Management/planning – example

	general	**aircraft**	**staff**
strategical	orientation, alliances	fleet planning	hire, train
tactical	price setting, time table	fleet assignment and routing	crew scheduling
operational	class reservation, customer management	fleet operations	crew operations

Market Situation

- Monopoly, oligopoly or free-market?
  - ✤ Many countries have (had) state aided companies
  - ✤ Deregulation and increased competition (in Sweden and Europe)
  - ✤ Does deregulation lead to more or fewer companies?
- Alliances
- Market characteristics
  - ✤ Few players, local market
  - ✤ High entry threshold
  - ✤ Growth by acquisition

TGAI - Chapter 3.2

How to define a market?

- Typical Air Passenger Trip:

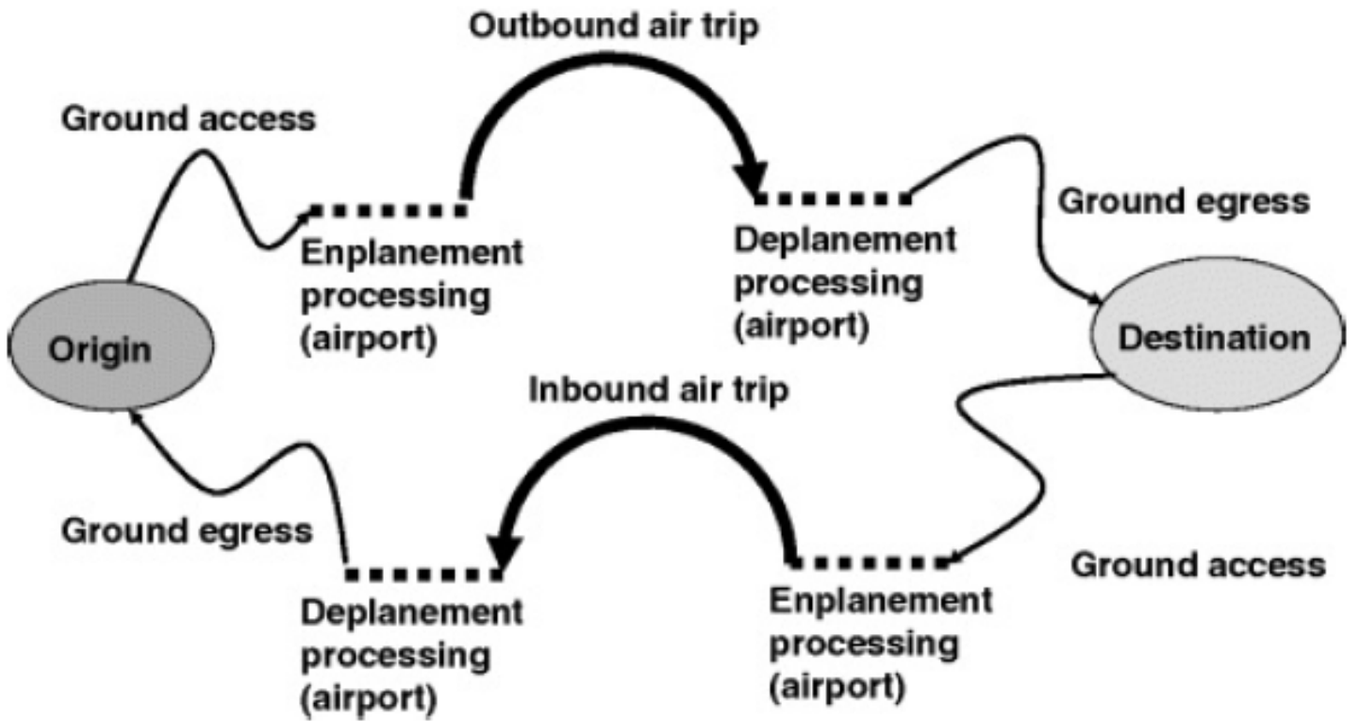


Figure 3.1 Representation of a typical air passenger trip

Read TGAI Chapter 3.2 until the end of 3.3.4 (11 pages)

Take a look at these slides by Peter Belobaba: http://aviation.itu.edu.tr/%5Cimg%5Caviation%5Cdatafiles/Lecture%20Notes/Network%20Fleet%20Schedule%20Strategic%20Planning/Lecture%20Notes/6%20-%20Fundamentals%20of%20Airline%20Markets.pdf

Then:

https://docs.google.com/forms/d/e/1FAIpQLSfsaFBXJ-rHZaTGN-NkuDlxp9UrBaGkR6-VIWaiF1omZ-9kiw/viewform?usp=sf_link

TNFL01 market, demand, supply

A business traveller usually opts for 1 punkt

- a short egress time
- lower fares

Travel demand is defined for 1 punkt

- an O-D market
- a flight leg

Travel supply is generated for 1 punkt

- an O-D market
- a flight leg

Let the departure times of passengers be uniformly distributed between 12:00 and 17:00. If only one flight is offered at 14:30, what is the mean schedule displacement time? 1 punkt

- 0:30
- 0:45
- 1:00
- 1:15
- 1:30
- 1:45
- 2:00
- 2:15
- 2:30
- 2:45
- 3:00
- 3:15
- 3:30
- 3:45
- 4:00
- 4:15
- 4:30

Dichotomy of Demand and Supply

You are working for a large, international airline. In conversation with a representative of a large dairy company at a conference, said representative asks you to quantify demand and supply on the route Arlanda-Newark. He is surprised to hear that you cannot easily quantify the demand and supply, as he easily can for, for example, milk with 3,25% fat in Stockholm in January. Give the dairy representative a detailed explanation on dichotomy of demand and supply in the airline industry.

Customer orientation

- Cargo or passengers
- Time table or charter
- Business travel or low price company
- Big or small
- Domestic, international, continental or intercontinental

Factors affecting volume of O-D demand

TGAI - Chapter 3.3

- Affected by many variables, models include usually only those variables with greater impact on demand and those that can be measured.

