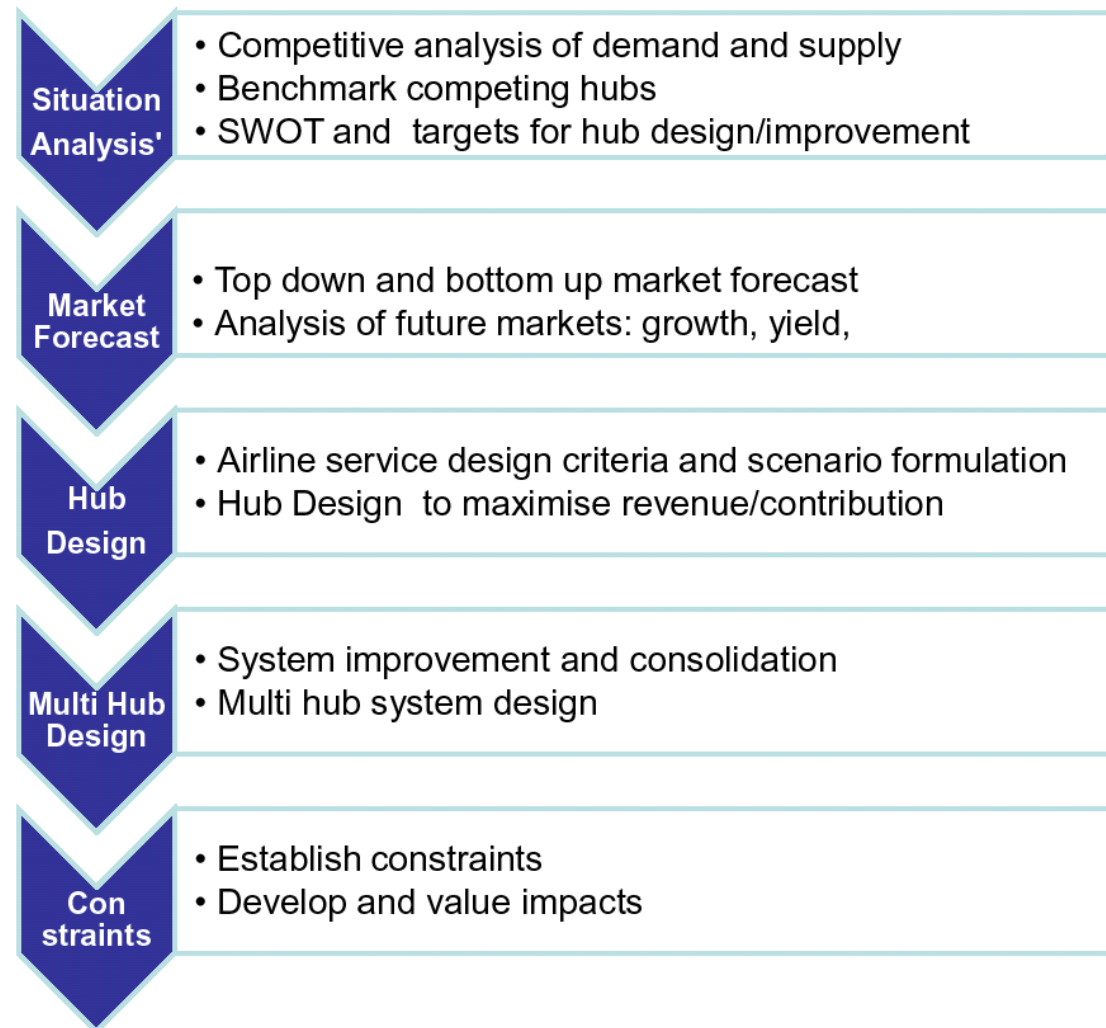# Approach to Hub Design
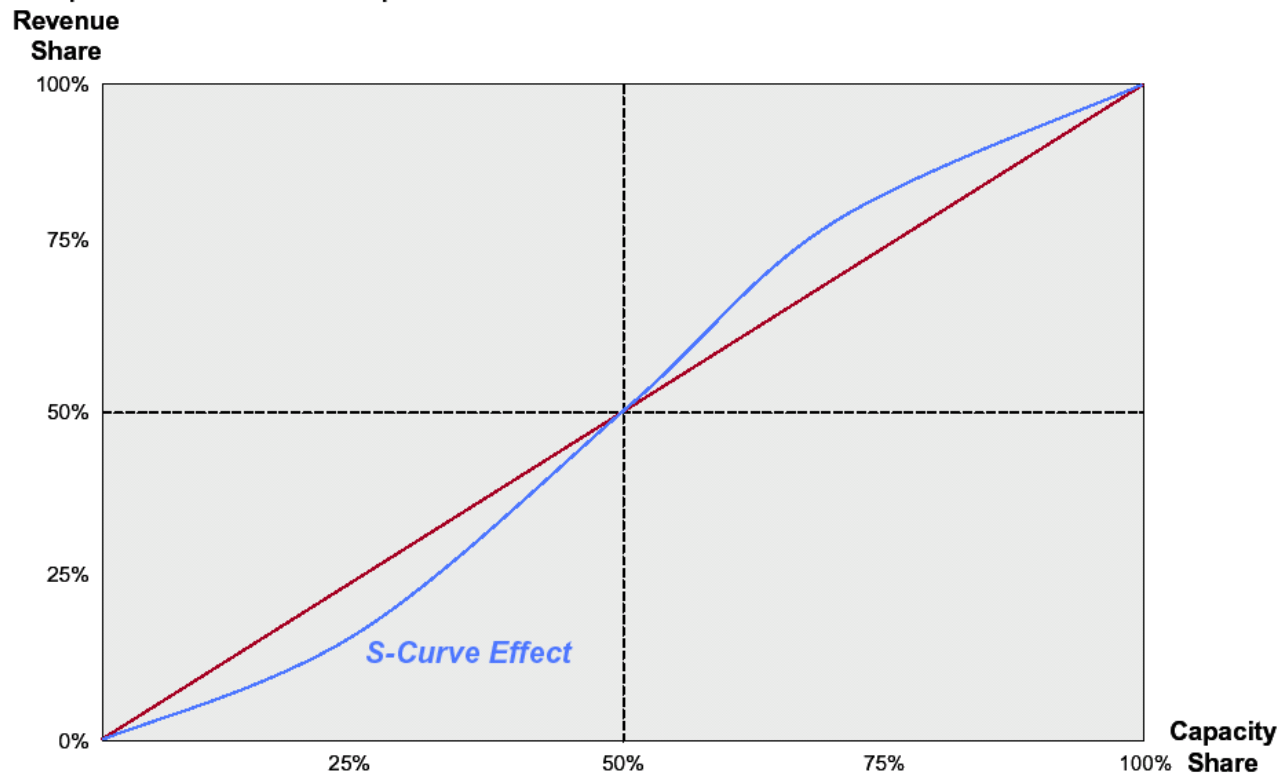
Dr. Emre Serpen, Executive Vice President, InterVISTAS
Mr. Joeri Aulman, Region Manager India, NACO

Overview of Hub Design Process

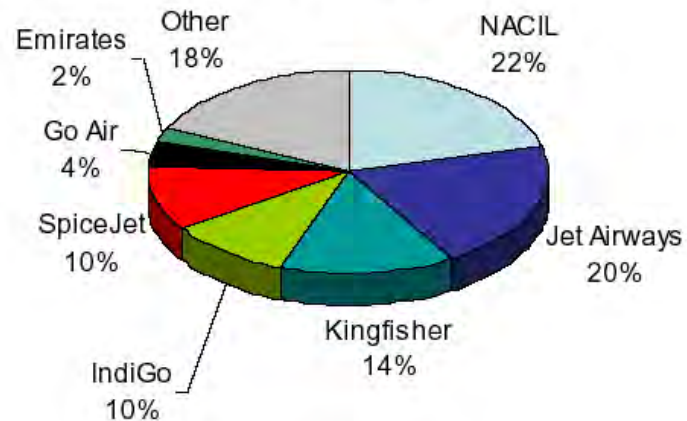| Situation Analysis'	• Competitive analysis of demand and supply • Benchmark competing hubs • SWOT and targets for hub design/improvement
Market Forecast	• Top down and bottom up market forecast • Analysis of future markets: growth, yield,
Hub Design	• Airline service design criteria and scenario formulation • Hub Design to maximise revenue/contribution
Multi Hub Design	• System improvement and consolidation • Multi hub system design
Con straints	• Establish constraints • Develop and value impacts

Sufficient S-curve effect?

- High yielding business passengers, prefer airlines that offer the most frequency in a given O&D markets

- Market dominance, is a an airline's ability to achieve a passenger or revenu share in excess of its capacity share

- Dominant airlines typically have positive share gaps, and achieve yield premiums vs. competitors.: S curve effect
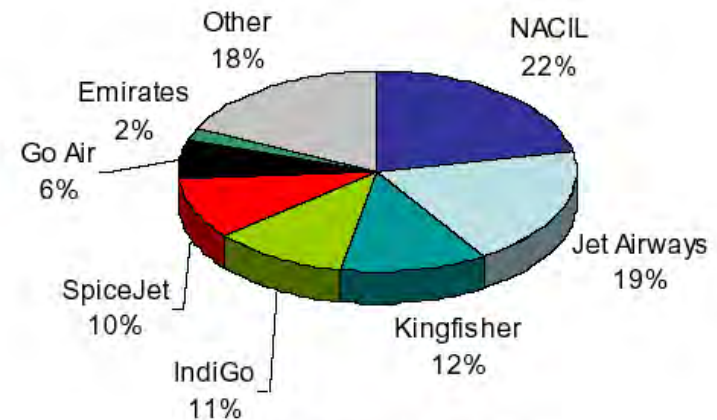
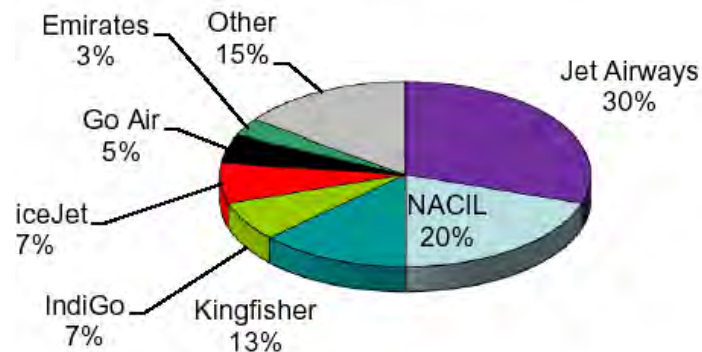# Overview of Indian Airports

YE JUNE 2010

Delhi (DEL)

- Other 18%
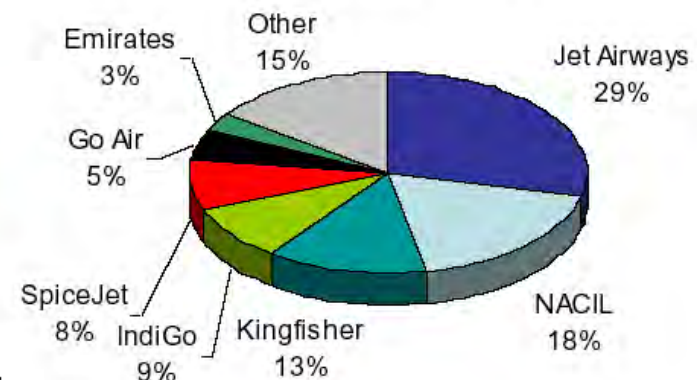- Emirates 2%
- Go Air 4%
- SpiceJet 10%
- IndiGo 10%
- Kingfisher 14%
- Jet Airways 20%
- NACIL 22%

Mumbai (BOM)

- Emirates 3%
- Other 15%
- Go Air 5%
- iceJet 7%
- IndiGo 7%
- Kingfisher 13%
- NACIL 20%
- Jet Airways 30%

YE JUNE 2011

Delhi (DEL)

- Other 18%
- Emirates 2%
- Go Air 6%
- SpiceJet 10%
- IndiGo 11%
- Kingfisher 12%
- Jet Airways 19%
- NACIL 22%

Mumbai (BOM)

- Emirates 3%
- Other 15%
- Go Air 5%
- SpiceJet 8%
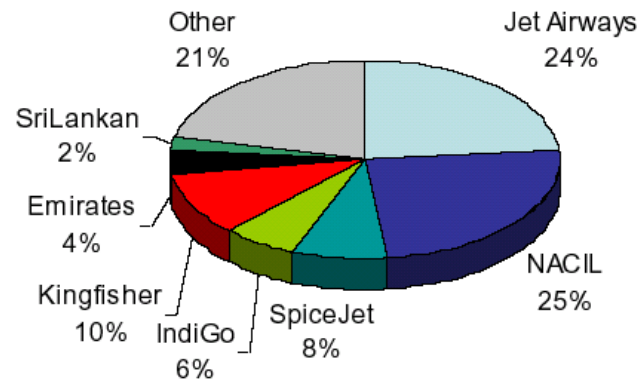- IndiGo 9%
- Kingfisher 13%
- NACIL 18%
- Jet Airways 29%

Source: OAG July 2009 – June 2011, NACIL Includes Air India, Air India Express and Indian Airlines, Jet Airways includes Jet Lite
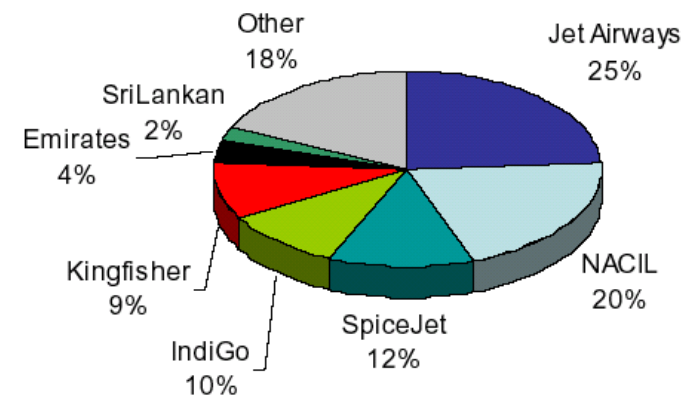
Overview of Indian Airports
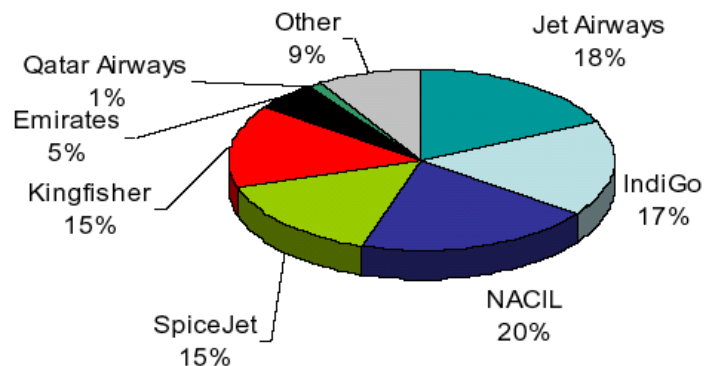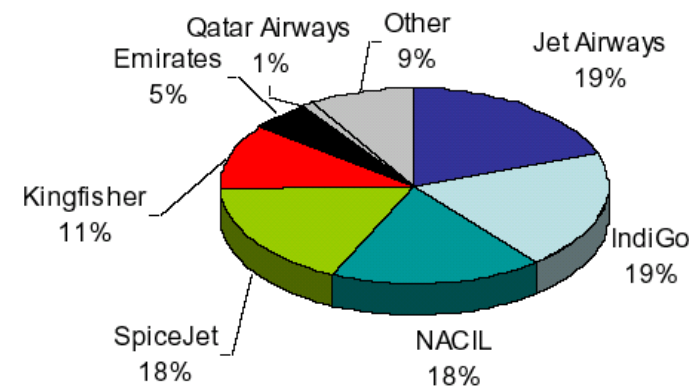

