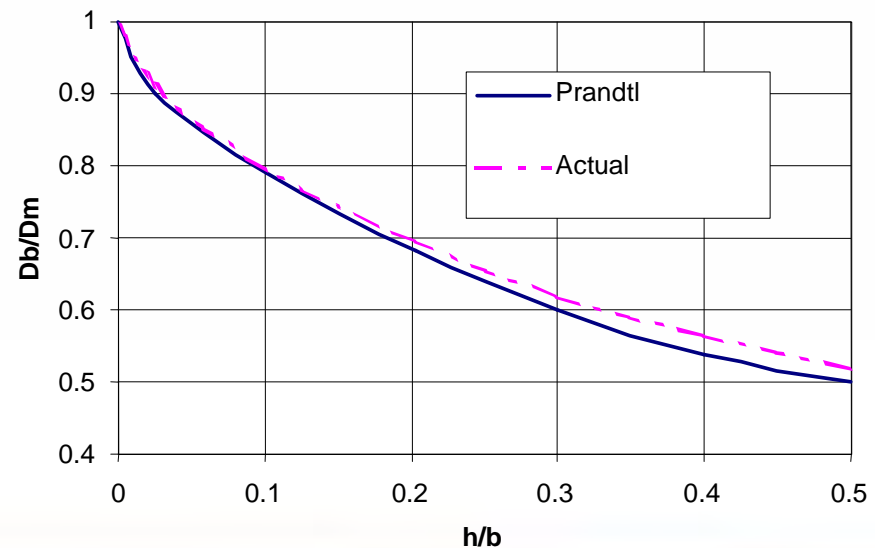
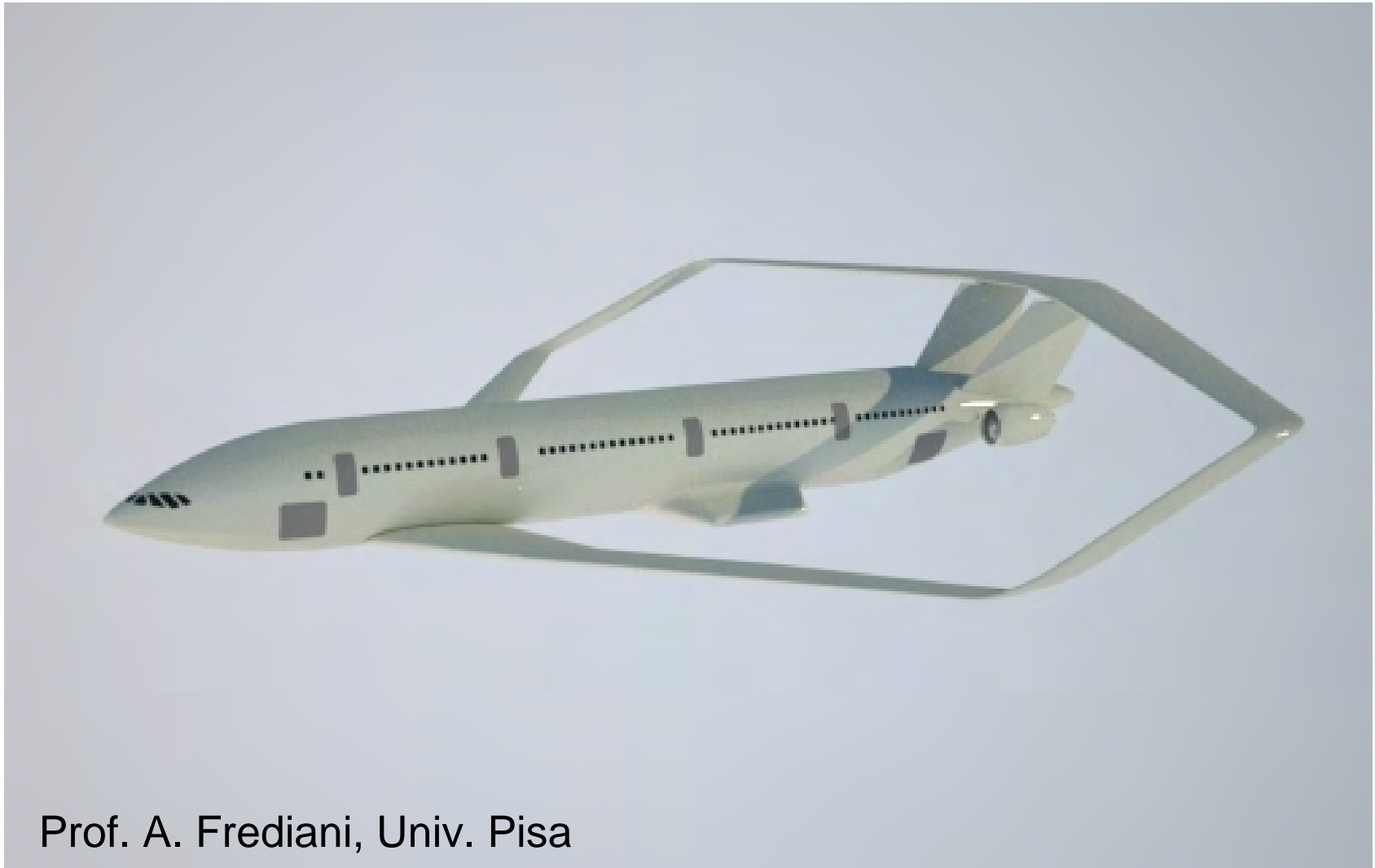


