Benchmarking Airport Efficiency

Regional Airport Terminal Processes

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1.

Research Initiation

Challenge by Eindhoven Airport

Some Numbers

- Rapid increase in passengers
  - 2001: 0.3M pax
  - 2009: 1.7M pax
  - 2010: 2.1M pax (expected)
- Ryanair main growth driver
  - 2002: 7 flights/week
  - 2010: ~100 flights/week (summer season)
- Low fare carrier (LFC) pax / total pax = 85% (2009)

Challenge by Eindhoven Airport

Problem Statement

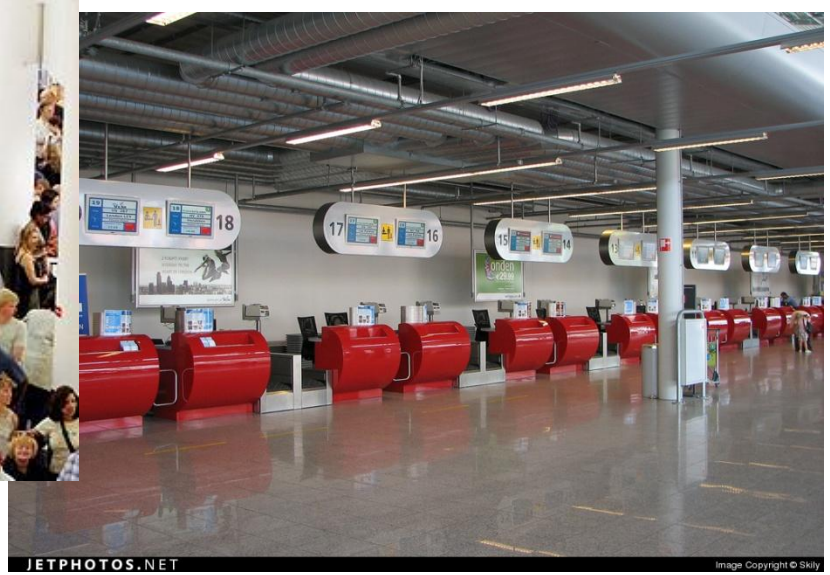
- Rapid growth of airport entirely linked to LFC
- LFC exercise tough airport performance demands
- While generally refusing to pay high airport charges
- Route termination by higher yield 'traditional' airlines

Downward pressure on the airport's aviation revenues!

Strategy by Eindhoven Airport

Operational Excellence

- Continuous improvement of operational cost/quality ratio
  - Delivering generic high quality service for lowest possible cost
  - Resulting in best practice regional airport



Research

- Developing a benchmark tool to evaluate the efficiency of the operational processes in the terminal.

- Aim
  - Quantify process efficiency at participating airports
  - Identify best practices amongst participating airports
  - Add external optimization path for airport management

Research

Constraints -1

- Management decision tool for airport management
- Complete picture of passenger processes in terminal
  - Decision units → Handling and security processes
- Process resource efficiency level of detail
  - Daily operations benchmark
  - Managerial influenceable parameters only
- Equal comparisons → equal processes
- Sample group of (comparable) regional airports

Research

Constraints -2

- Process efficiency driven
  - No cost, quality, strategy influences
- Transparancy for all participating airports
- Limiting data to non-competitive, observable data

Literature Study

Filling the gap-1

- 32 airport benchmark studies investigated
  - Incl. Gillen and Lall, Barros, Graham, Neufville, Müller, Pels etc.
- All studies consider one unit: complete airport
- Sample groups:
  - Airports in selected country: e.g. Martín and Román (2006, Spain)
  - Airports in two countries: e.g. Müller (2009, Germany and UK)
  - Major/hub airports: e.g. Pels et al. (2003, Europe)

Research constraints:	Processes	= decision unit
	Sample	= Regional Airports

Literature Study

Filling the gap-2

- No airport or terminal process benchmarks, but:

Indicator	*Times used in 32 studies*
Total number of passengers	ALL
Total number of aircraft movements	25
Invested capital / cost of capital	14
Total number of employees	13
Number of runways	12
Total labor cost	12
Total sales	13
Terminal area	12
Operational cost	9
aeronautical / non-aeronautical sales	8
Number of gates	8
Airport area	7
Number of luggage reclaim belts / reclaim hall area	5
Runway area	4
Total runway length	5
Total cost	5
Number of car parking spots	4
Apron area	3
Number of check-in desks	4
Number of aircraft parking stands	3
Profitability	2
Departure lounge area	**1**

Literature Study

Filling the gap-3

- Some indicators of process level of detail are found, although not coupled to process

- Most relevant indicators found in
  - Gillen and Lall (1997)
  - Pels et al. (2003)
  - Müller et al. (2009)

Area	***Number of***
Apron	Aircraft parking stands (1x)
Departure lounge	Check-in desks (2x)
Reclaim Hall	Gates (2x)
	Luggage reclaim belts (2x)

2.