YE JUNE 2010

Chennai (MAA)

- Other 21%
- Jet Airways 24%
- SriLankan 2%
- Emirates 4%
- Kingfisher 10%
- IndiGo 6%
- SpiceJet 8%
- NACIL 25%

YE JUNE 2011

Chennai (MAA)

- Other 18%
- Jet Airways 25%
- SriLankan 2%
- Emirates 4%
- Kingfisher 9%
- IndiGo 10%
- SpiceJet 12%
- NACIL 20%

Hyderabad (HYD)

- Other 9%
- Jet Airways 18%
- Qatar Airways 1%
- Emirates 5%
- Kingfisher 15%
- SpiceJet 15%
- NACIL 20%
- IndiGo 17%

Hyderabad (HYD)

- Qatar Airways 1%
- Other 9%
- Emirates 5%
- Jet Airways 19%
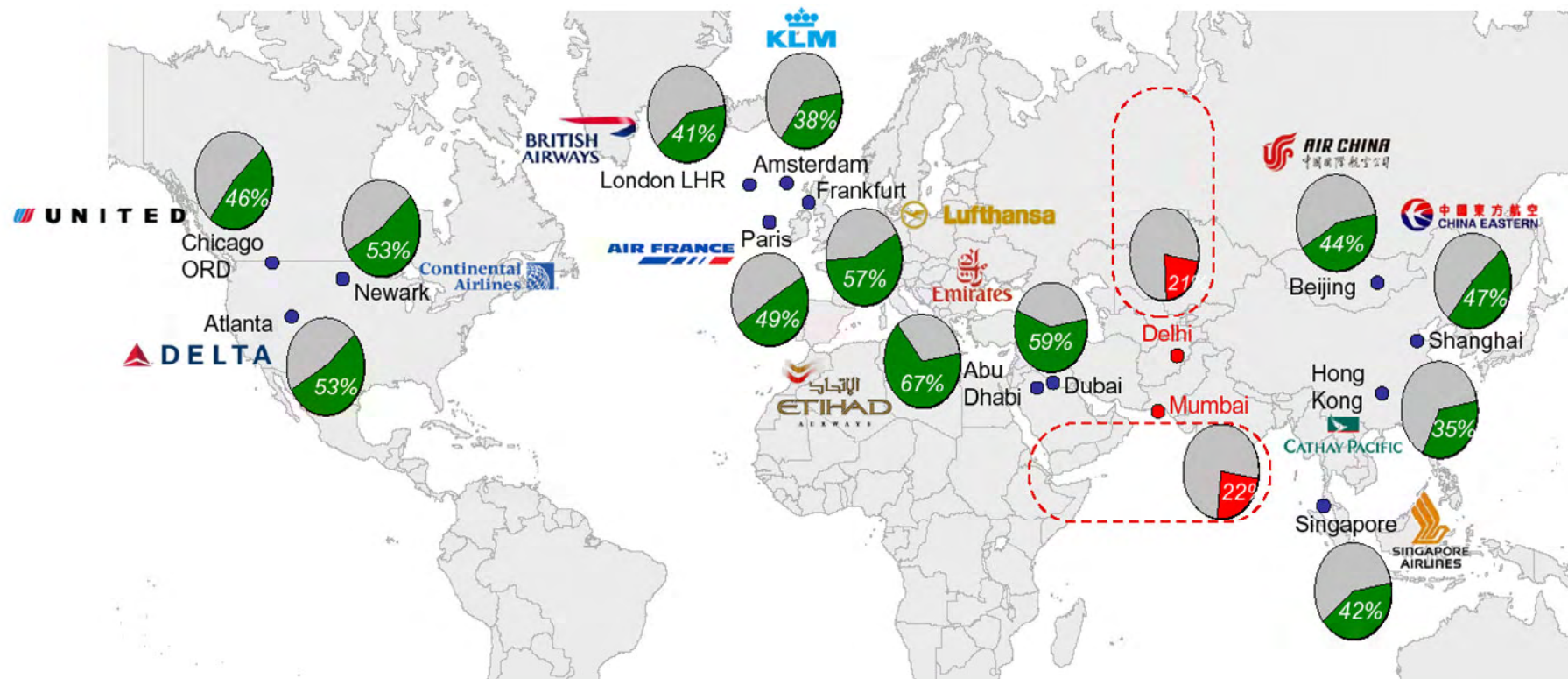- Kingfisher 11%
- SpiceJet 18%
- NACIL 18%
- IndiGo 19%

Source: OAG July 2009 – June 2011, NACIL Includes Air India, Air India
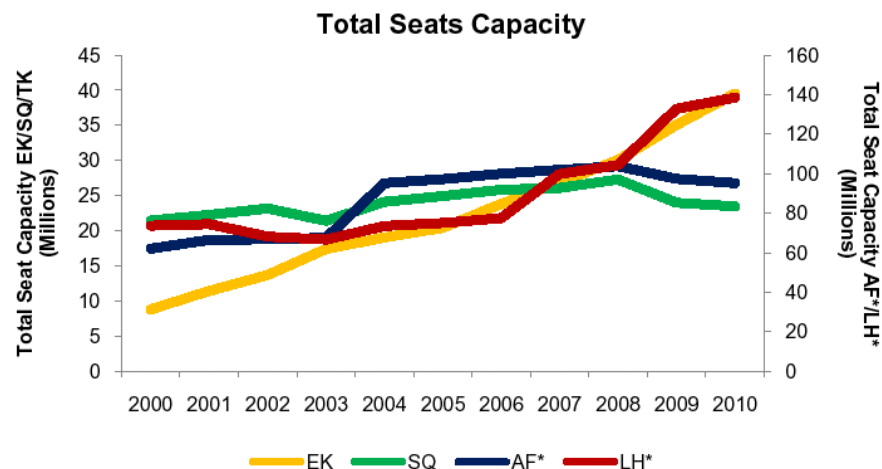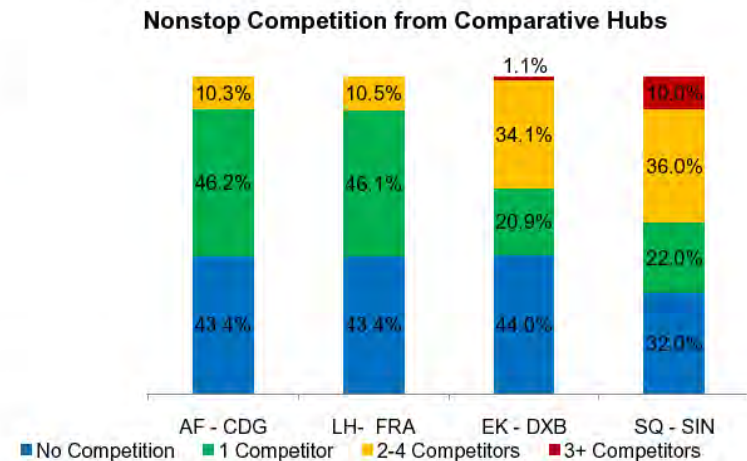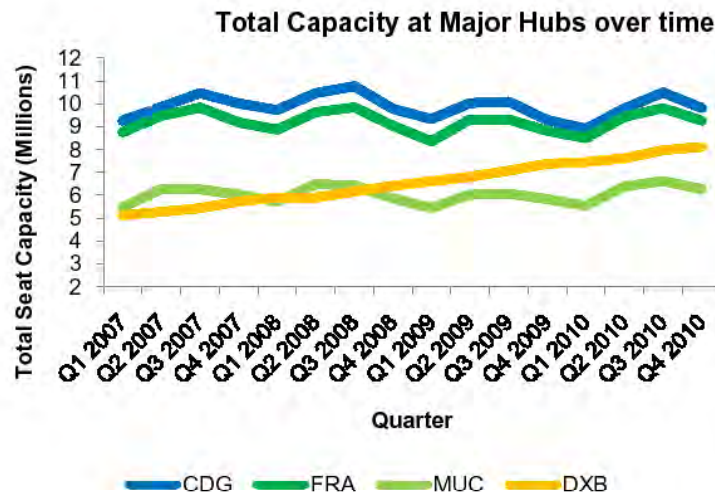Express and Indian Airlines, Jet Airways includes Jet Lite

Comparison with other hubs

- **Worldwide we see dominant carrier with leading share**

Benchmark competing hubs
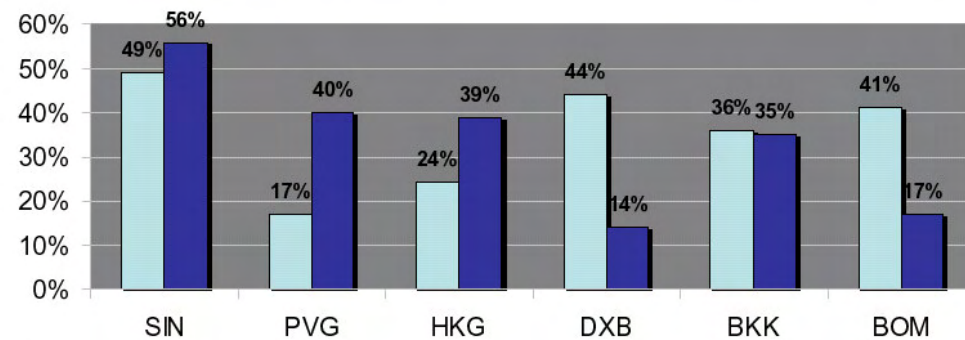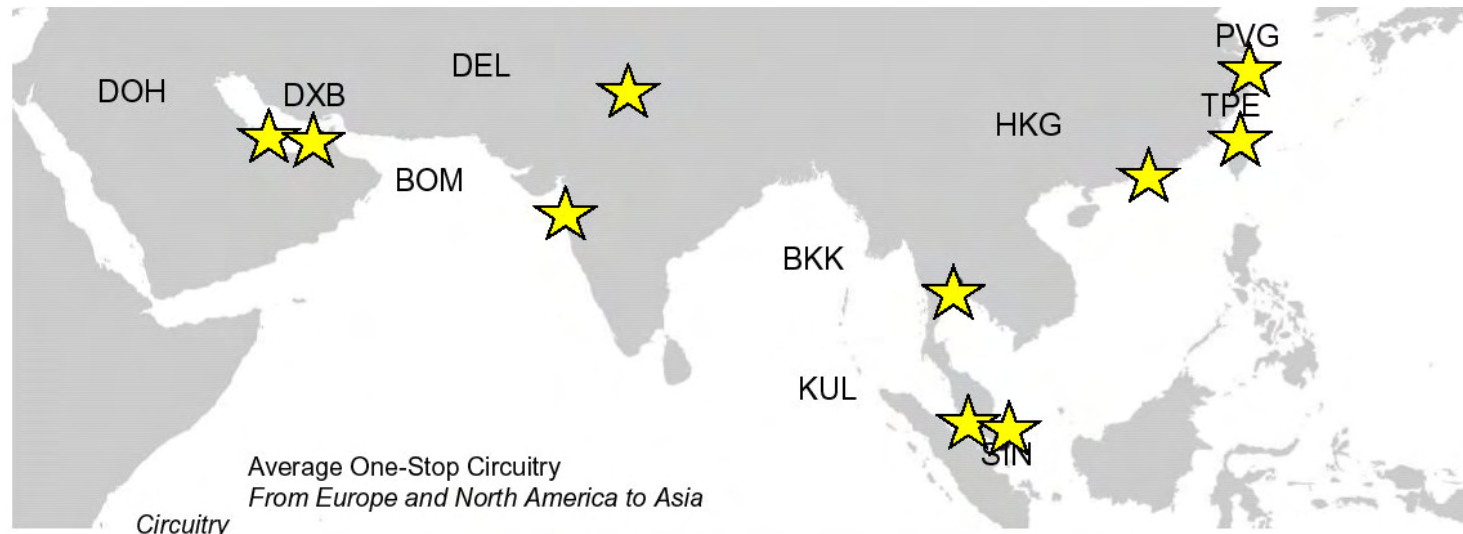
- **Identify Opportunities & Weaknesses**

Total Capacity at Major Hubs over time

Legend: CDG — FRA — MUC — DXB

Nonstop Competition from Comparative Hubs

	AF - CDG	LH- FRA	EK - DXB	SQ - SIN
3+ Competitors			1.1%	10.0%
2-4 Competitors	10.3%	10.5%	34.1%	36.0%
1 Competitor	46.2%	46.1%	20.9%	22.0%
No Competition	43.4%	43.4%	44.0%	32.0%

Legend: ■ No Competition ■ 1 Competitor ■ 2-4 Competitors ■ 3+ Competitors

Total Seats Capacity

Legend: EK — SQ — AF* — LH*

EK - DXB				SQ - SIN		
Region	Countries	Destinations	Frequencies	Countries	Destinations	Frequencies
Africa	16	18	159	2	3	14
Domestic	0	0	0	0	0	0
Europe	13	24	288	11	14	100
Far East	9	12	168	11	18	344
Latin America	1	1	7	0	0	0
Middle East	10	13	200	3	5	32
North America	2	5	38	1	5	45
Oceania	2	6	98	2	7	113
South Asia	5	17	275	4	9	69
TOTAL	58	96	1,233	34	61	717

6

Circuitry (uni-directional)

- **Identify own hub advantage compared to other hubs**

Source: Great Circle Distance calculator; Note: Circuitry represents pct. diff. in distance between a non-stop flight vs. connection over a given hub. For trips from the 20 largest inter-regional origins (by seats) in North America (blue) and Europe (green) to the 20 largest hubs in Asia and Australia (by seats)
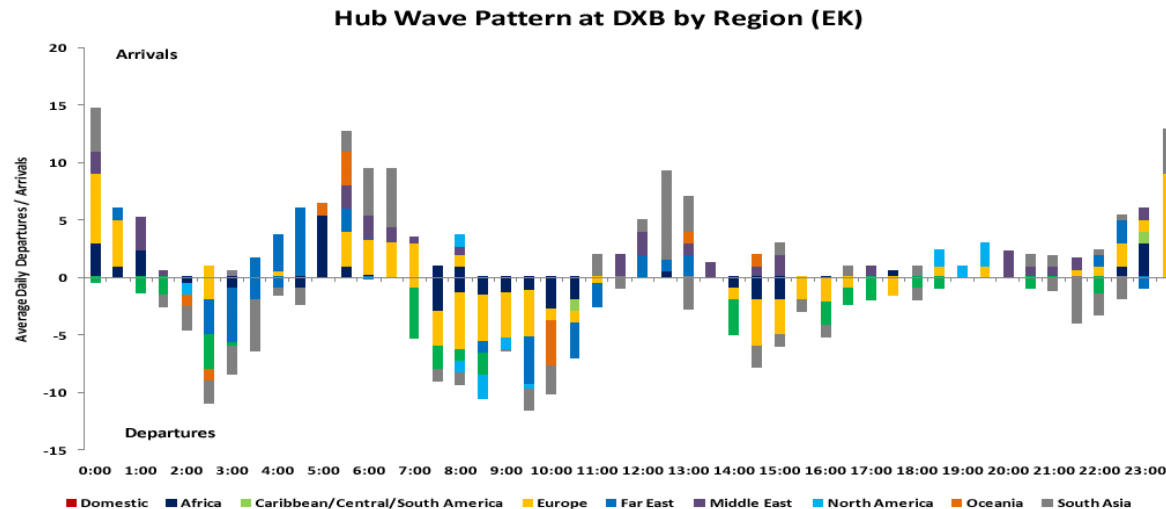
Leverage strengths of own hub