Fig. 2: Efficiency of the BWS as the non-dimensional gap increases.





Prof. A. Frediani, Univ. Pisa



Concept from ACARE - Study „Out of the Box“, Dec. 2006

- PATRIA – an EC Proposal
 - 10 European Universities have elaborated a project proposal for investigating the potential of a „Box Wing“ - configuration, amongst others TUM, VUTBR, RWTH, Pisa, Cranfield, TU Delft, Glasgow, WU etc.
 - In several work packages the main aspects of structural concept, aerodynamics, flight control, aeroelastics, performance etc. should be investigated and possible design solutions will be elaborated.
 - The results of the EC evaluation are just communicated: 12.5!
 - It is an important element, to have interesting new aircraft concept studies run by universities, as this is a major element of motivation for the education of young and talented aeronautical students.

- Transport in Europe and US
- Road is basic transport system
- Railway well established in Western Europe
- Air passenger transport well established

- Basic question: Is it worth to install an expensive railway system in Eastern Europe?
- Or better establish the air transport system?

- What is needed??
 - Airport, airlines, air traffic control, aircraft choice
 - Own aircraft industry to be developed ??



- Europe has still a fragmented transport system
 - The Western part has a very good infrastructure in rail and road
 - The Eastern part has still a big deficit in infrastructure
 - There are several ideas to further develop the road and the rail infrastructure
 - Transport is normally investigated by specialists **from Civil Engineering**
 - This means a concentration on tracks, bridges, tunnels, etc.
 - but less of a global approach including the vehicle, including cost of transport, including flexibility of development
 - A global approach is still missing with clear criteria like:
 - Development of a flexible system
 - Comparing the key parameters cost, environmental impact (noise, land use, primary energy use) infrastructure, flexibility for adaptation if transport streams may change, etc.