Constructing the tool

Methodology

Research

Step 1: Defining standard terminal processes

Step 2: Deriving (input and output) efficiency drivers per process

Step 3: Selecting sets of Key Efficiency Indicators (KEI)

Step 4: Benchmarking between sample airports

- On individual weighed KEI level
- On process level from set of KEI

Literature Study (steps 1,2)
Observations of processes (steps 1,2)
Expert opinions via discussion sessions (steps 1,2,3)

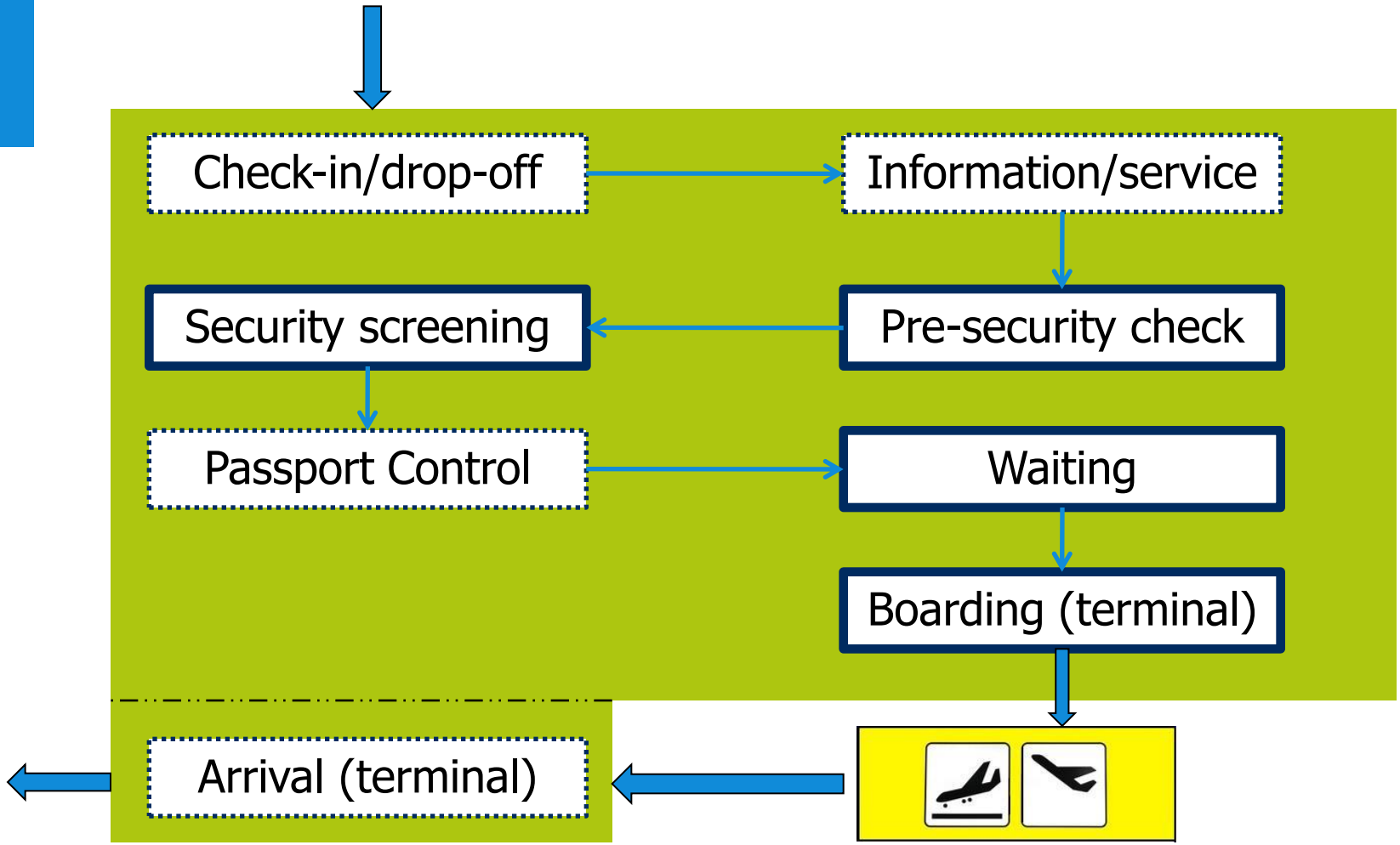
Methodology

Benchmark tool

- Airport benchmarking literature
  - Partial Fraction Analysis (PFA)
  - Data Envelopment Analysis (DEA)
  - Stochastic Frontier Analysis (SFA)

- PFA with Surface Measure of Overall Performance (SMOP)
  - Easy interpretable radar plot with KEI at axes
  - Total enclosed area is measure for total efficiency
  - Real, unbiased picture of measured KEI
  - One plot for each process at each measured time period
  - Small sample group (three airports), large decision unit group (processes)

Terminal Processes

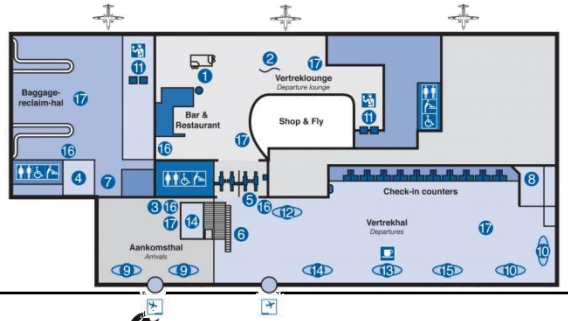


Terminal Processes

Efficiency Drivers

- Input efficiency drivers
  - "Infrastructure" (*dedicated terminal area*)
  - "Equipment" (*number of desks, lanes, gates, reclaim belts*)
  - "Labor" (*number of staff*)

Type efficiency driver	***Peak measurement***	***Year measurement***
Infrastructure	Dedicated terminal area [m^2]	Dedicated terminal area [m^2]
Equipment	Maximum # in use	Total # available
Labor	Maximum # in use	Total fte available



Terminal Processes

An example: Check-in/drop-off process

Complete Check-in/drop-off process at the airport

Passenger checks information screen for desk number
→ passenger moves to check-in/drop-off terminal area
<START TERMINAL PROCESSES>
<START PROCESS>