- ## Do detailed review to identify opportunities

Hub Wave Pattern at SIN by Region (SQ)

Hub Wave Pattern at DXB by Region (EK)
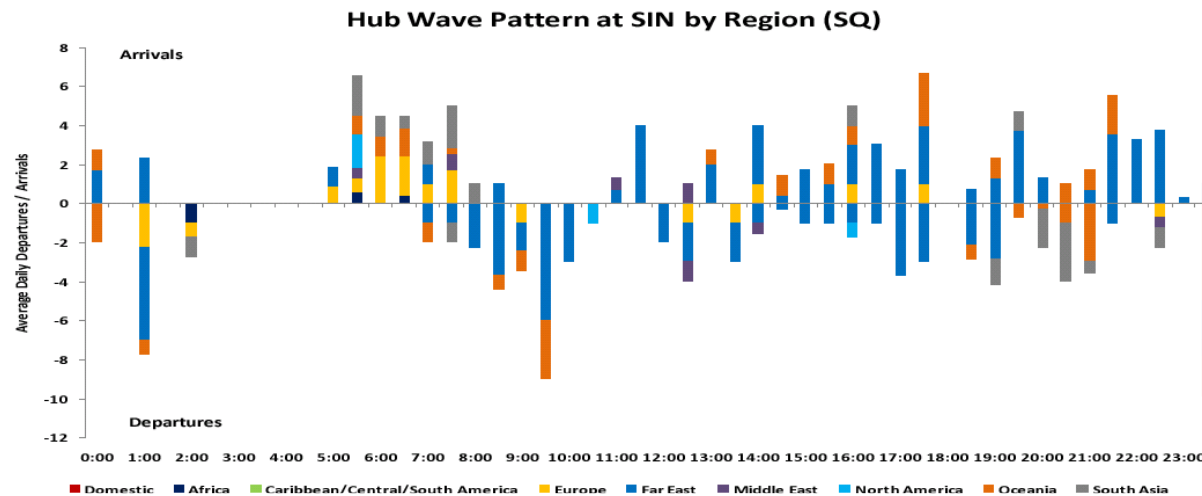
- • Completion
- • Time of Day advantage
- • Non-stop advantage

Check demand/supply changes

- ## Focus both on region and market level

Region-Region	Circuitry	Yield		Onboard O&D		Industry O&D		Growth		A1 Share
		Aug-09	Aug-10	Aug-09	Aug-10	Aug-10	Aug-10	A1	Industry	of Industry
EU-NO	108%	8.8	9.0	869,909	1,019,118	8,330,229	8,479,367	17.2%	1.8%	12%
NO-EU	109%	8.7	9.1	835,797	986,496	8,330,229	8,479,367	18.0%	1.8%	12%
AP-AF	107%	9.4	9.3	657,943	703,314	5,776,835	5,630,906	6.9%	-2.5%	12%
AF-AP	106%	9.4	9.3	655,028	701,660	5,776,835	5,630,906	7.1%	-2.5%	12%

1. Relative growth of region to region flows considering yield and circuitry

Region	A1	A2	A3	Yield
EU-EU	6.2	6.6	8.5	9.6
LA-EU	9.4	9.2	11.0	9.1
EU-NO	9.1	9.1	10.6	9.0
AP-EU	9.5	9.1	8.8	9.3

2. Benchmark connectivity with key competitors considering yield

Connect Markets	2005	2006	2007	2008	2009	2010
CDG-MED	87	391	853	793	1,717	2,566
DAM-MXP		35	29	56	2,347	2,561
PEK-ODS	1,452	2,050	1,195	1,539	2,539	2,528
BKK-TLV	847	1,294	2,308	3,745	3,679	2,499

3. Historical growth O/D growth

4. Relative growth of airline market share share compared to O/D market flow considering yield and circuitry

| Connect Markets	Service Share		O&D Share		% Change		CCt	O&D	Yield
	Jan-09	Jan-10	2009	2010	Service	O&D			
BKK-ARN	0.8%	0.9%	2.0%	3.3%	8%	61%	101%	6,786	3.0
PEK-TIP	0.6%	0.7%	1.6%	2.9%	4%	79%	101%	5,968	3.0
IKA-YYZ	1.4%	1.3%	7.3%	8.9%	-9%	23%	110%	5,674	2.8
ALG-MED	50.2%	100.0%	86.0%	86.3%	99%	0%	117%	5,196	7.7

Focus on city pairs we want to develop/improve

- ## Important to consider circuitry & yield

Check demand/supply changes

- ## Focus both on region and market level

  - 100 o/d thru the hub, relative changes of share of different airlines – given the hub advantage of the home airline

  - Relative market share growth of the hub carrier compared with overall O/D market growth
    - Growing share of growing O/D
    - Reducing share of growing O/D
    - Growing share of reducing O/D
    - Reducing share of reducing O/D

  - Above analysis vis a vis hub carrier's share and average O/D fares

% Passenger Change by Carrier
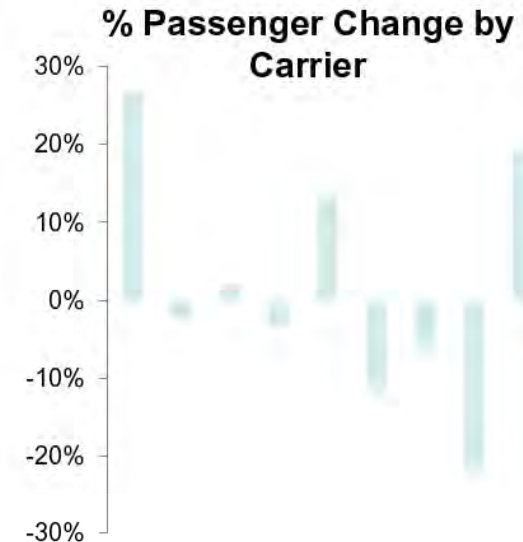
City Pair	Total O&D Pax		A1 O&D Pax		A1 market share		Market growth			Average fares in US$			
							Total O&D market	A1	A1 share growth	Total market	A1	Total market	A1
	2009	2010	2009	2010	2009	2010			(in pct. points)	2009	2009	2010	2010
AUH - KUL	316,744	375,481	1,078	527	0.3%	0.1%	18.5%	-51.1%	-0.2%	444	345	393	389
BKK - DOH	236,195	236,616	11,824	7,020	5.0%	3.0%	0.2%	-40.6%	-2.0%	181	162	184	161
AUH - SIN	162,075	199,025	165	186	0.1%	0.1%	22.8%	12.7%	0.0%	957	608	1065	416
AUH - BKK	150,334	161,140	283	206	0.2%	0.1%	7.2%	-27.2%	-0.1%	978	253	1071	412

- **Do detailed review to identify opportunities**

Hub improvement by definition is in future, and environment analysis focused on present and past is insufficient

Market forecast should include both long term and (GDP driven) and short term (Paxis, Calibrated MIDT driven) elements
- Base year O&D market sizes
- Point of Sale by origin and destination country shares for each O&D market
- GNI Growths for each origin and destination country*
- GNI Multiplier: GNI Growth/Passenger Growth for each country

Markets are forecast on an airport O&D pair basis, and then summarized for the city pair, and then for the country pair basis

Air travel, which is correlated with wealth, has increased over the years with a rise in global GNI

Passenger Trips vs. GNI/Capita - 2002

GNI/Capita (2002 USD)
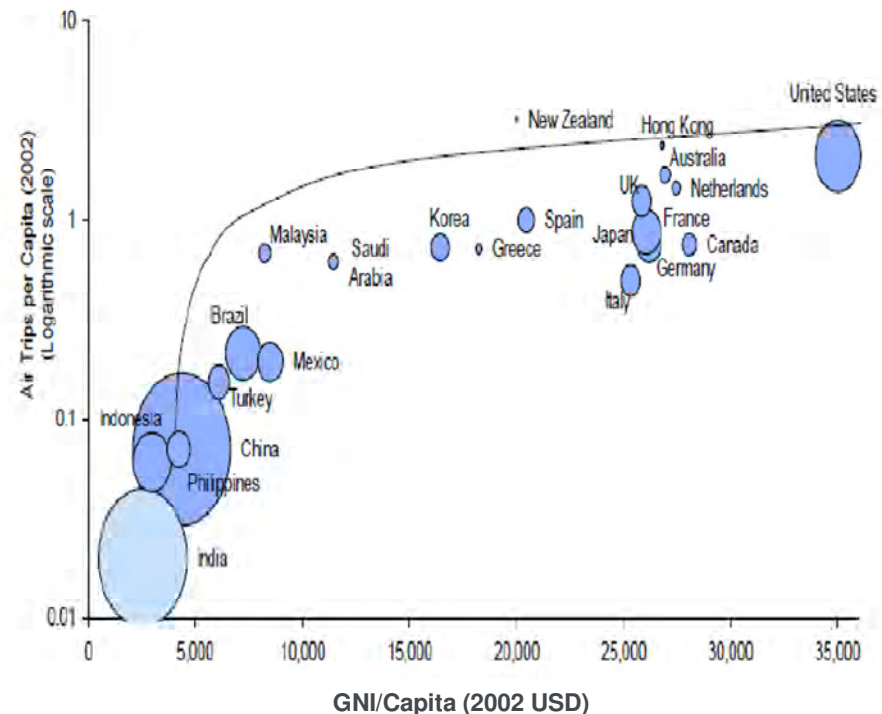
Note: Air Trips per Capita calculated using the number of passengers carried by the airlines of each country. Circle indicates population size

Leverage strengths of own hub

Objective is to focus on large, fast growth, high yield third/fourth freedom, and good circuitry, and fifth and sixth freedom O/D

Further to market forecast slice and dice to identify markets for scenario development, following are examples

- Largest region to region markets
- Largest and Fastest growing region to region markets
- Largest country to country markets
- Largest and Fastest growing country to country markets
- Fastest growth X largest markets (prioritize by product of fastest growth and largest markets)
- Prioritize by largest markets
- Prioritize by fastest growth markets
- Prioritize by fastest growth X largest markets that airline is not flying
- Prioritize by largest markets that airline is not flying
- Prioritize by fastest growth X largest markets that airline is not flying
- Given the growth and strategic fit, identify largest airport that airline is not flying
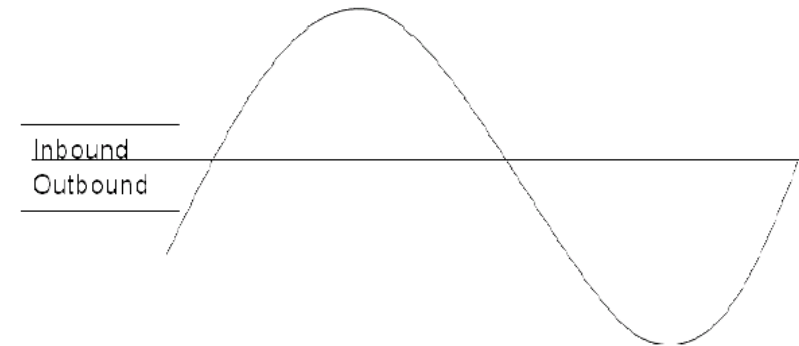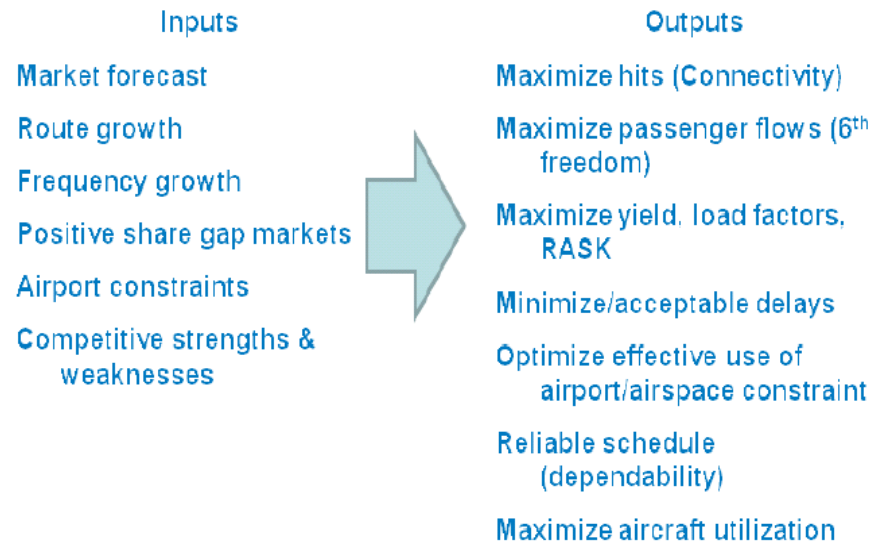
Examples

Country Flows	2010	2014	Yield	CAGR
Kuwait -India	2,000	3,500	180	10%
India-Saudi Arabia	1,900	3,300	250	11%
India-United Kingdom	1,300	2,400	170	10%
India-Indonesia	1,200	2,300	170	11%
Australia-UK	900	1,500	180	9%

Airport Markets	YTD	2014	Yield	CAGR
COK-DXB	520	1,000	250	12%
CAN-DXB	580	1,000	150	10%
BKK-DXB	400	800	120	11%
BKK-BOM	270	500	400	12%

Code	Airport	Country	Region	Notes
ABV	Abuja	Nigeria	Africa : Central/Western Africa	Possible less than Weekly frequency, less competition, Growing Market

Hub design principles - overview

Inputs

Market forecast

Route growth

Frequency growth

Positive share gap markets

Airport constraints

Competitive strengths & weaknesses

Outputs

Maximize hits (Connectivity)

Maximize passenger flows (6th freedom)

Maximize yield, load factors, RASK

Minimize/acceptable delays

Optimize effective use of airport/airspace constraint

Reliable schedule (dependability)

Maximize aircraft utilization

Inbound
Outbound

Design process schedule is a generator of alternatives, and selection of the best fit. Ideally, this is a combination of different optimization tools

Selecting the Best Hub Structure Requires Definition Alternative competing hub structures and selection of the best structure that leads to the optimal outputs

Peer Hub Bank Time Comparison			
	AF @ CDG	LH @ FRA	EK @ DXB
BDI	1.50	3.75	3.17
BDO	1.57	3.88	3.50
MCT	1.00	0.75	0.75
BDT	4.07	8.38	7.42
# Banks	7	4	3