❖ Socioeconomic and demographic variables
  - ❖ Larger populations, greater potential demand for air travel
  - ❖ Amount and type of economic interaction between cities: two cities with common industries will generate more demand for air travel
  - ❖ Disposable income
  - ❖ Levels of education
  - ❖ Age of the populations

❖ Prices of travel options
  - ❖ Monetary price
  - ❖ Disutility cost of fare restrictions
  - ❖ Prices of competing modes (train, bus, car)

❖ “Quality of service”
  - ❖ Frequency of flight departures
  - ❖ Time spent flying
  - ❖Together: total trip time (“true” origin to “true” destination)
  - ❖ Comfort
  - ❖ Safety
  - ❖ Ease of travel

Demand

- Strategical, technical, operational level
- How to measure?
  - Market analysis
  - Check other companies
  - Prognosis

Prognosis models

qualitative models	**quantitative models**
based on opinions and assessment (from experts)	mathematical
long-term prognosis	use of historical data
no historical data	extrapolation of historical values
	time series models

Different types of prognosis need different methods

- Estimate demand for a completely new flight
  - How many pax can we obtain Norrköping – Brussels
- Estimate demand for a proven route
  - How many pax during the winter half year on the route Norrköping – Munich

Prognosis models

- Based on historical data
  - Time series analysis
    - Trends, cyclical variations, seasonal variations, irregular events
    - Moving average, exponential smoothing
- Based on knowledge of influencing factors
  - Regression analysis
  - Example for factors?

Prognosis models

- Based on historical data
  - Time series analysis
    - Trends, cyclical variations, seasonal variations, irregular events
    - Moving average, exponential smoothing
- Based on knowledge of influencing factors
  - Regression analysis
  - Example for factors?
- Based on knowledge of future events
  - Delphi method
    - Panel of experts
    - Experts answer questionnaires in two or more rounds
    - After each round anonymous summary of the experts forecasts from the previous round
    - Experts answer same questions
    - It is believed that during this process the group will converge towards the “correct” answer

Air Travel Demand Models

Various models, for more details, see TGAI Chapter 3.4

- Elasticity of Air Travel Demand:
  - Price elasticity of demand is the percent change in total market demand that occurs with a 1% increase in average price charged.
  - Price elasticity is negative for normal (<-> luxury) goods and services: A 10% price increase will cause an x% demand decrease, all being equal.
  - Business air travel slightly “inelastic” ($0<E_p<-1.0$): volume of demand does not change as a change in price (in %)
  - Leisure demand for air travel is assumed to be much more elastic ($E_p<-1.0$)
  - Similarly time elasticity

Air Travel Demand Models

Various models, for more details, see TGAI Chapter 3.4

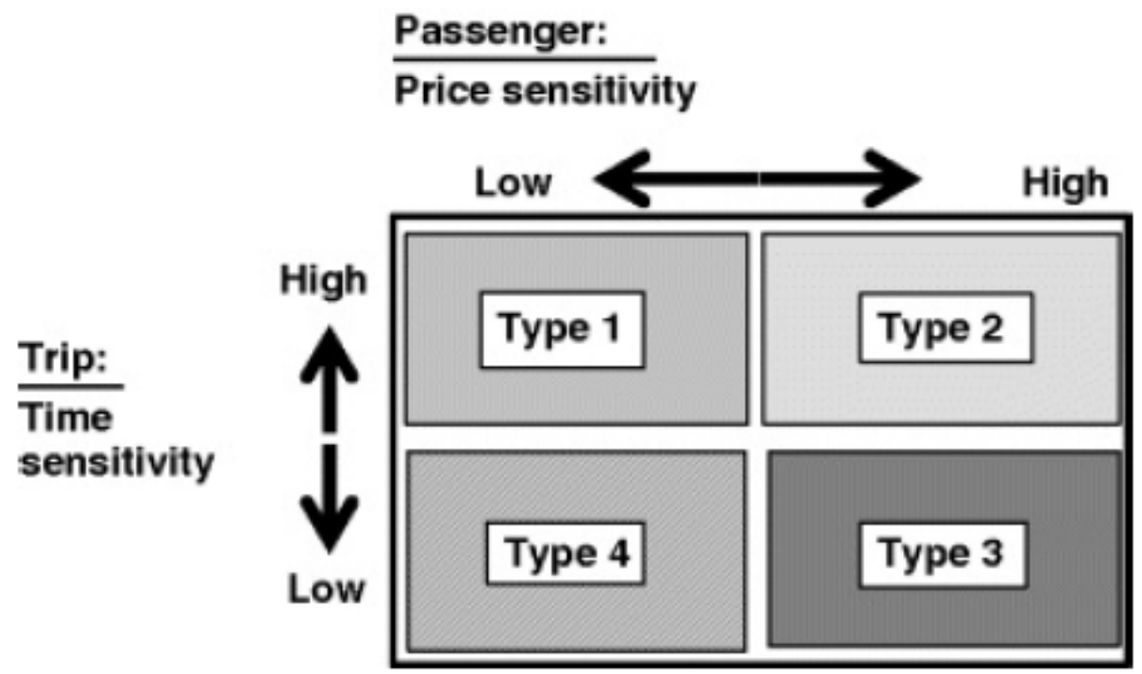
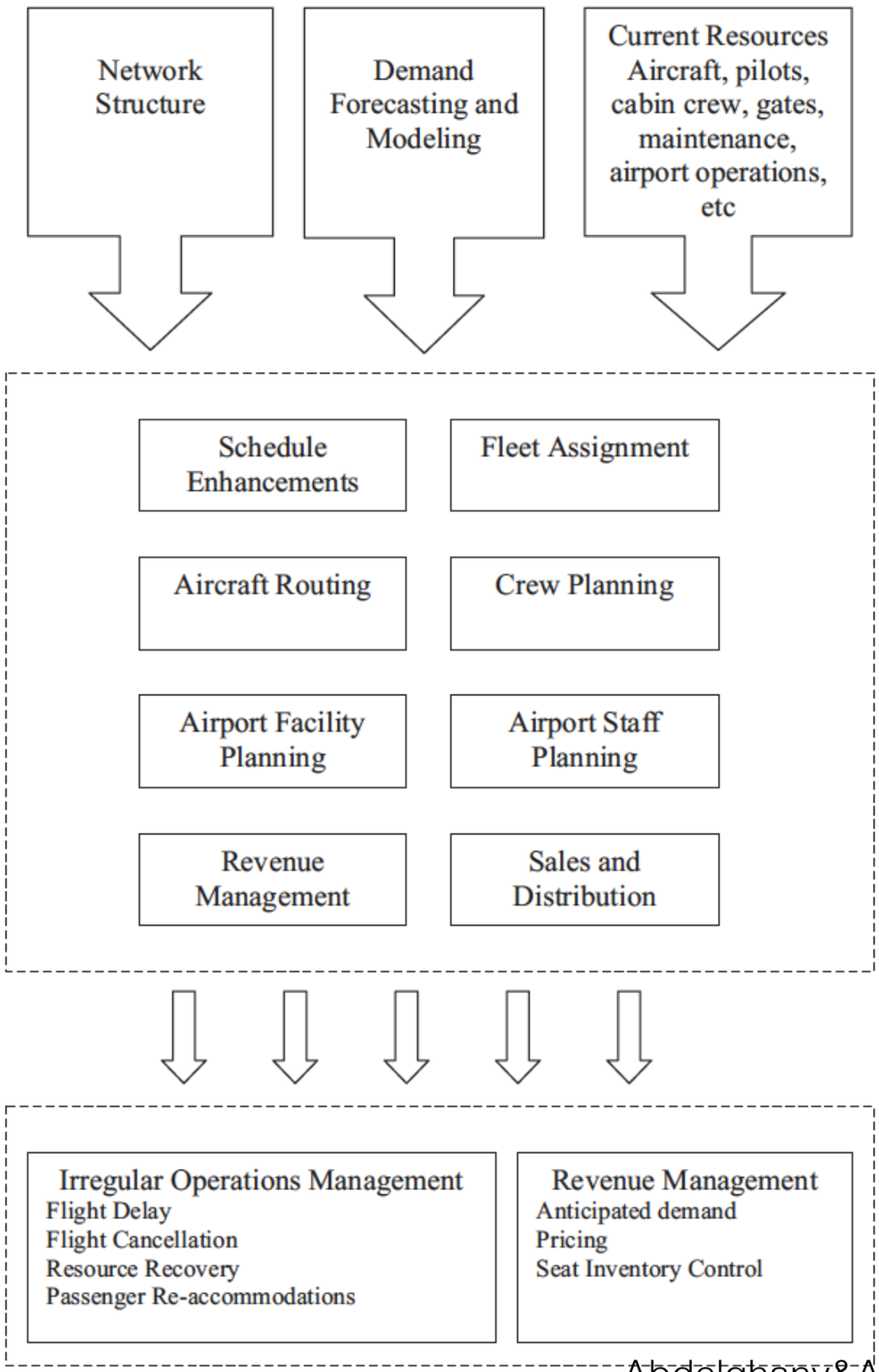