→ passenger joins queuing line
→ passenger arrives at desk
→ staff handling company:
- performs passenger check-in process
- performs luggage check-in process
- checks hand luggage for airline requirements
- issues boarding pass and bag tag receipt
- provides flight information

<END PROCESS>

Terminal Processes

Efficiency Drivers Selection

Infrastructure
Equipment
Labor

Process	*Output efficiency driver(s)*	*Input efficiency drivers*
Passport Control	TotalPax_nonschengen	Area
		Desks
		Staff
Waiting	DepPax	Departure lounge area
		Commercial use area
Boarding (terminal)	DepPax	Area
	DepFlights	Gates
		Staff
Arrival (terminal)	ArrPax_luggage	Area
	ArrFlights	Reclaim belts
		Lost & found Staff

Key Efficiency Indicators (KEI)

The Concept -1

- Indicates efficiency level of resource usage only
  - Process quality and cost are neglected (basic quality assumed)
  - Airport management strategy is neglected
- $$KEI = \frac{output\ efficiency\ driver}{input\ efficiency\ driver}$$; max. 2 outputs, 3 inputs
- Is directly influenceable on (daily) operations level
  - Via input efficiency drivers
- Is readily obtainable for benchmarking!

KEI (efficiency) **≠ KPI** (performance, quality)

Key Efficiency Indicators (KEI)

Benchmarking -1

- Relative efficiency benchmarking

Airport sample group {A, B, C}
j decision making units (processes, *j = 1,2,…8)*
Each process described by *i* inputs (*i* = 1,2,3)
Each process described by 1 or 2 outputs
$KEI_{i,j}$ = KEI with input *i* for process *j* (1 output)
$KEI_{i,j-1}$ / $KEI_{i,j-2}$ = KEI input *i*, process *j* (2 outputs)

- Most efficient KEI in process *j* for input *i* :

$$KEI^*_{i,j} = max\left\{\left(KEI_{i,j}\right)_A, \left(KEI_{i,j}\right)_B, \left(KEI_{i,j}\right)_C\right\} \quad ; \quad KEI^*_{i,j} \equiv 1$$