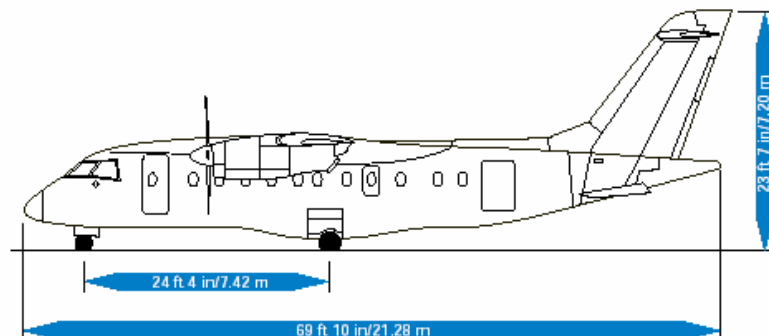
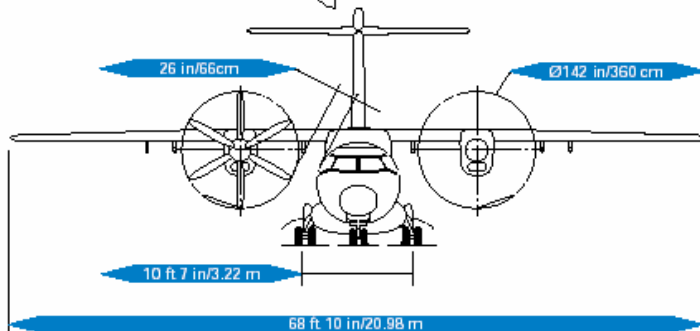
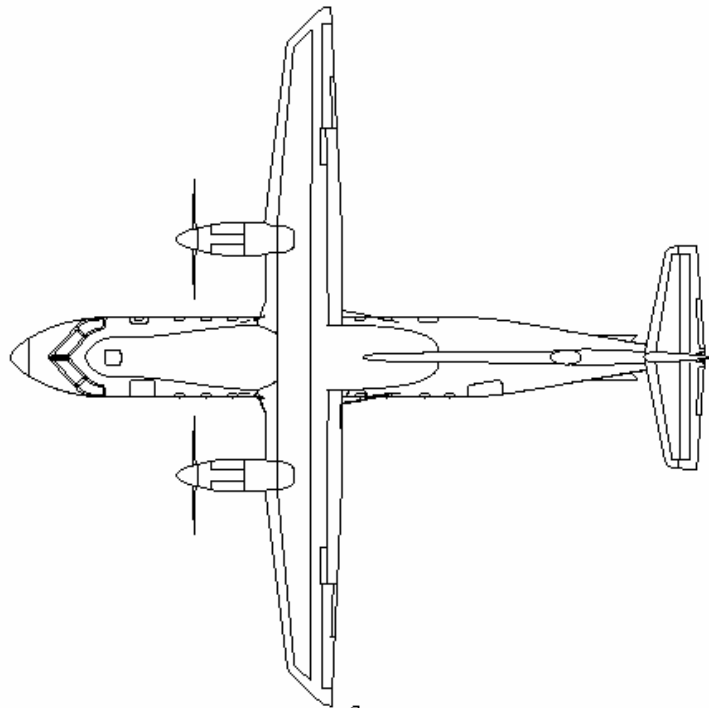
- Transport Situation in Western Europe
 - France and Germany have a well developed transport infrastructure
 - A good road system with many motorways, connecting all major cities via the motorway system
 - A Highspeed railway system, connecting also all major cities
 - A well developed normal railway system allowing trains to run at 160 km/h
 - All major cities, having an airport
 - A well established regional air transport system
 - International network
 - The Highspeed railway network is expanded to the neighbour countries (B,NL, UK,E, CH, A)
 - Conclusion:
 - There are several alternatives to go from City **A** to City **B**
 - Strong competition between rail and air transport!

- Transport Situation in Eastern Europe
 - Poland , Czech Rep., Hungary ,..
 - A good road system with motorways is needed, connecting all major cities via a motorway system (100 km distance max.)
 - A Highspeed railway system, connecting also all major cities!
Is it really needed??
 - A well developed normal railway system allowing trains to run at 160 km/h
 - All major cities will have to develop an airport (airfields are available)
 - A well established regional air transport system to be developed
 - *Very easy!*
 - International network
 - All links are going to Brussels !!
 - The connection points are Berlin, Frankfurt, Munich or Vienna !
 - Main direction for highspeed roads and future rail is East - West
 - Conclusions:
 - There are several projects running for East – West routes
 - **Strong competition between road, rail and air transport!**
 - **However air transport needs only little new infrastructure!!**



Is there no interest in North – South Transport ??





- There are several projects on European basis to integrate Eastern Europe into the European transport scheme:
 - Main roads are being developed West – East
 - Main railway lines are envisaged to go to Moscow, Kiev, Black Sea ...
 - What is with North – South connections??
 - There are some geographical barriers! Tatra, Carpates etc.
 - This will be costly to develop road or rail tracks, bridges and tunnels.
 - A flexible air transport system could provide a less costly solution!
 - Some studies are needed to identify a good and robust system
 - Studies should include market, technical, financial and environmental aspects

- Air freight system needs an own infrastructure with airports, freighter aircraft and freight operators
- Normal passenger aircraft have some deficits when converted to freighter aircraft wrt Turn around! – No Front loading capability!
- The big aircraft manufacturer have no interest to develop a dedicated freighter aircraft
- The Beluga has shown, that it is fairly easy to develop a good freighter aircraft out of an existing passenger aircraft!

- Europe could start to develop the air cargo network in Eastern Europe up to Russia, where the territorial infrastructure (road/rail) is still very poor!