Figure 3.6 Air travel demand segments (Belobaba, 1987)

Air Traffic and Air Transportation
Flygtrafik och flygtransporter

Airlines #2
Management of Resources

Processes in planning&operations phases of airlines



Planning:

- Starts by recording anticipated demand and supply
- Set of interrelated planning processes is considered:
  - Schedule planning
  - Time banking
  - Fleet assignment
  - Aircraft routing
  - Crew scheduling
  - Airport facility planning
  - Airport staff scheduling
  - Pricing
  - Seat inventory control
  - Sales
  - Marketing initiatives
- Planning processes typically completed by a month/few months before implementation of the schedule
- Repeated on a frequent basis

TGAI Chapter 7

Operations phase:

- Implementing the planned airline schedule, while
- Taking into consideration recovery for any unanticipated incidents such as:
  - Adverse weather conditions
  - Aircraft breakdown
  - Crew absence
- Decisions are made to:
  - Recover the airline schedule from flight delay and cancellations
  - Compensate for missing or delayed aircraft and crew
  - Reaccommodate stranded passengers
- Monitors seat bookings in different markets
- Updates seat inventory control and pricing decisions

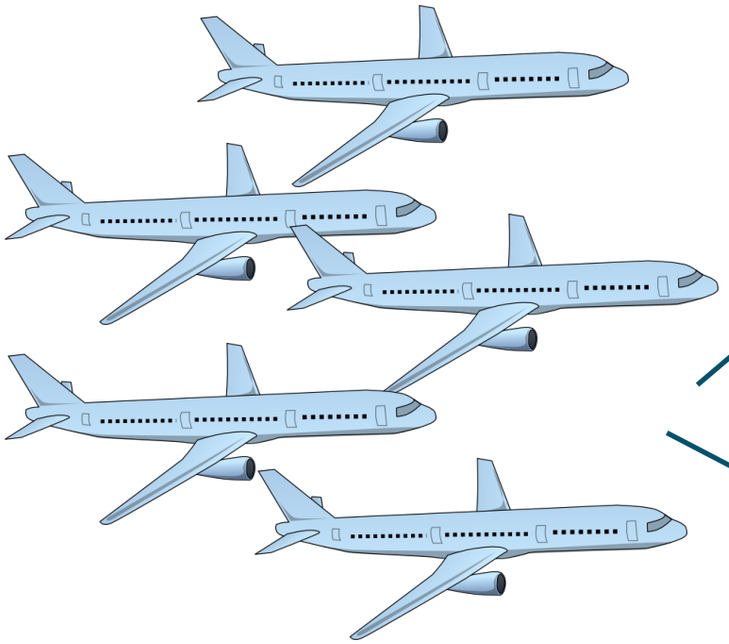
Abdelghany&Abdelghany, 2010

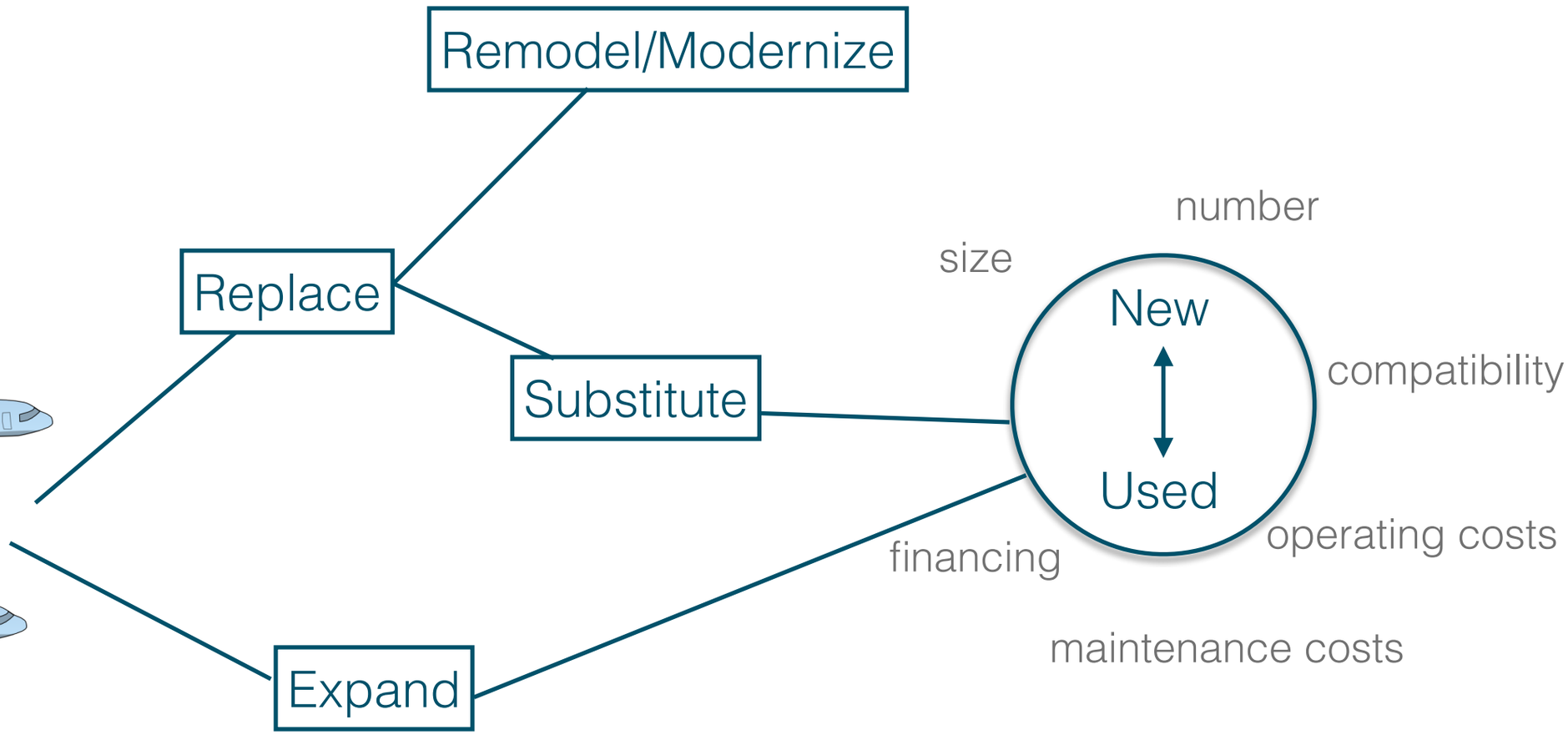
TGAI Chapter 7

Airline Planning

How to determine which aircraft to use?

TGAI Chapter 7.1





Fleet planning

What is available?

- Boeing
  - American company
  - 737-787
  - http://www.boeing.com/company/about-bca/index.page%23/prices
  - Older: DC and MD
- Airbus
  - European company
  - A300-A380
  - http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/new-airbus-aircraft-list-prices-for-2016/