Key Efficiency Indicators (KEI)

Benchmarking -2

- Say $KEI^*_{i,j}$ at airport A:

$$(KEI_{i,j})'_A = KEI^*_{i,j} = 1$$

- The relative efficiency value for {B,C} are:

$$(KEI_{i,j})'_B = (KEI_{i,j})_B \Big/ (KEI_{i,j})_A$$

$$(KEI_{i,j})'_C = (KEI_{i,j})_C \Big/ (KEI_{i,j})_A$$

Key Efficiency Indicators (KEI)

Benchmarking -3

- For all processes (j = 1,2,…8) for peak and year periods:

<u>KEI level benchmark</u>

- Sample group in radar plot with $\{KEI'_{i,j}\}_{A,B,C}$ at axes for each output

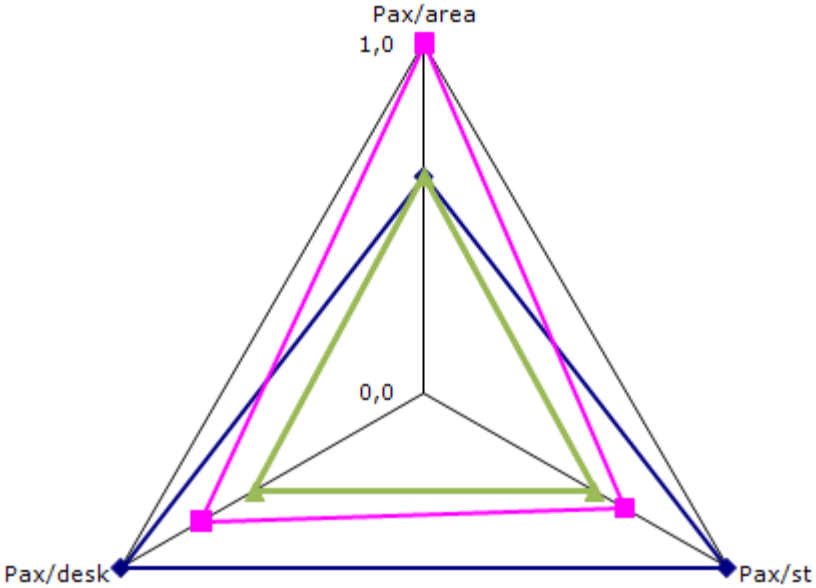
<u>Process level benchmark</u>

- SMOP calculation for process radar plot
- Largest surface area = "best-in-class" efficiency
- Weighed against $\{KEI'_{i,j}\}$ = 1,1,1 (for i = 1,2,3)

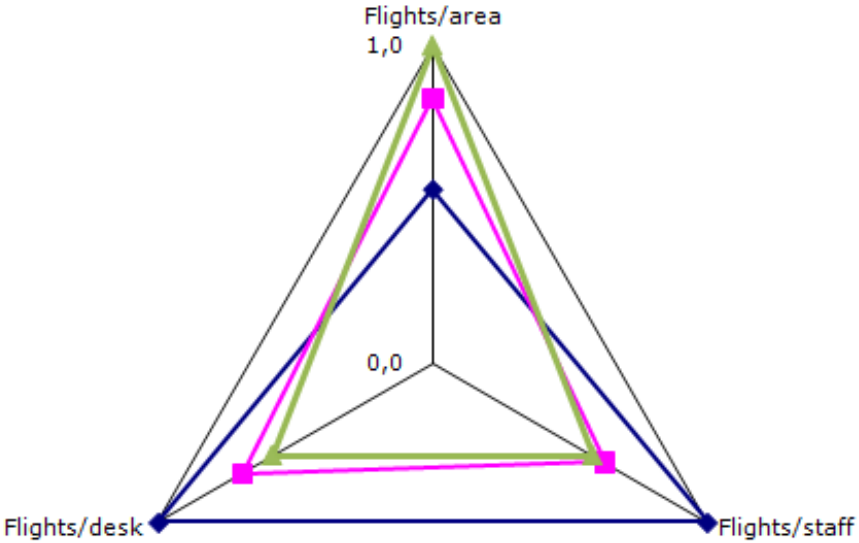
Key Efficiency Indicators (KEI)

Benchmarking -4

PEAK - Pax output



PEAK - Flights output



Key Efficiency Indicators (KEI)