Source: OAG, July 12-18, 2010

Bi- versus Omni-Directional hub

Hub Wave Pattern at DTW (DL)

Arrivals

Departures

Average Daily Departures / Arrivals

Time of Day (Local)

■ DL ■ OA

Hub Wave Pattern at DXB (EK)


Arrivals

Departures

Average Daily Departures / Arrivals

Time of Day (Local)

■ EK ■ OA
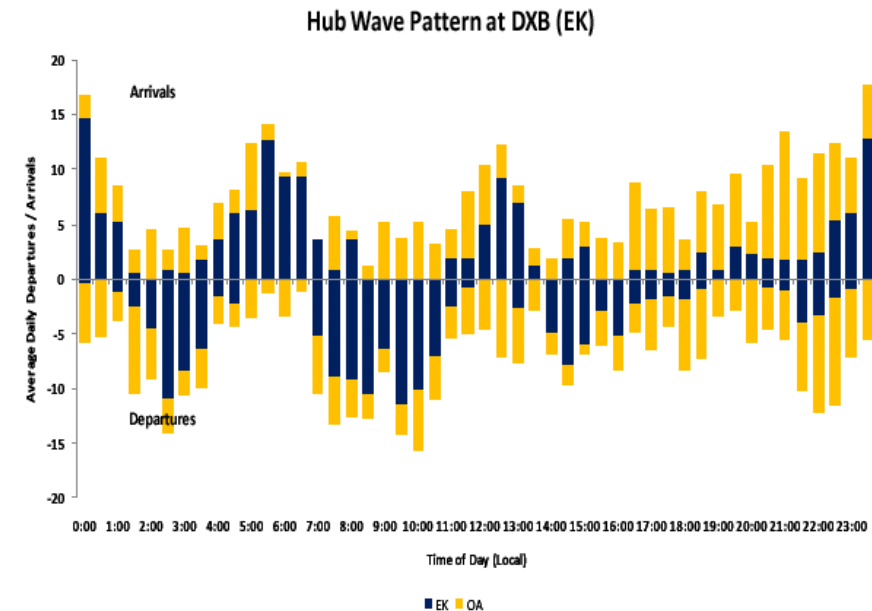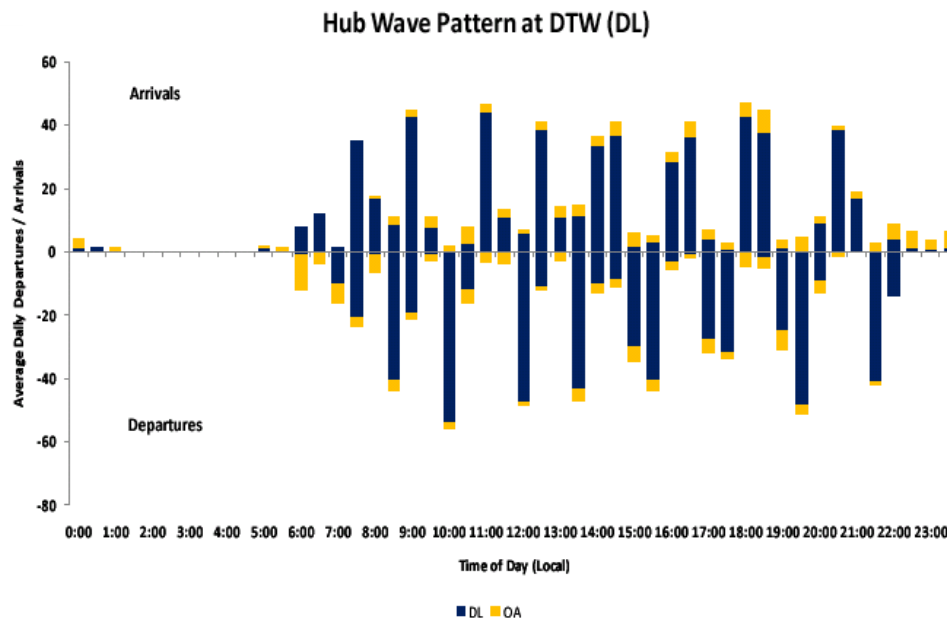
❑ DL's DTW hub is bi-directional (east-west) and has a 9-wave pattern

❑ Bi-directional hubs typically have 6+ waves in their daily hub structure

❑ This type of structure is most commonly found in U.S. hubs

❑ EK's DXB hub is omni-directional and has a 3-wave pattern

❑ Omni-directional hubs are more commonly found in European, Gulf and Asian hub patterns and typically have 3-7 waves per day

Source: OAG, July 12-18, 2010

Impact of Capacity Constraints

**Hub Wave Pattern at CDG (AF)**

Hub Wave Pattern at FRA (LH)
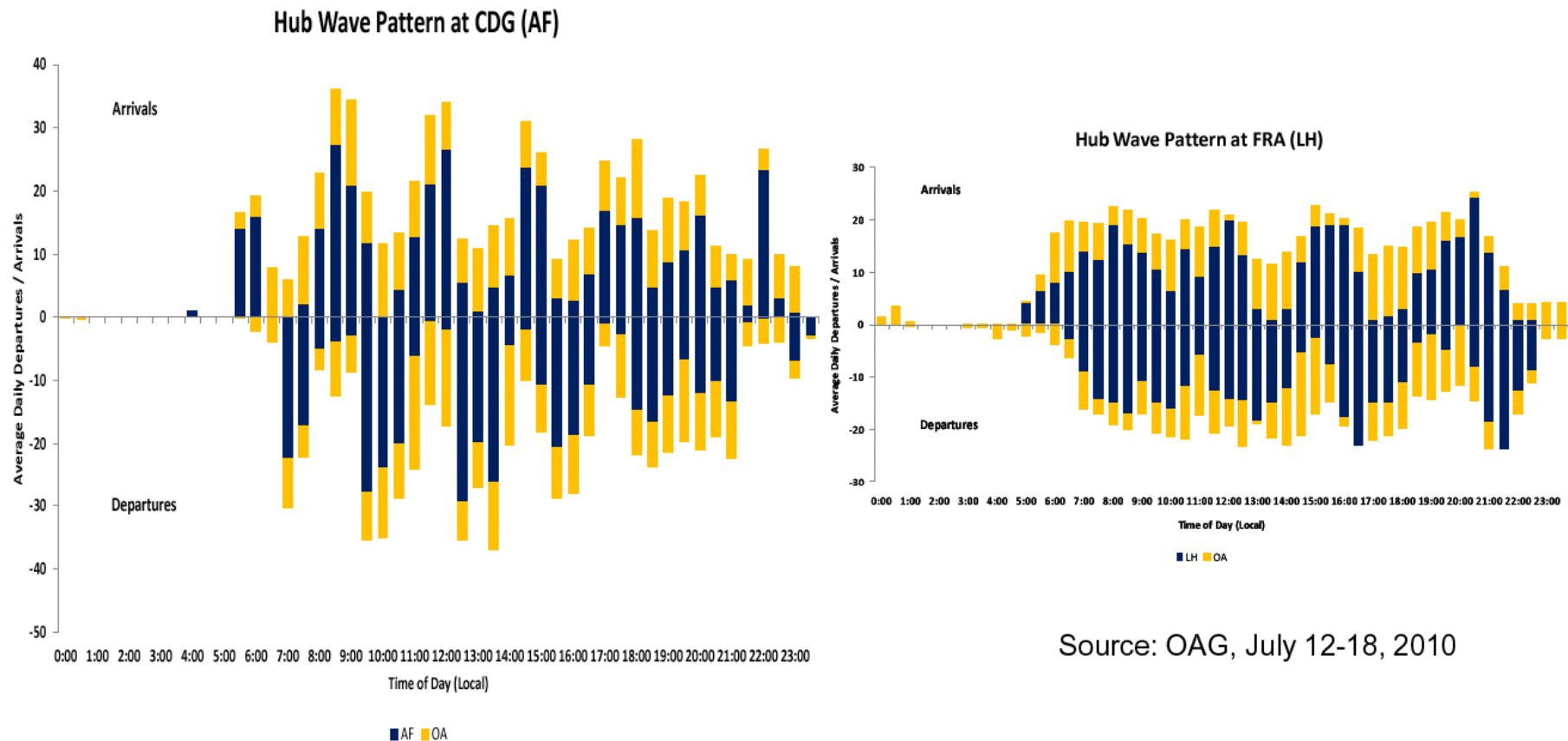
Source: OAG, July 12-18, 2010

❑ Capacity constraints limit spiked bank patterns, resulting in a more flattened design pattern serves many connections involving long-haul flights using wide body aircraft

❑ A trade-off exists between bank overlap and number of connections
❑ Revenue benefit of longer connections gained offsets revenue lost by bank overlap

De-peaking to reduce OPEX

Hub Wave Pattern at DFW (AA)
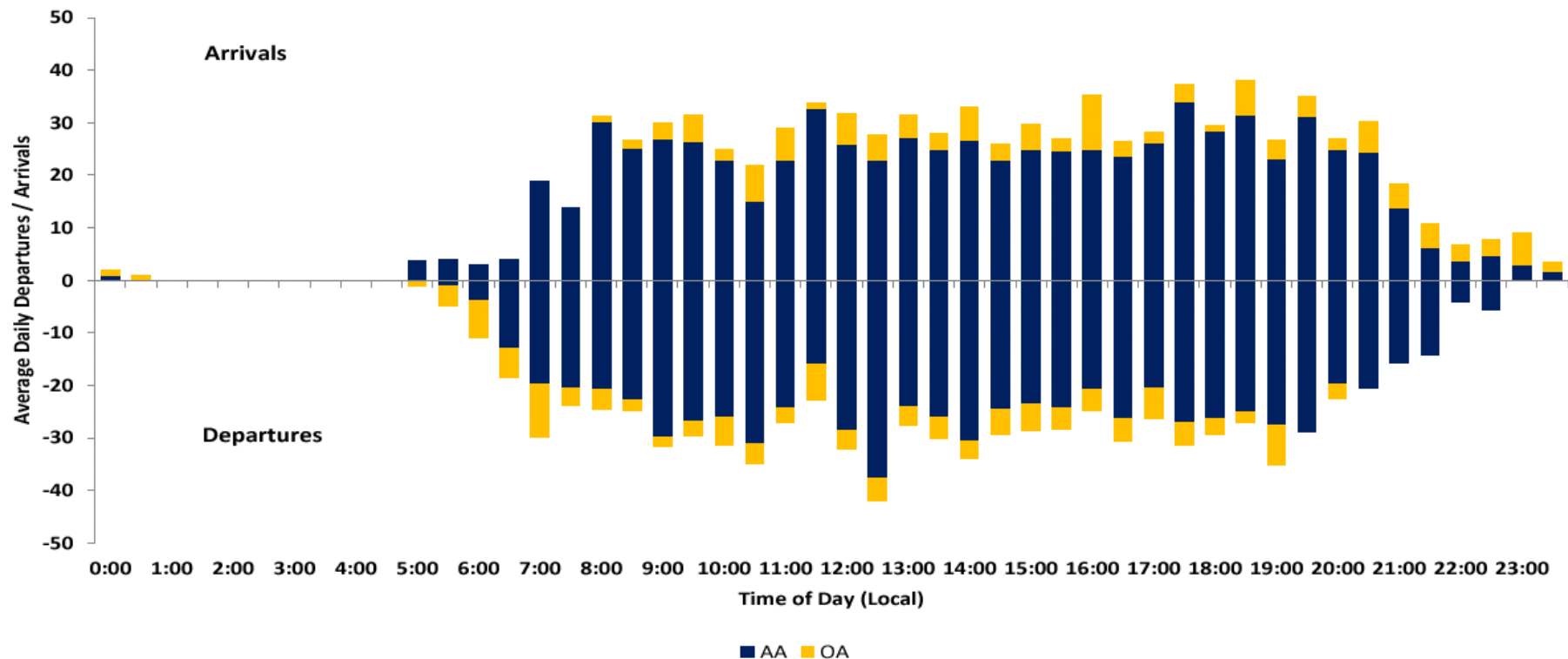
- ❑ AA employs a continuous, or rolling wave pattern at it's primary (largest) hub at DFW
- ❑ The operational efficiency benefits of this structure outweigh the financial benefits of increased directional connectivity
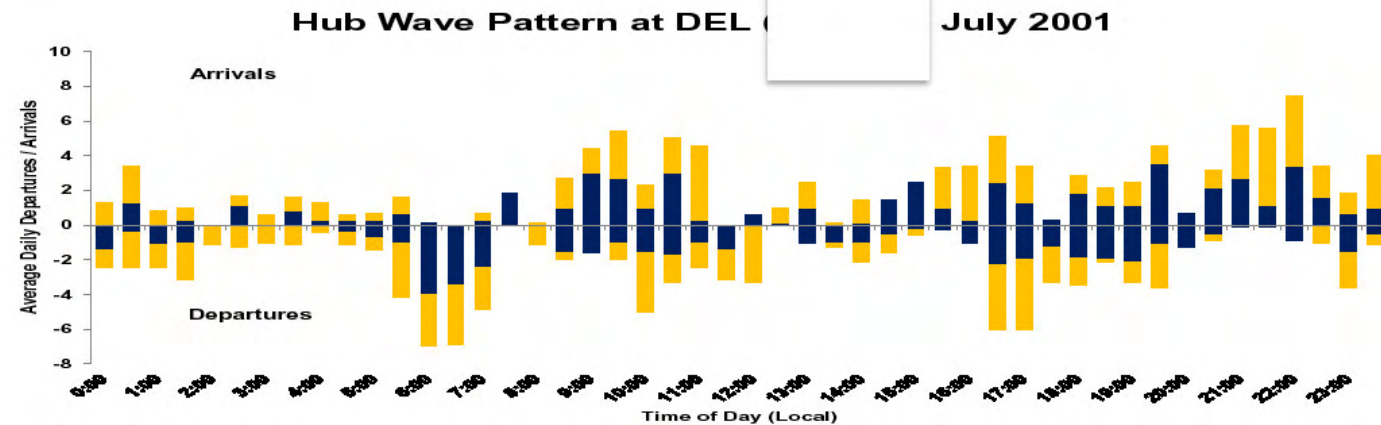
Source: OAG, July 12-18, 2010