- Fokker
- Bombardier
- Canadair
- Embraer
- SAAB

Aircraft fleet SAS

The SAS Group's fleet of aircraft at October 31, 2012[1]

	Age	Owned	Leased	Total	In service	Leased out	On order
Airbus A330/A340	10.4	5	6	11	11	0	
Airbus A319/A320/A321	8.8	4	10	14	12	0	30
Boeing 737 Classic	19.4	0	10	10	10	0	
Boeing 737NG	11.4	23	49	72	72	0	
Boeing 717	12.2	0	9	9	9	0	
McDonnell Douglas MD-80-serien	23.1	13	8	21	19	0	
McDonnell Douglas MD-90-serien	0.0	8	0	8	0	8	
Avro RJ-85	0.0	0	5	5	0	1	
deHavilland Q-serien	14.7	32	10	42	39	0	
Bombardier CRJ900NG	3.4	12	0	12	12	0	
Total	**13.1**	**97**	**107**	**204**	**184**	**9**	**30**

1) In addition, the following aircraft are wet leased: four CRJ200s and one ATR for SAS in Denmark and two ATRs and four SAAB 2000s for Blue1 in Finland.

The aircraft fleet divided by airline and leased-out aircraft

	Age	Owned	Leased	Total	In service	Leased out	On order
SAS Scandinavian Airlines	12.6			143	136	8	30
Widerøe	14.9			39	39	0	
Blue1	12.2			13	9	1	
Leased-out aircraft				9			
Total	**13.1**			**204**	**184**	**9**	**30**

SAS FLYGPLANSFLOTTA 31 OKTOBER 2015

SAS flygplan i trafik	Ålder	Ägda	Leasade	Totalt	Order köp	Order lease
Airbus A330/A340/A350	11,9	7	7	14	10	-
Airbus A319/A320/A321	10,7	6	19	25	30	-
Boeing 737NG	12,8	15	69	84	-	-
Totalt	**12,3**	**28**	95	123	40	0

Flygplan i trafik under annan trafiklicens än SAS (SK)	Ålder	Ägda	Wet leasade	Totalt	Order på wet lease
Boeing 737	10,2	-	1	1	-
Bombardier CRJ900	6,4	12	-	12	8
ATR-72	3,7	-	13	13	3
SAAB 2000	18,6	-	3	3	-
Totalt	**6,6**	**12**	**17**	**29**	**11**

Read TGAI Chapter 7.1 until before 7.1.2.1 starts (9 pages)

Find data on the fleet development of either Emirates, Etihad, Qatar or Turkish airlines over the last ~5-15 years.