Benchmarking -5

Eindhoven Airport

i	PEAK - pax output		$KEI'_{i,1-1}$
1	Pax/area	0,81	0,619
2	Pax/staff	88,52	1,000
3	Pax/desk	88,52	1,000

	PEAK - flights output		$KEI'_{i,1-2}$
1	Flights/area	0,008	0,545
2	Flights/staff	0,857	1,000
3	Flights/desk	0,857	1,000

Total -pax	0,649	**74,6%**
Total -flights	0,607	**69,7%**

Charleroi BS Airport

i	PEAK - pax output		$KEI'_{i,1-1}$
1	Pax/area	1,30	1,000
2	Pax/staff	58,67	0,663
3	Pax/desk	65,19	0,736

	PEAK - flights output		$KEI'_{i,1-2}$
1	Flights/area	0,012	0,830
2	Flights/staff	0,535	0,624
3	Flights/desk	0,595	0,694

Total -pax	0,548	**62,9%**
Total -flights	0,443	**50,9%**

Rotterdam TH Airport

i	PEAK - pax output		$KEI'_{i,1-1}$
1	Pax/area	0,81	0,621
2	Pax/staff	49,83	0,563
3	Pax/desk	49,83	0,563

	PEAK - flights output		$KEI'_{i,1-2}$
1	Flights/area	0,014	1,000
2	Flights/staff	0,500	0,583
3	Flights/desk	0,500	0,583

Total -pax	0,295	**33,9%**
Total -flights	0,437	**50,2%**

SMOP: max surface 3 axes {1,1,1} = 0.87

Key Efficiency Indicators (KEI)

KEI Selection by Process

j	*Two outputs*	*Process*
1	X	Check-in/drop-off
2		Information/service
3		Pre-security check
4		Security screening
5		Passport control
6		Waiting
7	X	Boarding (terminal)
8	X	Arrival (terminal)

j	Process	KEI	
1	**Check-in/drop-off**	Pax/area	$KEI_{1,1-1}$
		Pax/staff	$KEI_{2,1-1}$
		Pax/desk	$KEI_{3,1-1}$
		Flights/area	$KEI_{1,1-2}$
		Flights/staff	$KEI_{2,1-2}$
		Flights/desk	$KEI_{3,1-2}$

j	Process	KEI	
6	**Waiting**	Pax/area	$KEI_{1,6}$
		Comm.area/area	$KEI_{2,6}$

j	Process	KEI	
4	**Security screening**	Pax/area	$KEI_{1,4}$
		Pax/staff	$KEI_{2,4}$
		Pax/lane	$KEI_{3,4}$

3.