Delhi hub - geography

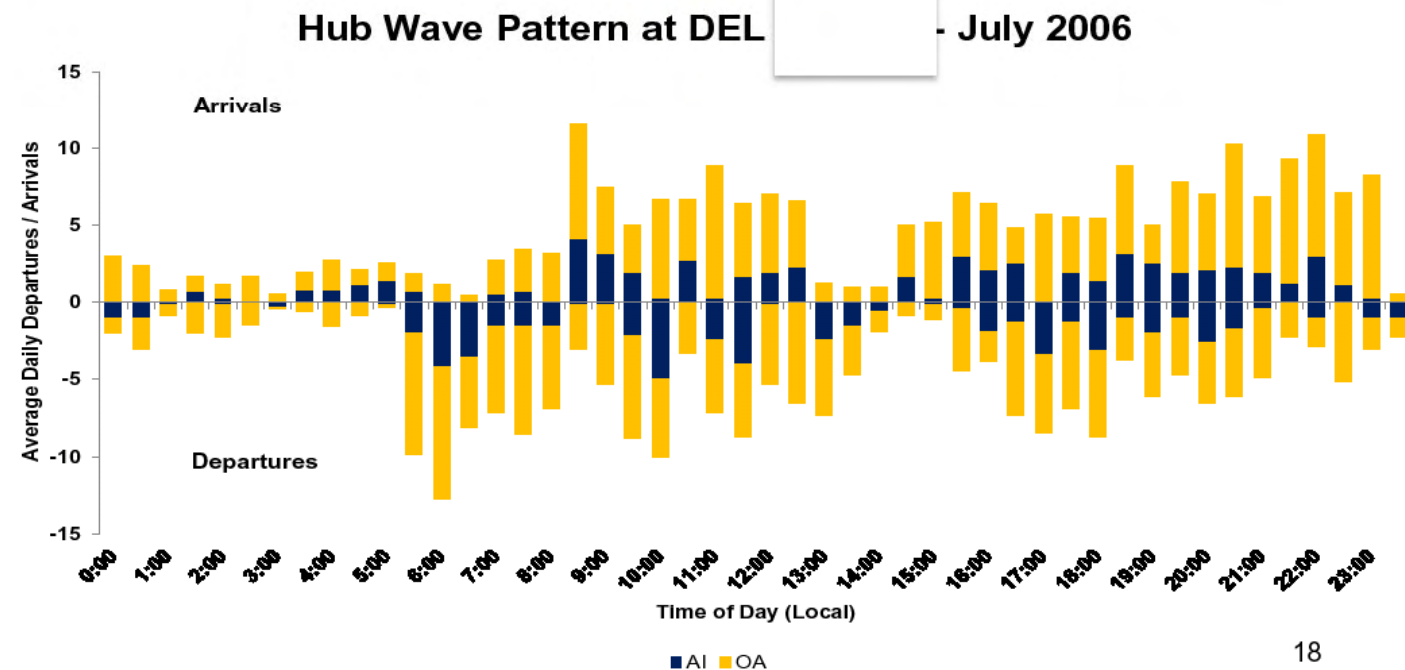- **Direct routing to 6th Freedom markets**
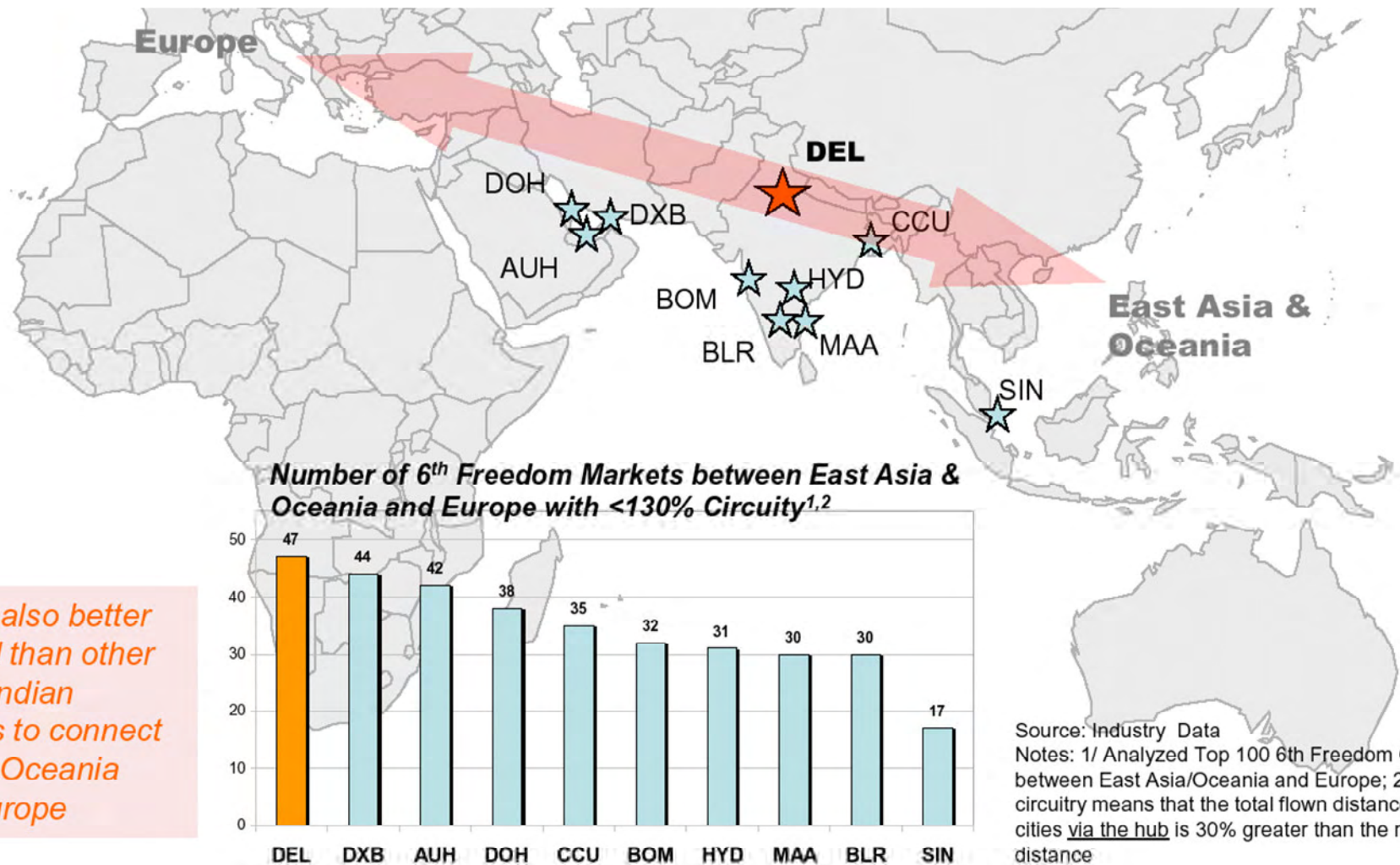
DEL is also better located than other major Indian airports to connect Asia & Oceania with Europe

Number of 6th Freedom Markets between East Asia & Oceania and Europe with <130% Circuity[1,2]

DEL	DXB	AUH	DOH	CCU	BOM	HYD	MAA	BLR	SIN
47	44	42	38	35	32	31	30	30	17

Source: Industry Data
Notes: 1/ Analyzed Top 100 6th Freedom O&Ds between East Asia/Oceania and Europe; 2/ 130% circuitry means that the total flown distance between cities via the hub is 30% greater than the nonstop distance

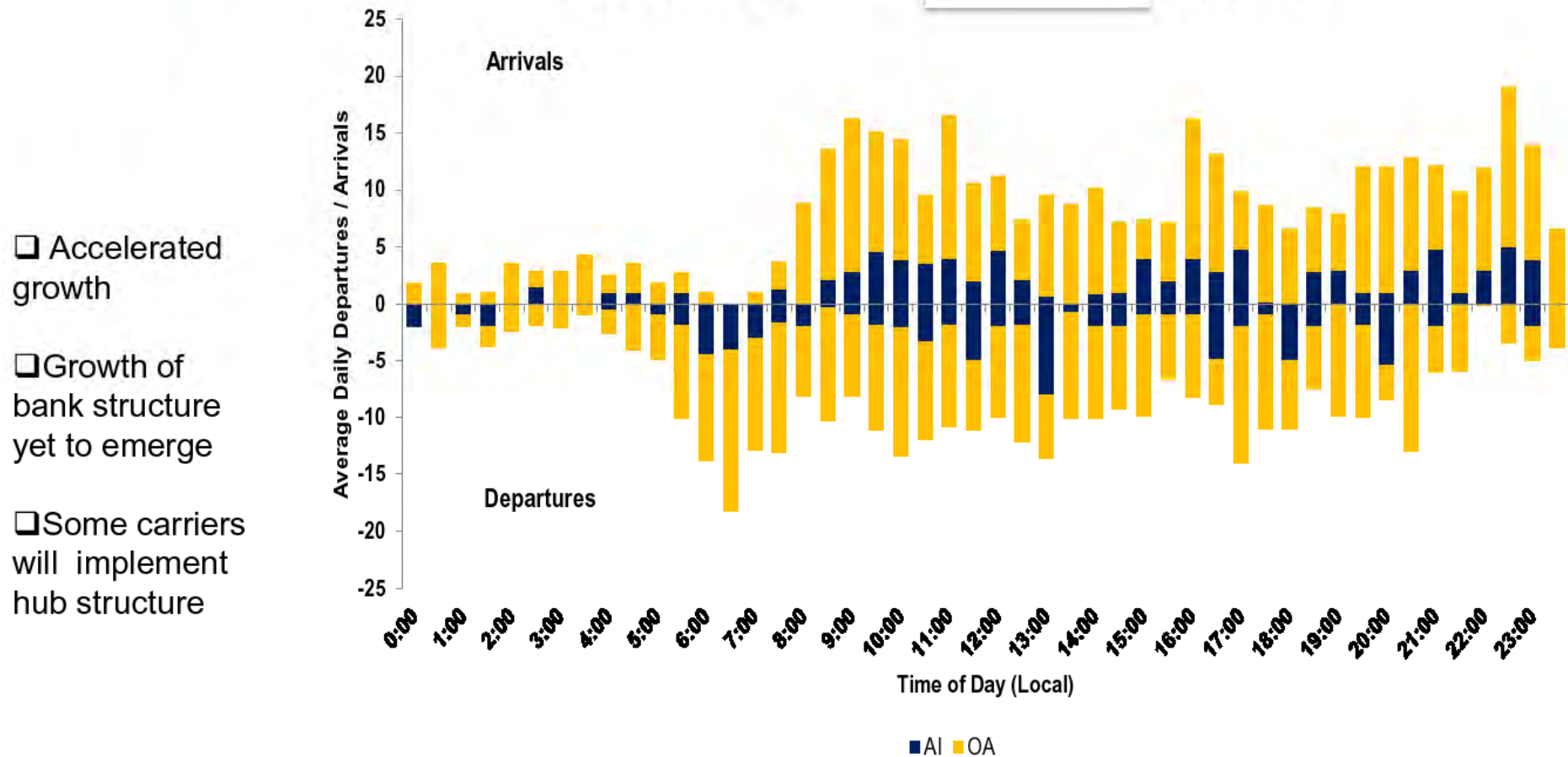# Delhi hub - growth pattern

Hub Wave Pattern at DEL — July 2001

□ Growth without a well defined hub structure

□ Opportunities lost for connecting markets and growth opportunities for 6th freedom traffic

Hub Wave Pattern at DEL — July 2006
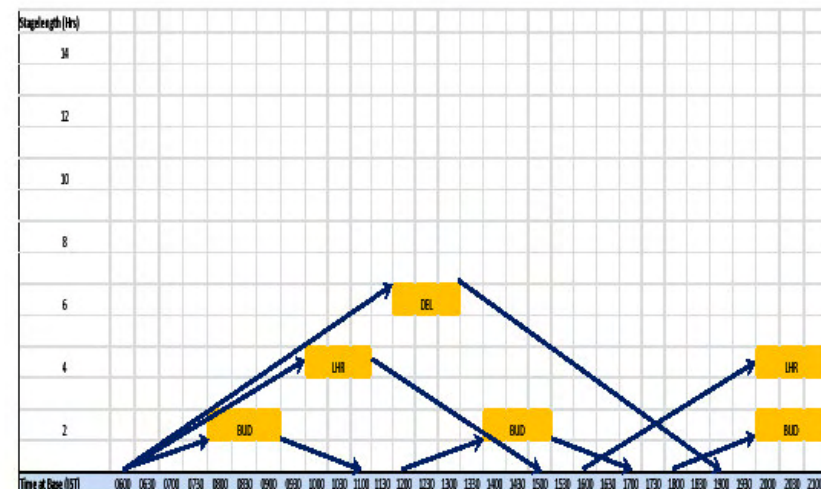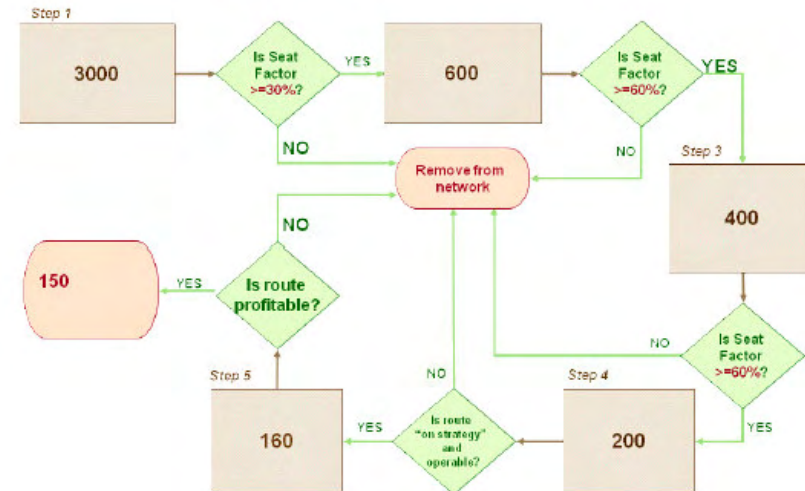
Source: OAG, July 9-15, 2010

Delhi hub - growth pattern

❑ Accelerated growth

❑ Growth of bank structure yet to emerge

❑ Some carriers will implement hub structure
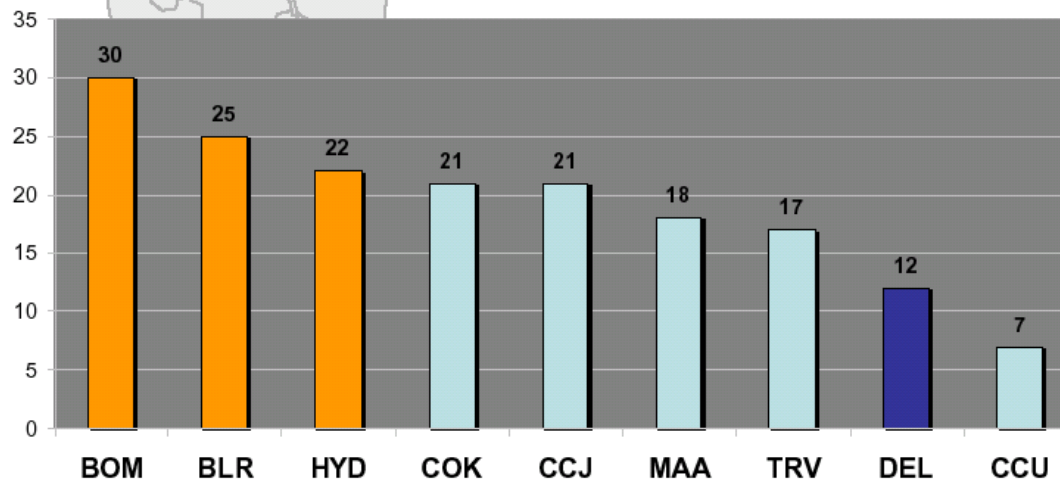
Source: OAG, July 11-17, 2011

Hub Design & Optimisation

❑ Overbuild – maximise margins

❑ Lang haul flights optimisation

❑ Medium to short haul flights optimisation

❑ Within bank flight optimisation

❑ Maximising connection of high yield markets

❑ Optimise hub connectivity

BOM/BLR/HYD - Regional Hubs?