Answer:https://goo.gl/forms/vVOMR1qCFhqUeaXV2

Fleet planning, TNFL01

Why are airlines interested in fleet commonality? 4 punkter

- [ ] Lower cost to train crew and mechanics
- [ ] Higher cost to train crew and mechanics
- [ ] Greater flexibility in crew scheduling
- [ ] Crew qualified to operate one a/c type may be qualified to operate other a/c types directly
- [ ] Crew is usually trained for a specific a/c manufacturer
- [ ] Maintenance requirements are similar

Turkish airlines

LINKÖPING UNIVERSITY

Fleet as of year-end 2010

Aircraft Type	Number	Fleet Age	Total Capacity (Seat)
Commercial Aircraft			
A340-300	9	14.2	2,446
A330-200	7	4.6	1,812
A330-300	4	0.1	1,156
B777-300ER	9	1.6	2,933
A319-100	4	4.9	528
A320-200	25	3.7	3,962
A321-200	21	4.8	4017
B737-400	3	18.9	450
B737-800	52	7.5	8,596
B737-700	14	5.0	1,986
Cargo Aircraft			
A310-300F	4	22.5	-
A330-200F	1	0.3	-
TOTAL	**153**	**6.5**	**27,886**

2016

NARROW BODY (234 Ea)

15 Ea	B737-900ER
110 Ea	B737-800
29 Ea	A320-200
66 Ea	A321-200
13 Ea	A319-100
1 Ea	B737-700

WIDE BODY (87 Ea)

20 Ea	A330-200
31 Ea	A330-300
4 Ea	A340-300
32 Ea	B777-300ER

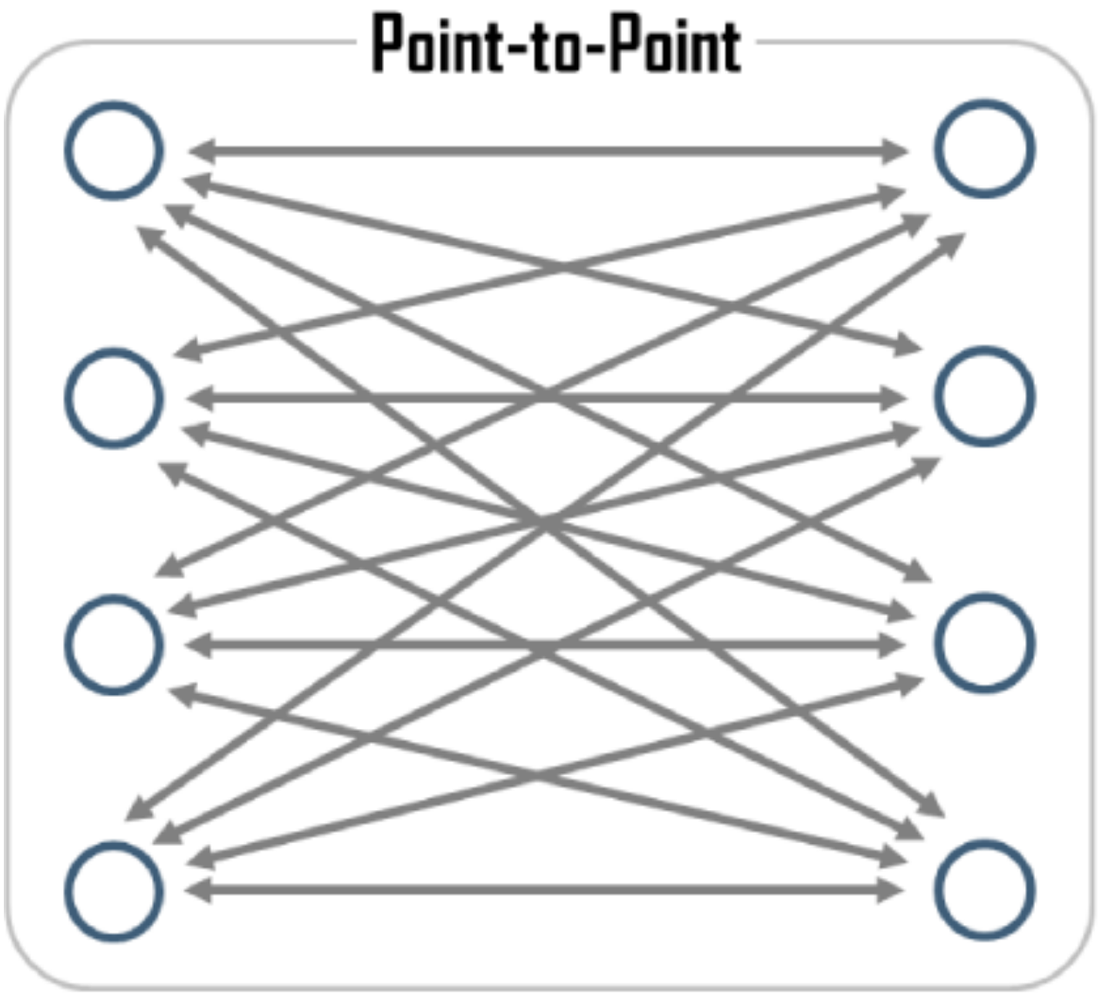
CARGO (13 Ea)