Applying the tool

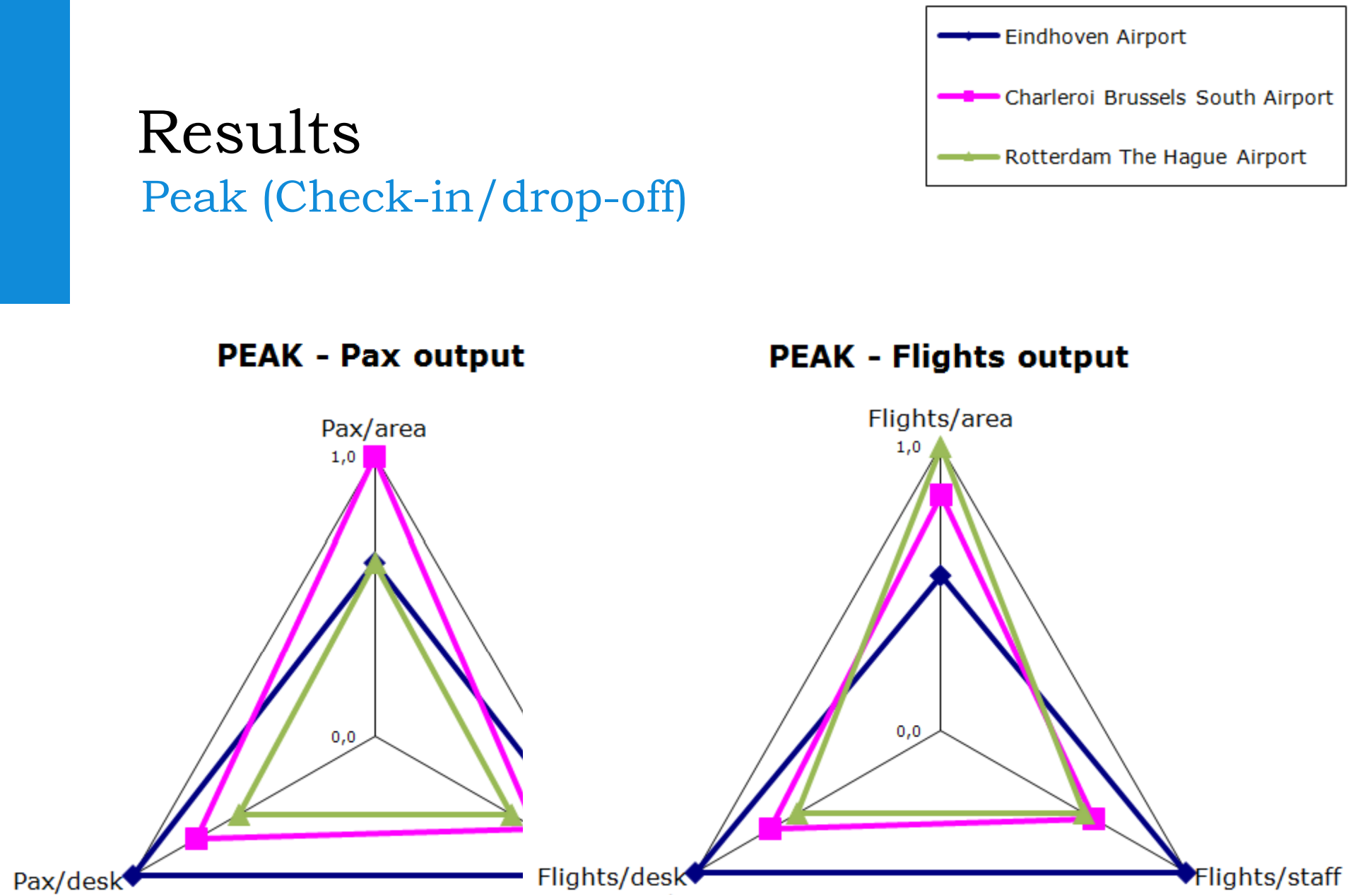
Sample Group

- Questionnaire efficiency drivers processes:
  - Peak (during summer 2010)
  - Year (August 2009-July 2010)

	EindhovenAirport	BRUSSELS SOUTH CHARLEROI AIRPORT	Rotterdam The Hague Airport
Total movements (8/09-7/10)	14.764	33.121	13.305
Total pax (8/09-7/10)	1.944.280	4.628.625	969.936
Pax/flight	132	140	73
Pax via check-in	50%	40%	92%
Peak DEP.FLIGHTS	9	11	6
	(6x FR / 2x W6 / 1x XQ)	(10x FR / 1x JAF)	(3x HV / 3x VG)