Europe

DOH

DXB

AUH

DEL

CCU

BOM   HYD

BLR   MAA

SIN

East Asia & Oceania
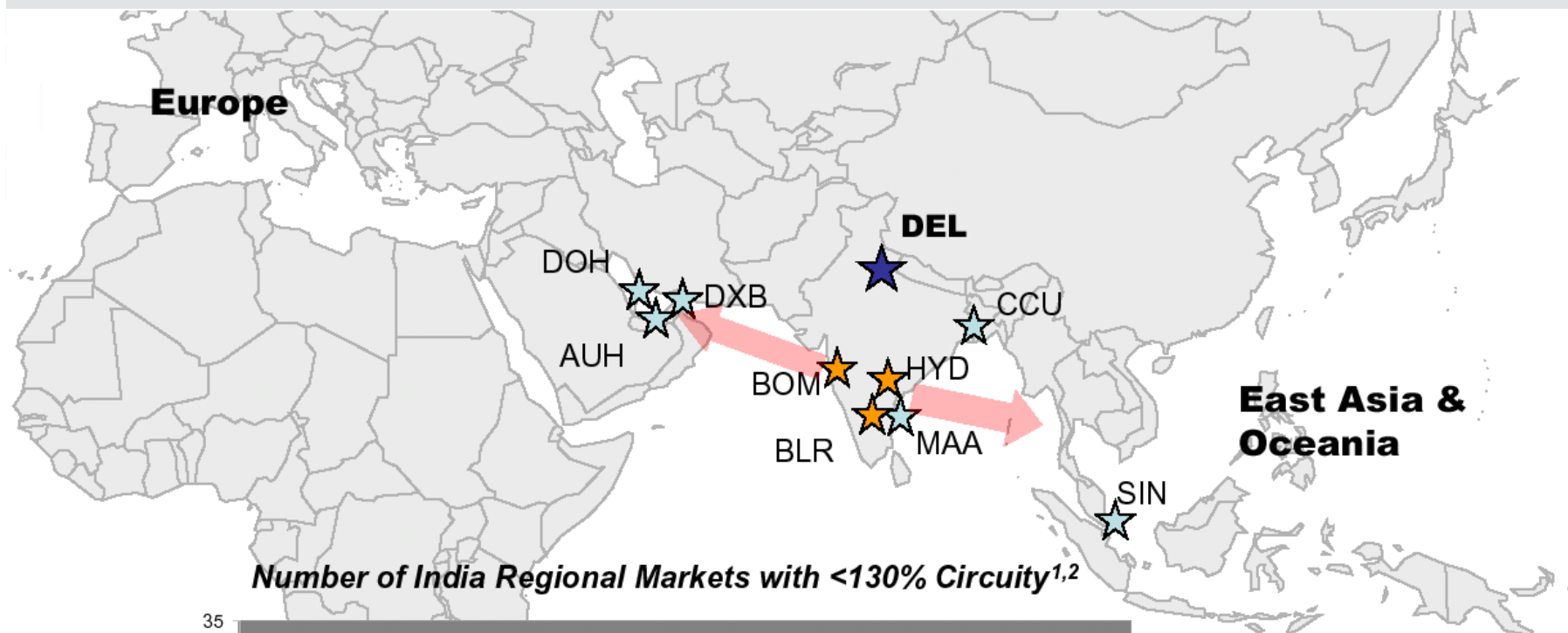
Number of India Regional Markets with <130% Circuity[1,2]

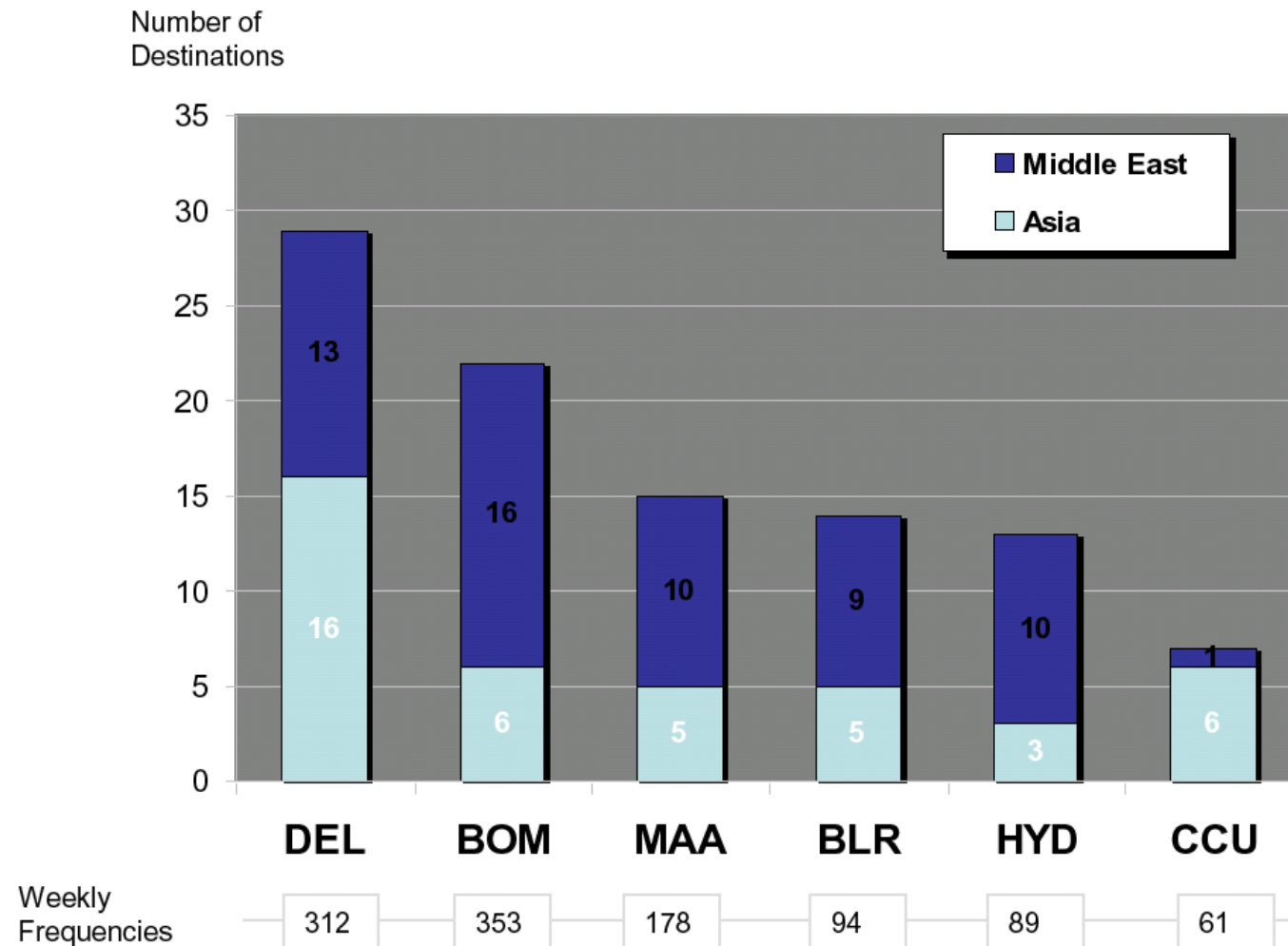| BOM	BLR	HYD	COK	CCJ	MAA	TRV	DEL	CCU
30	25	22	21	21	18	17	12	7

Source: Industry Data
Notes: 1/ 130% circuity means that the total flown distance between two cities via the hub is 30% greater than the nonstop distance
2/ Top 50 Regional O&Ds were analyzed accounting for 78% of all Regional O&D traffic

Comparative airport assessment

Number of Destinations

Source: OAG July 2009 – June 2011

Hub Evaluation Criteria

Primary Hubs

Evaluation Criteria	Minimum Requirement
Intl O&D demand	>1.5 million annual pax in 2008
Dom O&D demand	>1.5 million annual pax in 2008
Good circuity for 6th Freedom markets	>30 of top markets <130% circuity
Potential for strong presence	achieves ranking in top 2 by seat share
Apt capacity for hubbing	>40 gates available simultaneously

Secondary Hubs

Evaluation Criteria	Minimum Requirement
Regional O&D demand	>1 million annual pax in 2008
Dom O&D demand	>1 million annual pax in 2008
Good circuity for regional markets	>20 of top regional markets <130% circuity
Good circuity for domestic markets	>20 of top domestic markets <130% circuity
Apt capacity for hubbing	>20 gates available simultaneously

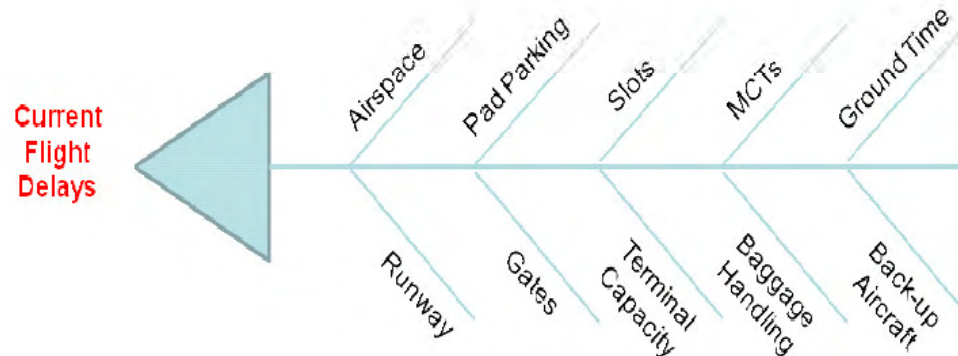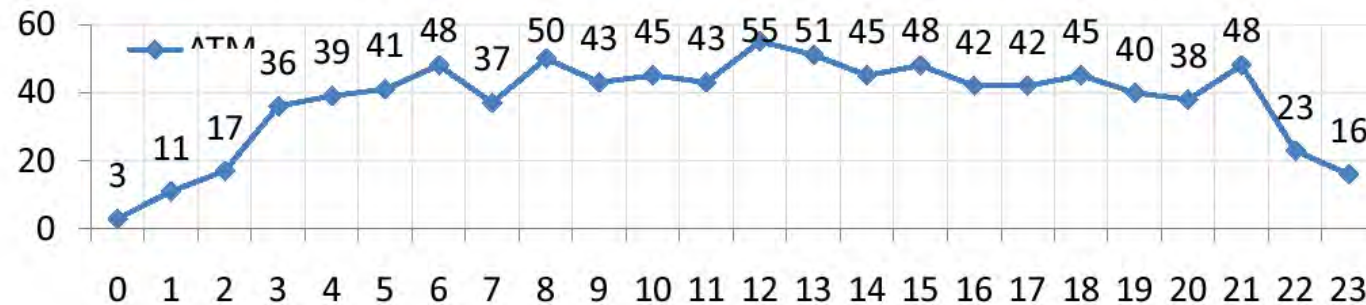# Criteria applied to India

✓ = Meets criteria

Evaluation Criteria	BOM	DEL	CCU	MAA	BLR	HYD	AMD	COK	CCJ	TRV	PNQ	NAG	ATQ	GOA	TRZ
Intl O&D demand	✓	✓		✓				✓							
Dom O&D demand	✓	✓	✓	✓	✓	✓									
Good circuity for 6th f'dom mkts	✓	✓	✓												
Strong presence	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
Apt capacity for hubbing	✓	✓		✓	✓	✓									
Conclusion	✓	✓													

Only BOM and DEL satisfy all of the criteria to be a Primary Hub

Line chart (ATM) with hourly values (hours 0–23): 3, 11, 17, 36, 39, 41, 48, 37, 50, 43, 45, 43, 55, 51, 45, 48, 42, 42, 45, 40, 38, 48, 23, 16

Fishbone diagram — Current Flight Delays: Airspace, Pad Parking, Slots, MCTs, Ground Time, Runway, Gates, Terminal Capacity, Baggage Handling, Back-up Aircraft

Airport	HC1	HC2	Standard				Hub Carrier #1				Hub Carrier #2			
			D-D	D-I	I-D	I-I	D-D	D-I	I-D	I-I	D-D	D-I	I-D	I-I
AMS	KL		25	50	50	50	50	50	50	50				
AUH	EY		60	60	60	60	60	60	40	60				
BKK	TG		30	120	120	75	30	90	90	45				
CAI	MS		30	90	90	90	60	60	60	60				
DOH	QR		20	60	60	60	20	60	60	30				
DTW	DL		45	60	90	60	30	40	75	75				
DXB	EK		20	60	60	75	20	60	60	45				
FRA	LH		45	45	45	45	45	45	45	45				
HKG	CX		n/a	n/a	n/a	60	n/a	n/a	n/a	50				
IAH	CO		45	60	60	75	30	30	50	50				
ICN	KE	OZ	40	100	100	70	40	70	100	45	40	70	90	45
IST	TK		30	90	75	60	45	75	75	60				
KUL			60	60	60	60								
MSP	DL		40	40	60	60	30	40	75	75				
MUC	LH		45	45	45	45	30	30	30	30				
NRT	JL	NH	30	100	100	60	20	100	90	60	20	100	100	60
PHL	US		40	90	90	90	30	50	90	90				
SAW	TK		20	60	60	60	30	45	45	45				
SEA	AS		70	70	90	90	40	40	80	80				
SIN	SQ		n/a	n/a	n/a	60	n/a	n/a	n/a	50				

Source: InterVISTAS Analysis

Constraints - Future delays

□ Growth of constrained hubs will expend delays
□ Establish baseline in terms of correlating delays to ATM
□ Values of constraints