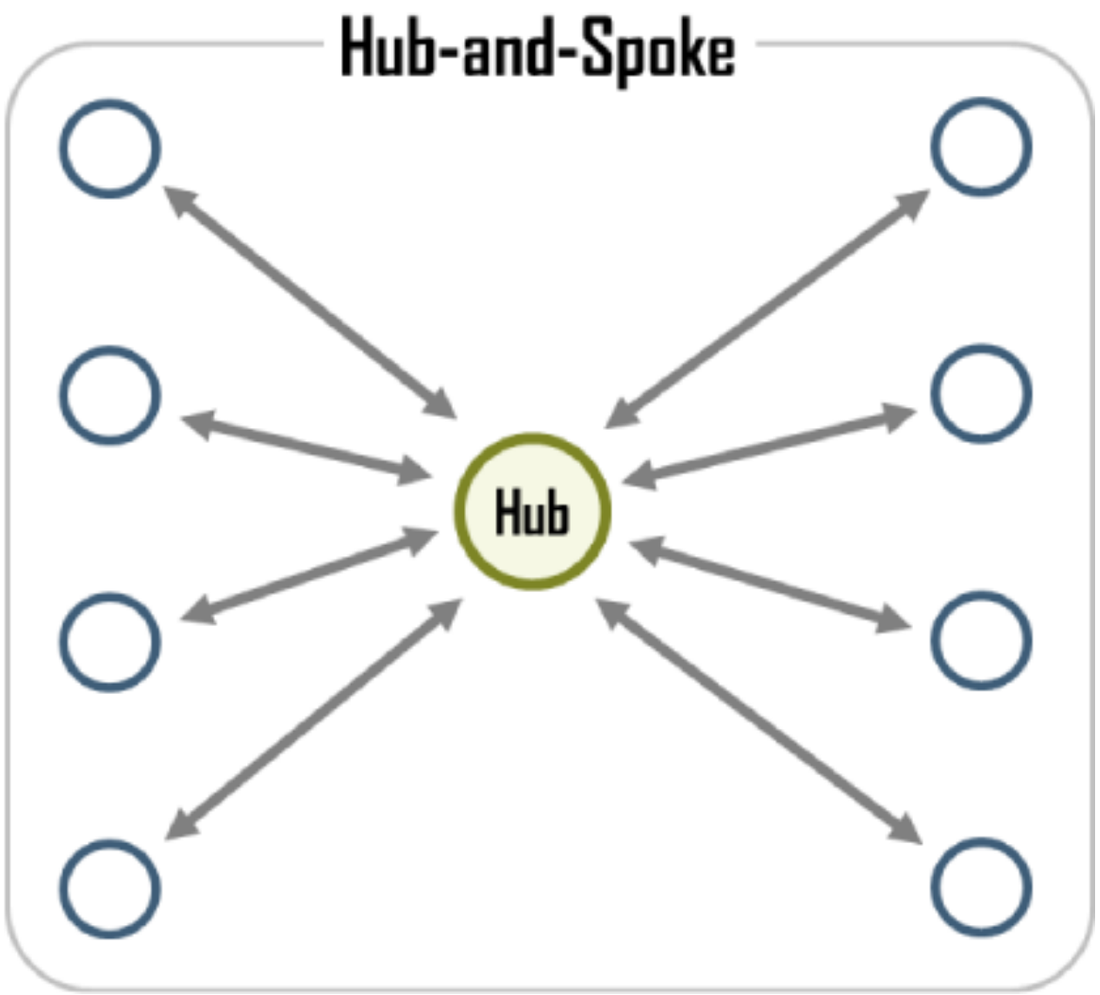
3 Ea	A310-300F
8 Ea	A330-200F
1 Ea	A300-600F
1 Ea	B747-400F