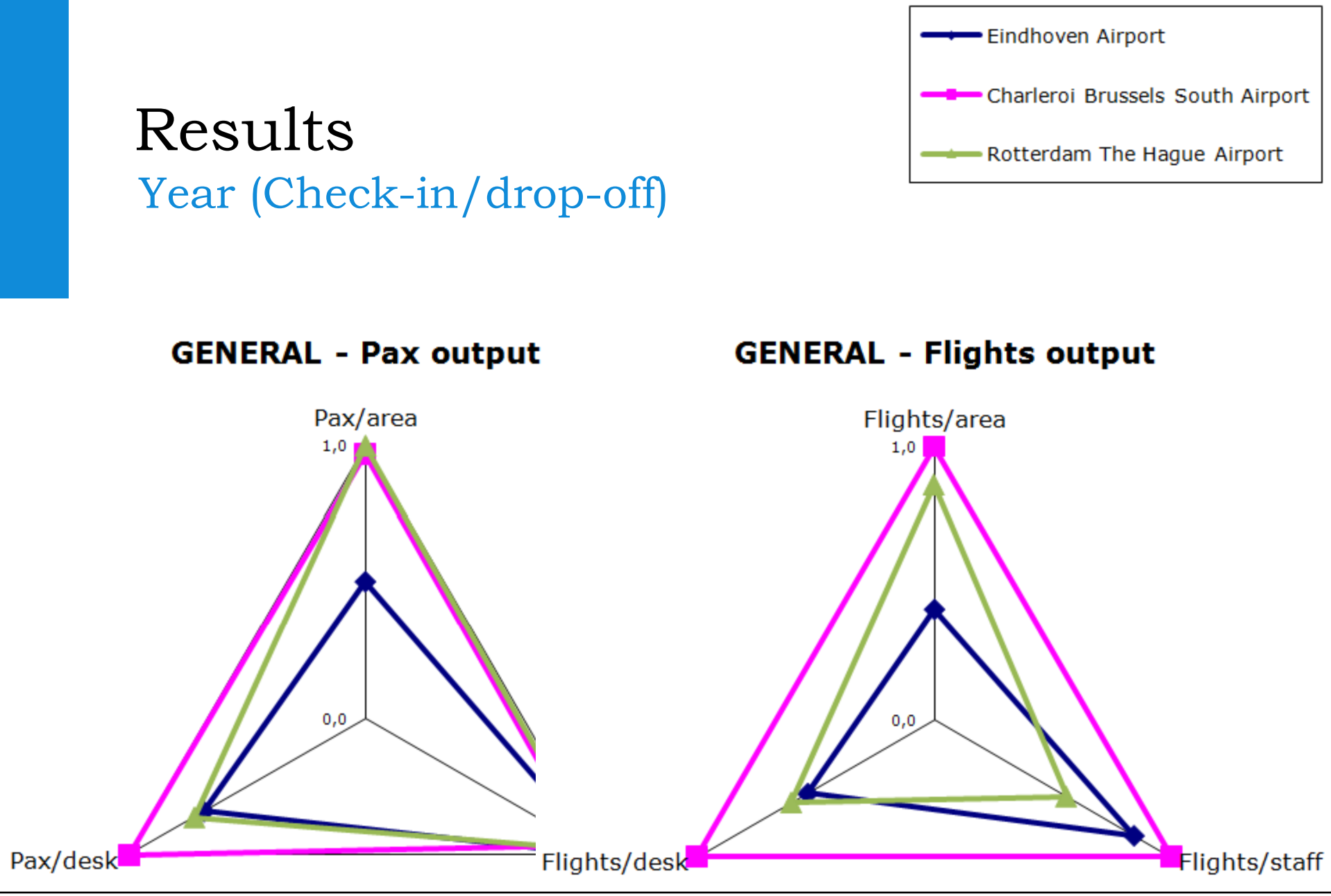
Results

Peak (Check-in/drop-off)



Results

Year (Check-in/drop-off)



Results

Peak vs. Year (Check-in/drop-off)

Peak

Check-in/Drop-off	
PAX output	
1. **Eindhoven Airport**	**74,6%**
2. Charleroi Brussels South Airport	62,9%
3. Rotterdam The Hague Airport	33,9%
FLIGHTS output	
1. **Eindhoven Airport**	**69,7%**
2. Charleroi Brussels South Airport	50,9%
3. Rotterdam The Hague Airport	50,2%

Year

Check-in/Drop-off	
PAX output	
1. Charleroi Brussels South Airport	93,4%
2. Rotterdam The Hague Airport	79,1%
3. **Eindhoven Airport**	**50,7%**
FLIGHTS output	
1. Charleroi Brussels South Airport	100,0%
2. Rotterdam The Hague Airport	44,7%
3. **Eindhoven Airport**	**33,7%**

4.

Discussing the tool

Conclusions

- Tool quantifies efficiency of terminal processes using KEI
  - At detail levels: KEI (PFA) & Process (SMOP)
- Best practices for each process and KEI are identified
  - But: only best practices amongst the 3 sample airports
- Strategic improvement fields identified by non-best-practice scores
  - Allows for collaboration between airports
- *Agenda* : discussion meeting EIN/CRL/RTM
  further interpretation results

Discussion and Recommendations

- Good scoring KEI may indicate bad process quality (within concept KEI)
  - Crowded areas, queuing lines due to few staff or desks
  - But processes are comparable and quality differences mentioned
- Coupling to (internal) KPI and cost structure -> complete picture
  - Efficiency (KEI) coupled to quality (KPI) and cost
- More participating airports (satisfactory)

First time terminal process benchmark

Difficulties obtaining data (obtaining participating airports)

One participating airport results and method!

- Fte for staff in year measurement difficult to achieve

- Peak measurement method (max # in use) lacks time variable
- More comparable sample airports (preferably with Ryanair)


Eindhoven Airport
Arrivals
Aankomst
Rotterdam The Hague Airport
BRUSSELS SOUTH CHARLEROI AIRPORT

Questions?