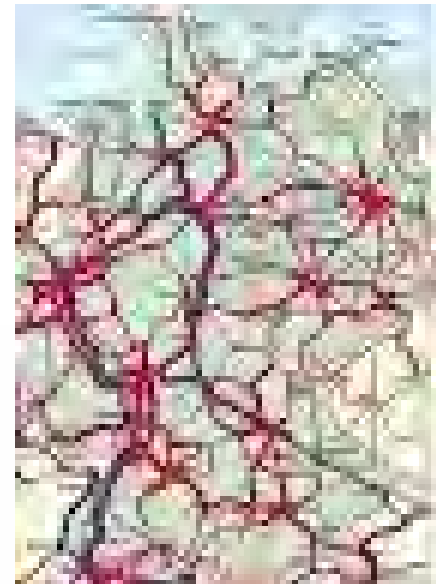
- With the development of bio-fuels, also the aircargo system for Europe may have to be re-investigated.



Thank you
for your attention!

Back - Up





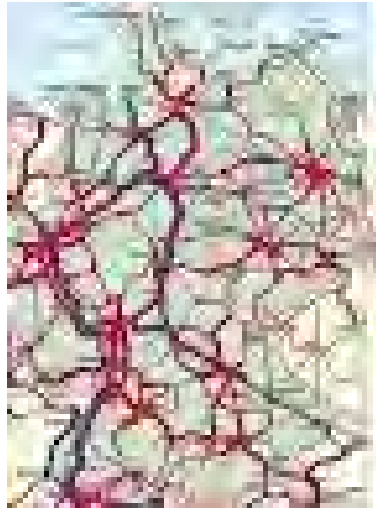


Porty lotnicze w Polsce
Airports in Poland

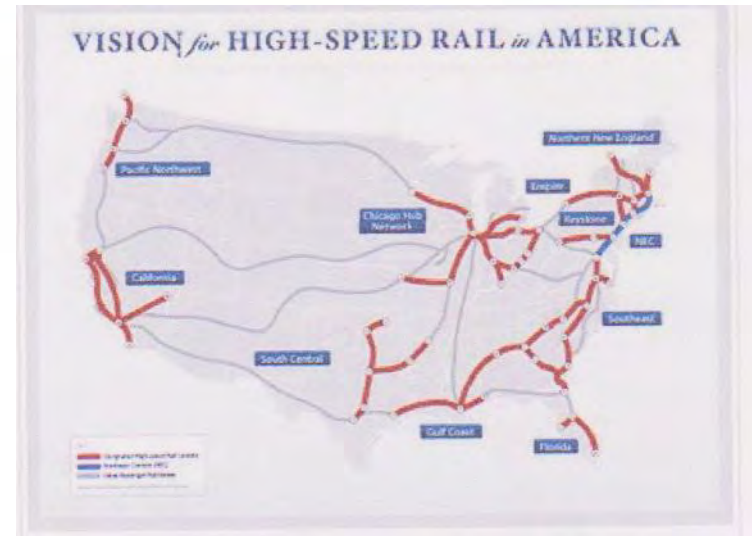
Pasażerowie w 2011
Passengers in 2011



Poland



Germany



United States of America

Conclusion: The example of the US is showing:
A prosper economy do not require mandatorily a HS Railway System as a backbone for transport.
However, a very differentiated air transport system is needed!

- Die Großindustrie (Boeing, Airbus) hat sich mit den neuen Programmen (A380/B787) viele industrielle Probleme eingehandelt. Die Innovationsfähigkeit wird sich wahrscheinlich weiter reduzieren.
- Größere Innovationen werden eher von neuen bzw. kleineren Industriefirmen kommen (Bombardier führt GTF ein!)
- Die eigenen R&T Ressourcen der Industrie werden soweit zurückgefahren, dass keine langfristige und weit gefächerte Technologiestrategie der Industrie (Airbus) mehr möglich ist.
- Dies wird noch gravierender für Airbus Deutschland, das keine eigene R&T Strategie haben darf! Hier gibt es Handlungsbedarf und eine neue Rolle für das DLR und andere Forschungseinrichtungen (Uni's; Fraunhofer; etc.)

ATM:

- Operationelle Aspekte werden bei Lärm und Emissionen zunehmend wichtiger !
- Es gibt sehr viele Vorschläge welche Auswirkungen (Verbesserungen) eine Änderung der Trajektorie im Landeanflug bzgl. Lärm und Emissionen bewirken kann. Es geht jetzt darum, eine sinnvolle Umsetzung im nationalen, europäischen und globalen Rahmen zu erarbeiten.