Total Aircraft: 334

Average Fleet Age: 7,1

TGAI Chapter 7.2.1

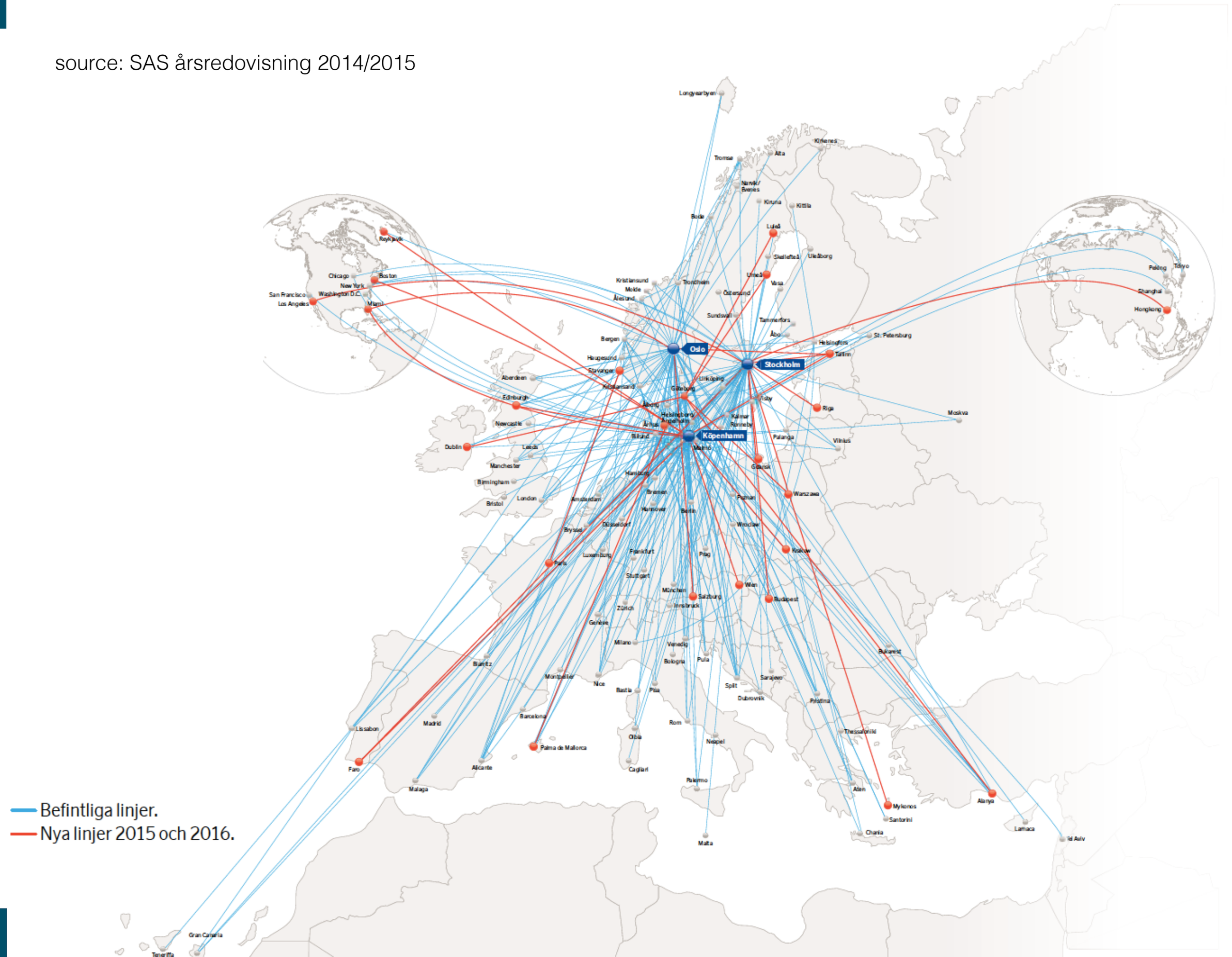




often mixed systems, or hub-systems with multiple hubs

source: https://people.hofstra.edu/geotrans/eng/ch1en/conc1en/hubnetwork.html

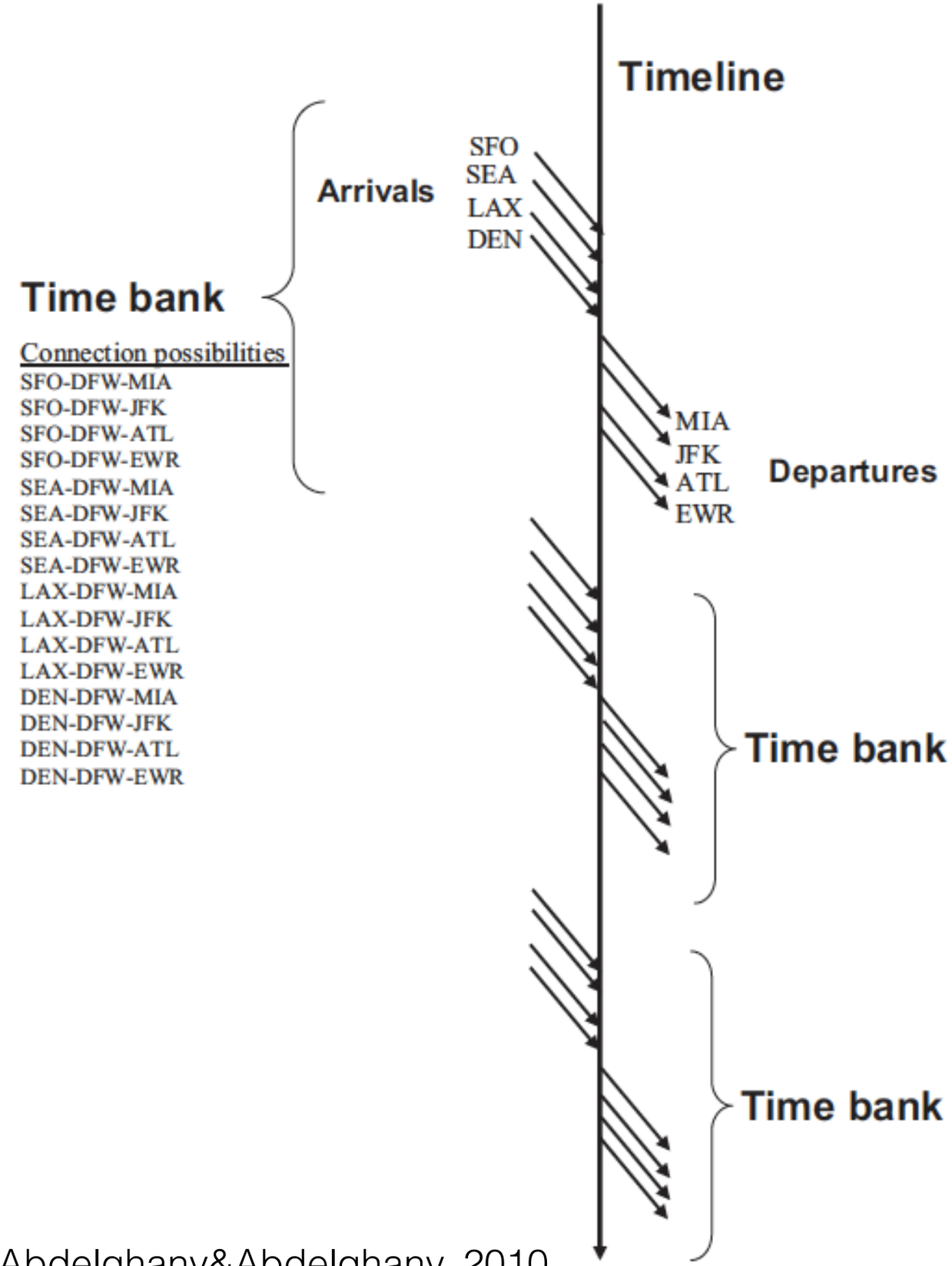
source: SAS årsredovisning 2014/2015

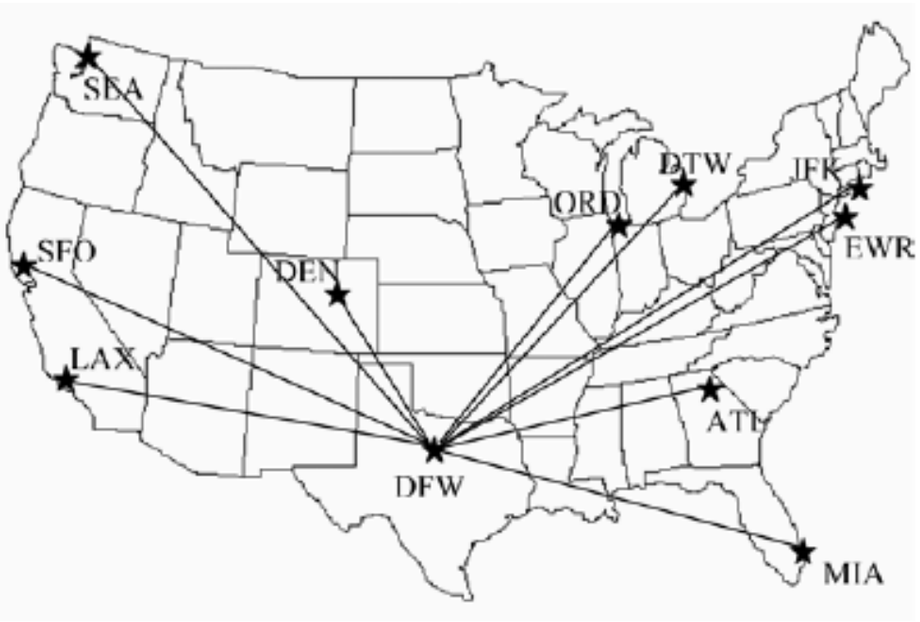


Example of time bank for hub-and-spoke airline

Time bank:

- Arrivals and departures at the hub are adjusted in time banks
- Consists of a set of flight arrivals followed by a set of departures
- Allows for several connection possibilities during a short period of time





AbdelghanyAbdelghany, 2010

Read TGAI Chapter 7.2 until before 7.2.2 starts (7 pages)

Answer:https://goo.gl/forms/2tm9p7NQXIjgIsyD2

Airline Network

An airline’s route network is often a mix of pure hub-and-spoke and pure point-to-point systems. Discuss how an airline can exploit the advantages and avoid the disadvantages of those two extremal network types by using a mixed route network.

Route Planning, TNFL01

Hub-and-spoke networks feature, in comparison to point-to-point networks

8 punkter

- [ ] Higher departure frequency
- [ ] Lower departure frequency
- [ ] More schedule displacement
- [ ] Less schedule displacement
- [ ] Reduced operating cost
- [ ] Higher crew and maintenance costs
- [ ] Lower crew and maintenance costs
- [ ] Harder a/c and crew scheduling
- [ ] Simplified a/c and crew scheduling
- [ ] Higher flexibility for swaps
- [ ] Lower flexibility for swaps
- [ ] Lower a/c and crew utilization
- [ ] Higher a/c and crew utilization
- [ ] Higher turn-around times
- [ ] Shorter turn-around times

Timetable

TGAI Chapter 7.3.2

- Two seasons: winter and summer
- Product range
  - Large selection of times
  - High cabin factor
- Limitations
  - Physical
  - Contract
  - Slots
    - IATA (International Air Transport Association): airport, strategical
    - CFMU (Central Flow Management Unit): ground holding, operational
  - Flight schedule
  - Staff schedule
  - Turnaround times

Conflictive

Timetable versus flight schedule

high cabin factor

maximal utilised capacity

Conflict

time table → flight schedule

Conflict

no passenger spill

robustness

rarely from scratch

Time table development

- Usually, during the timetable development some flights are deleted, and others are added
- One problem is to estimate the demand on the final flights