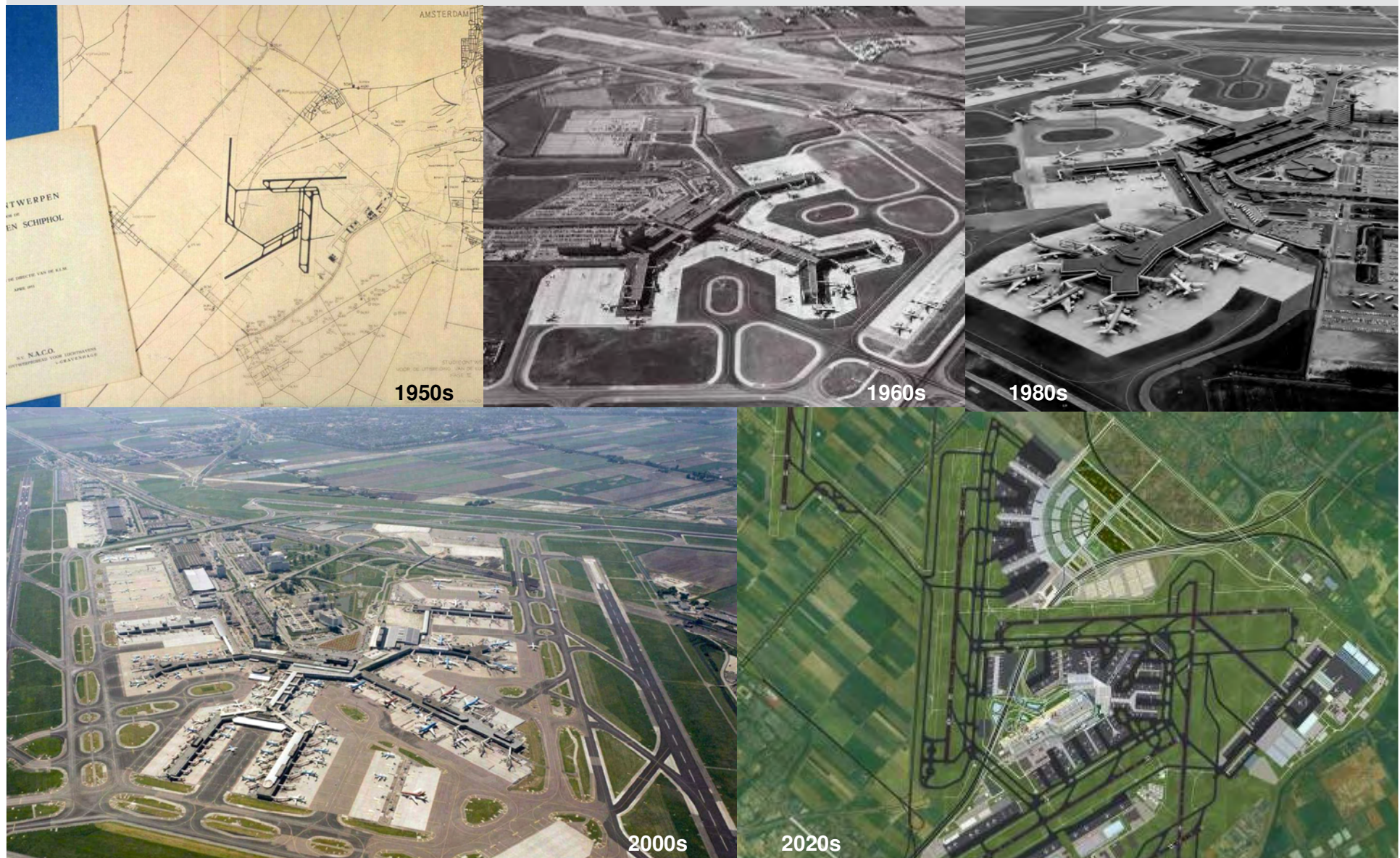**Avg. Delay * 2010)**

ATM as a % of current ATM

Normal Probability Plot

Sample Percentile
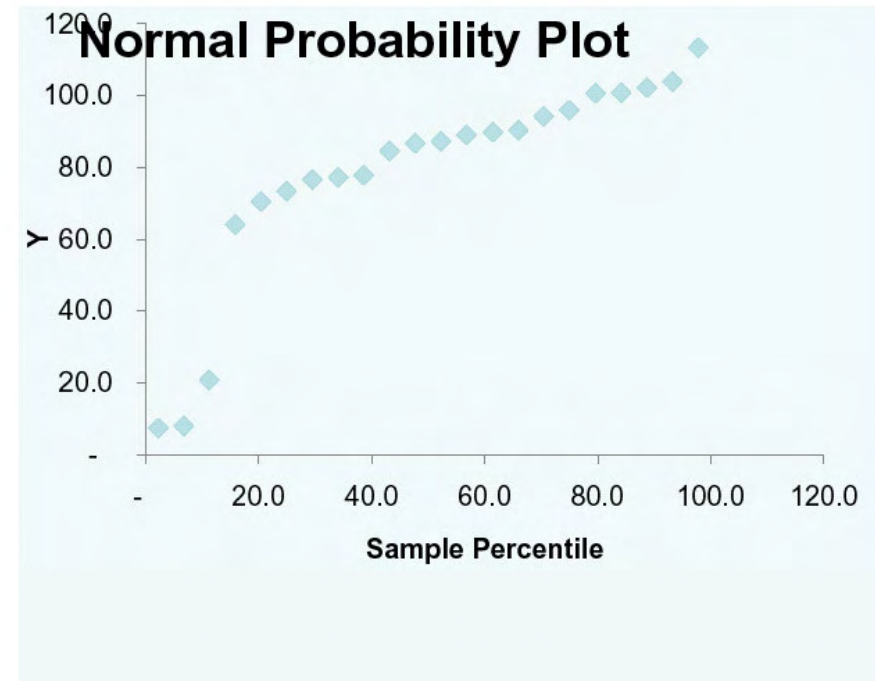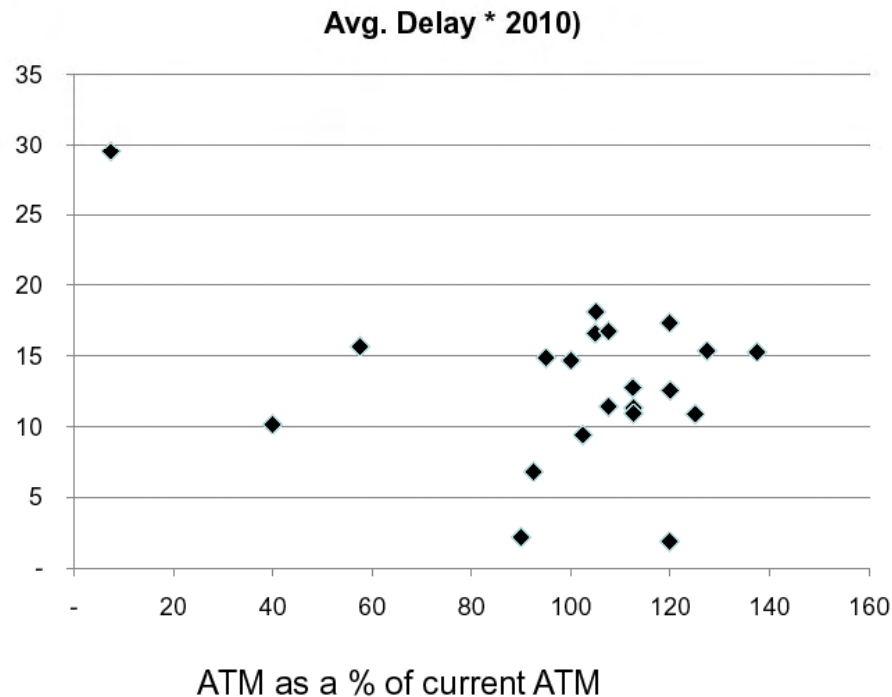
How to develop a Hub Airport

Development of Amsterdam Airport Schiphol
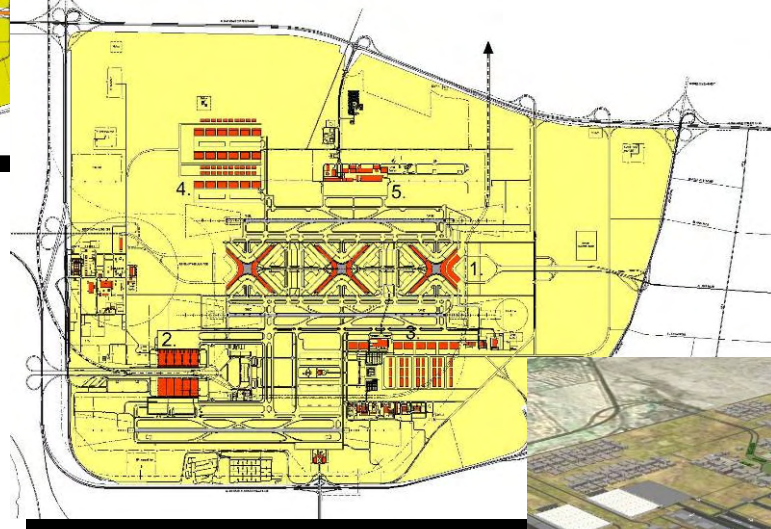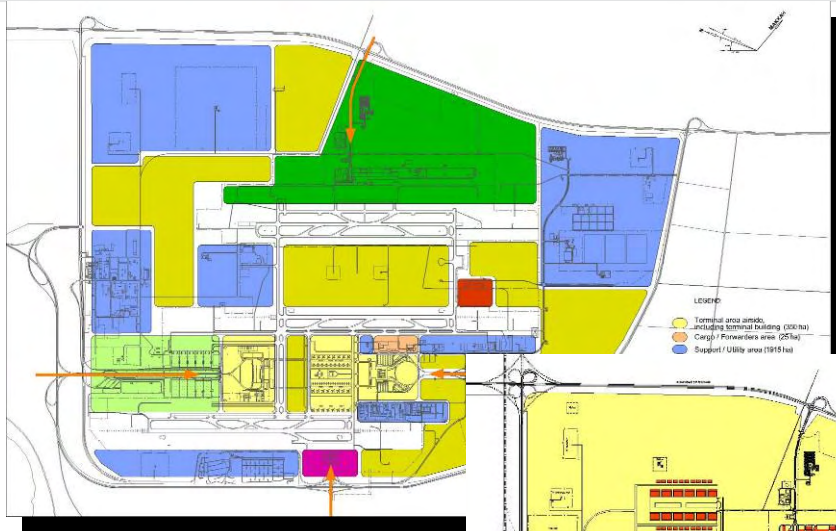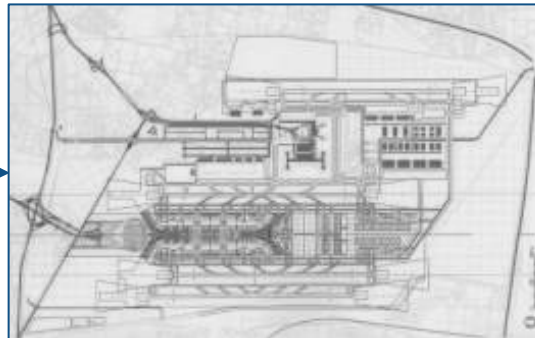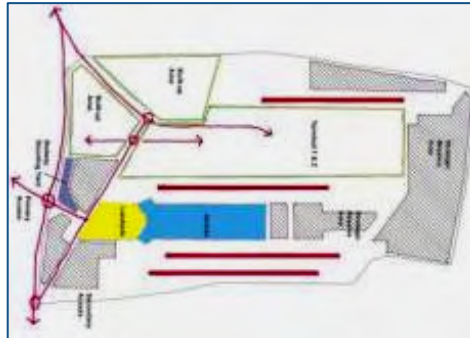
NACO: From Land Use Plan to Master plan: Beijing Capital International Airport, China
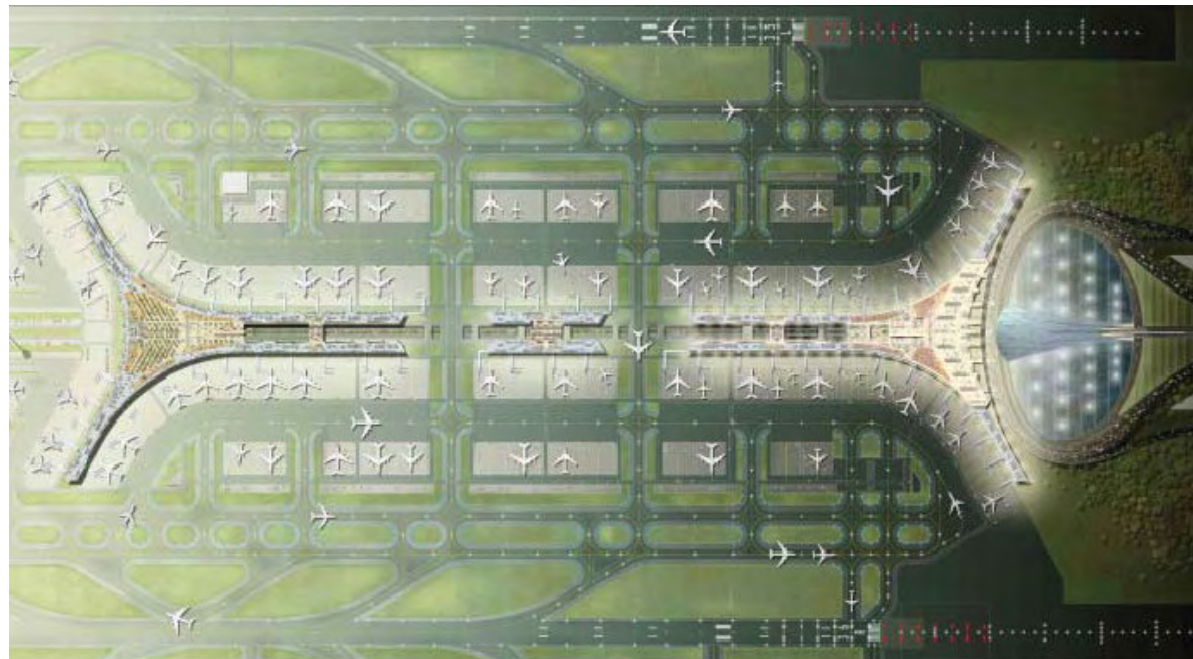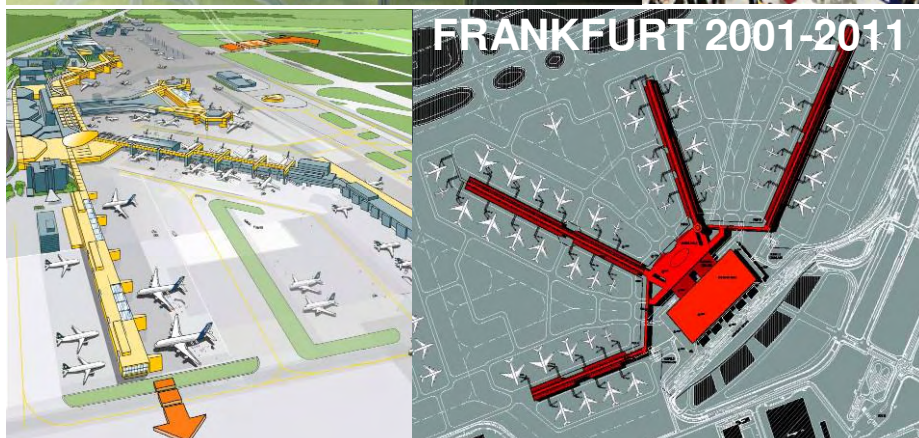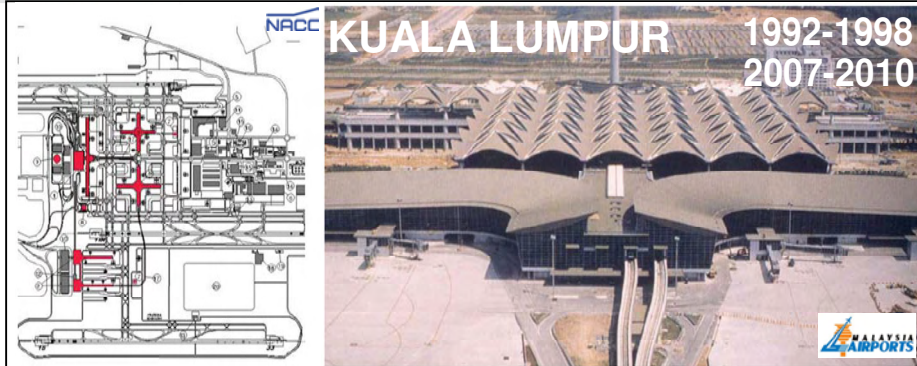

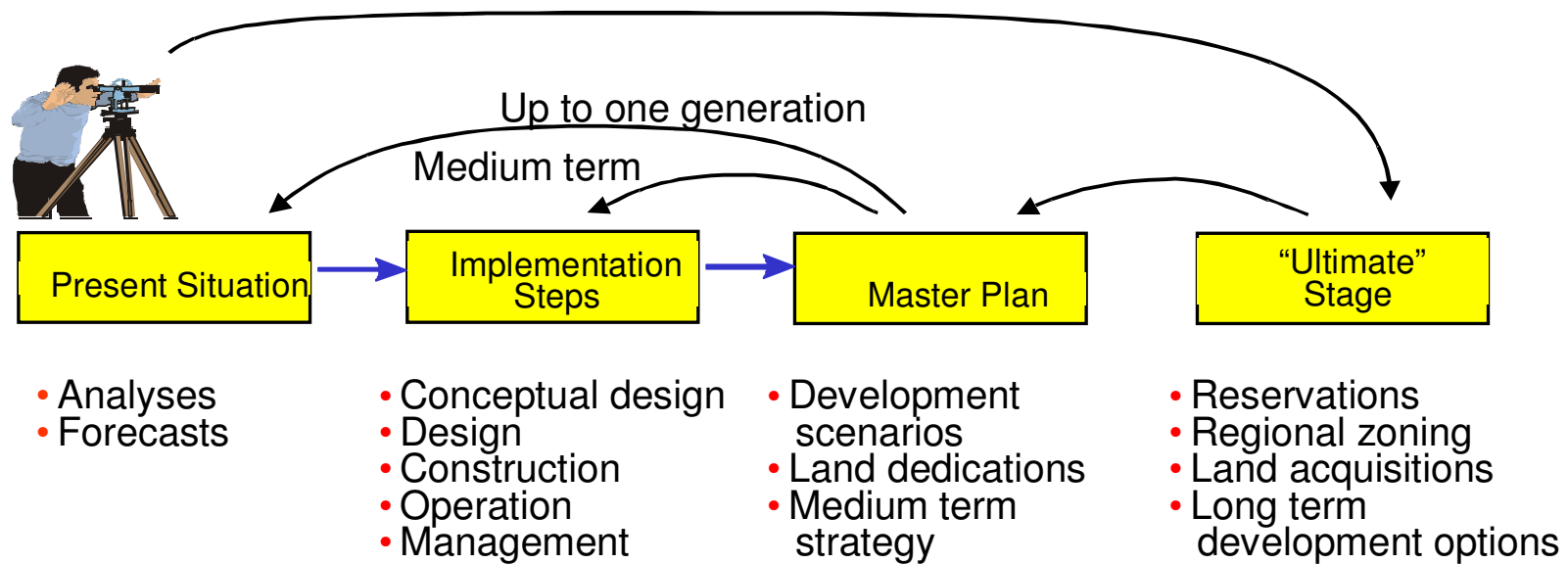**Followed by NACO i.a.w. Foster & Arup winning the design competition for the Midfield T3.**

How to develop a Hub Airport

Various NACO projects

KUALA LUMPUR 1992-1998 2007-2010

BANGKOK 1992-2000

BEJING 2004-2008

MUMBAI CSIA 2004-2007

FRANKFURT 2001-2011

DEVELOPMENT OF A MASTER PLAN

Up to one generation

Medium term

Present Situation	Implementation Steps	Master Plan	"Ultimate" Stage

- Analyses
- Forecasts

- Conceptual design
- Design
- Construction
- Operation
- Management

- Development scenarios
- Land dedications
- Medium term strategy

- Reservations
- Regional zoning
- Land acquisitions
- Long term development options

TERMINAL CONCEPT ALTERNATIVES

→ Terminal Concept according to land use plan and facility sizing
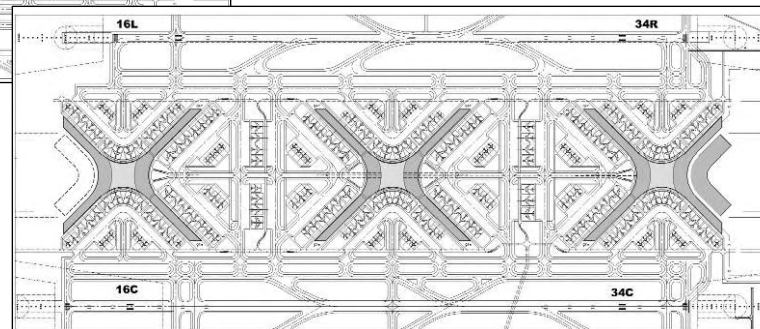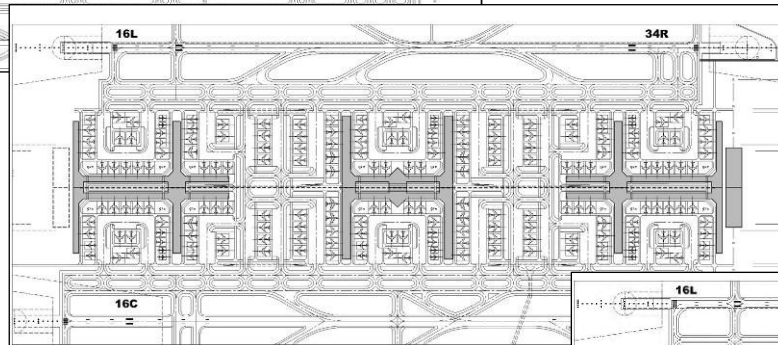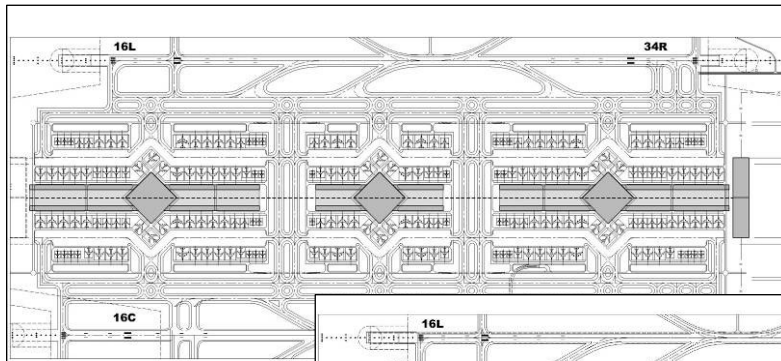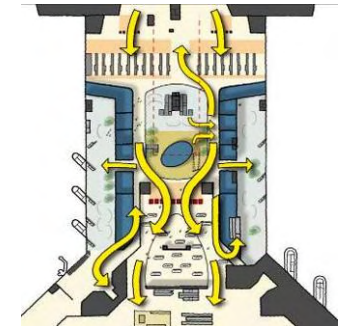→ Analyze alternatives (strengths, weaknesses, threats and opportunities)

1. **Develop**
2. **Evaluate**
3. **Select the best**

emre serpen

EXECUTIVE VICE PRESIDENT

Emre led the design of Delhi and Mumbai hubs part of the new network stratrgy for Air India. He is currently leading design of Ataturk hub for Turkish Airlies, previously led design of the Cairo hub after first year of implementation project delivered $ 60 million USD benefit . Emre is also currently leading a team for SLA, where project scope includes hub improvement .

Emre is focused on developing and executing optimal and implementable solutions in both strategy and business transformation assignments . His extended client relationships are driven by the delivery of business results.

- In Airline space, Emre has worked with over 40 carriers worldwide. Projects include feasibility, network design, revenue management, distribution, operations control, crew management and IT Strategy.

He won the 2002 ATTIS outstanding contribution award for his work in low cost modelling. Previously Emre led transformation practicefor SH&E , airline consulting for EMEA & APAC for Sabre, led IM for Travel and Transport in Gemini, and established technology consulting business for Ove Arup.

- Emre has a PhD in Cybernetics , and BSc in Industrial Engineering. He is a Chartered Engineer.

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joeri aulman

REGION MANAGER INDIA

Following the completion of the Mumbai Master plan by NACO, Joeri led the stakeholder meetings for the International Terminal Reconfiguration at Mumbai Airport; one of the primary enabling works to facilitate the development of a new common terminal building at Sahar.

He is currently leading design of Sarajevo International Airport Terminal expansion and, as Region Manager South Asia, managing NACO's projects in India.

This includes the following projects:

- Design for CSC's Greenfield Air Cargo Terminal at IGIA;

- MRO Bid Design for Punj Lloyd at IGIA;

- Landside Business Planning for Gulbarga Greenfield Airport;

-Terminal Design for Gulbarga Greenfield Airport.

-Previously Joeri was Business Unit Leader for ACLA's projects in India, a boutique Urban Design & Planning company, based in Hong Kong & Singapore.

-Joeri has a masters of science in Architecture.

Joeri Aulman

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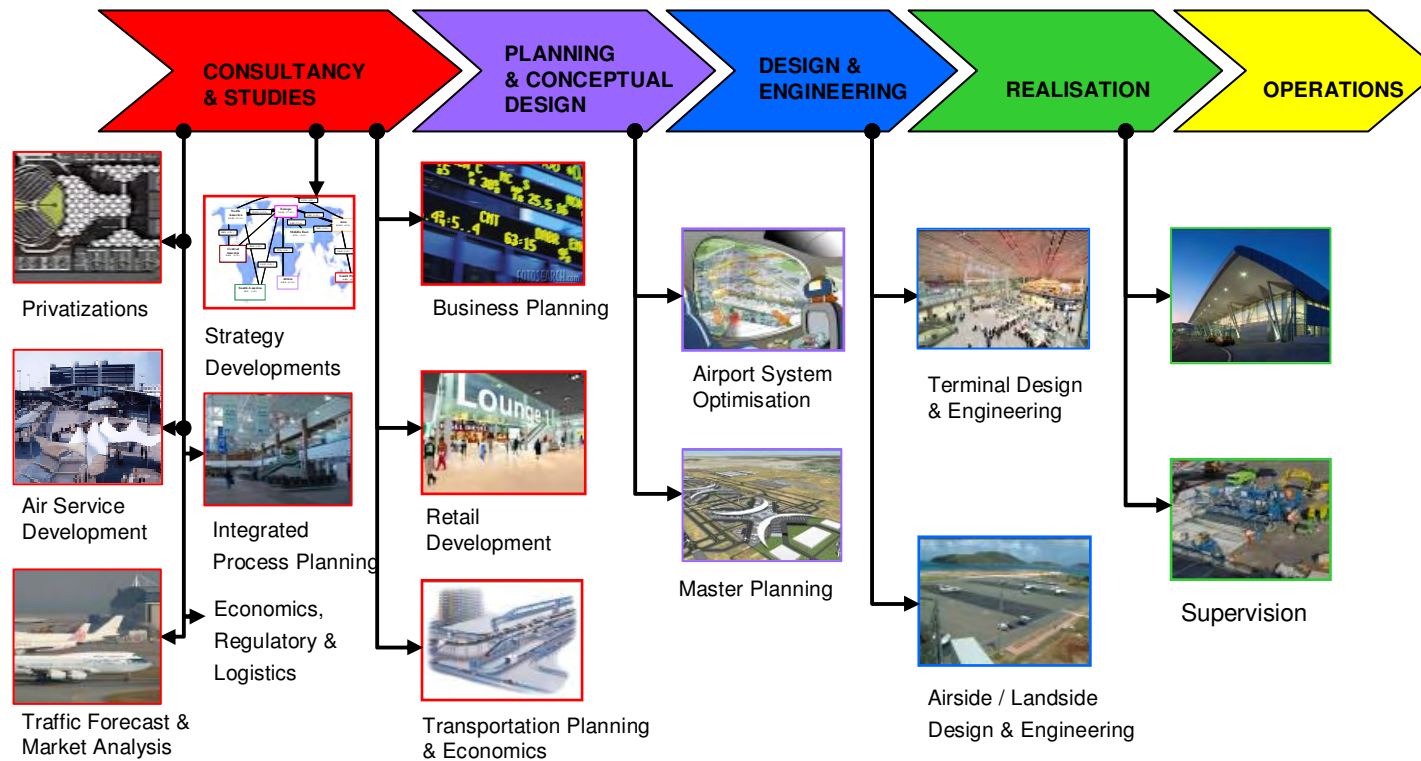
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We offer
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• Integrated expertise to provide multi-level services
• Independent advice

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Integrated Process Planning

Air Service Development

Economics, Regulatory & Logistics

Traffic Forecast & Market Analysis

Business Planning

Retail Development

Transportation Planning & Economics

Airport System Optimisation

Master Planning

Terminal Design & Engineering

Airside / Landside Design & Engineering

Supervision

We assist you with defining and realizing your ambitions. Translating your vision into *sustainable* and *concrete* implementation plans

InterVISTAS is a boutique global analytic and strategy consulting firm in the field of Aviation:
- Air Traffic Forecasts
- Airport Concessions
- Air Service Development
- Financial Analysis & Business Planning

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DHV India is a 200-strong local consultancy which supports NACO's local projects with the following fields of expertise:
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- Engineering

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CIVIL ENGINEERING & PLANNING

MEP & SPECIAL SYSTEM

Public-Private Partnerships & Finance
→ MOPA Greenfield Goa Airport – Air Traffic Forecast
→ Mumbai International Airport – Bid Services

Commercial & Airport City Planning
→ Gulbarga Landside Commercial Business Plan

Master Planning
→ Mumbai International Airport – Master Plan
→ Bangalore International Airport – Master Plan Update
→ Jaipur DMIC Aerotropolis – Master Plan

Airport Engineering
→ BIAL MRO Plot – Leveling & Utility Study

Airport Design
→ Gulbarga Terminal Design
→ CSC Greenfield Cargo Terminal, IGIA
→ MRO Bid Design, IGIA

✈ Planning

- Master Plan, King Khaled & King Fahd International Airport
- Master Plan, Vladivostok International Airport
- Development Plan, Mumbai International Airport
- National Airport Master Plan, Malaysia

✈ Facility Planning & Design

- Lounge 1, Schiphol International Airport
- Terminal 3, Beijing Capital International Airport
- New terminal, Pulkovo International Airport
- New terminal, Sir Seretse Khama International Airport

✈ Infrastructure Planning & Design

- Airside renovation, Taiwan Taoyuan International Airport
- 5th runway, Schiphol International Airport
- Airside & landside infrastructure, Abu Dhabi International Airport
- 4th runway, Frankfurt International Airport

✈ Construction Management

- Terminal 3, Cairo International Airport
- New terminal, Gibraltar International Airport
- New Terminal, Sofia International Airport
- New terminal, Princess Juliana International /
- New runway, Atyrau International Airport

✈ Air Service Development

- Air Service Development, Abu Dhabi International Airport
- MRO Development Strategy, Don Mueang Airport, Bangkok
- Impact of Air Service Liberalization, several countries

✈ Public-Private Partnerships & Finance

- Pristina International Airport
- Skopje and Ohrid Airport
- Queen Alia International Airport
- New York JFK International Airport

✈ Commercial & Airport City Development

- Airport Cities Development, Shenzhen Bao'an International Airport
- Retail Program Terminal 4, New York JFK International Airport
- Concession Planning, Schiphol Plaza
- Airport Walkthrough Store, Jersey Airport

✈ Border & Security Services

- Pre-clearance, Shannon Airport
- US Quick Connect, Edmonton Airport
- Business Case for Automated Borders