  - The total demand between two airports is reduced, when the supply is reduced
  - Certain pax choose different companies if the number of flights is reduced
  - The demand from connecting flights is reduced

Flight schedule planning

- Assume that fleet and timetable (and routes) are available and fixed: come up with a good feasible flight schedule.
- Discuss:
  - Talk to your neighbours
  - Make a list of goals and requirements for a flight schedule

Flight schedule planning

- Goals
  - High cabin factor
  - No pax spill
  - Robustness
- Requirements
  - Balance
  - Airport Limitations
  - Maintenance requirements
  - Aircraft limitations
  - Weather
  - Crew

Maintenance

- Regular check and service
- Requirement from civil aviation authorities (CAA): FAA, EASA,…
- Usually: each airline develops own CAA-approved maintenance program
- Executed at:
  - Maintenance base (largest, most versatile, best-equipped facility)
  - Major station (incl. large hub cities, substantial inventory of spare parts, extensive facilities)
  - Service station (large stations, not at major hub cities, well equipped and staffed, less than major stations)

Maintenance

Maintenance types:

- Visual inspection
  - Prior to flight (sometimes called “ walk-around”)
  - Ensure no obvious problems: leaks, missing rivets, cracks
- Overnight maintenance
  - End of working day
  - Ad hoc repairs
  - 1 – 1.5 hours
- A-check
  - Appx. every 125 flight hours (2 – 3 weeks)
  - Amplified visual inspection, easily reachable parts
- B-check
  - Appx. every 750 flight hours
  - Exterior wash, engine oil spectro-analysis, oil filters re ame carefully examined
  - Incorporates A-check
- C-check
  - appx. every 3000 flight hours or 15 months
  - Incorporates both A- and B-check
  - Plus: components repaired, flight controls chanisms tested, …
- D-check
  - Most intensive form
  - Every 6-8 years/appx. every 20000 flight hours
  - Cabin interiors removed —> careful structural inspections
  - 15-30 days

“line” maintenance:
at airport
usually overnight

“heavy” maintenance:
special facilities
extensive downtime

Maintenance

Maintenance types:

- Non routine Maintenance
- Unforeseen event (accident, random occurrence)
- Response to AD (Airworthiness Directive)

Maintenance

Planning:

- Timers used, e.g., A-timer
- If the check is not performed in time the aircraft can be grounded
- Maintenance must be carefully included in flight schedule