ATM2003 / Students' Programme

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Structuring of coordination parameters at airports

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1. Introduction

This paper presents possible structures of coordination parameters.

The connections between calculated capacity and coordination parameters as well as the different factors of influence on the structuring are explained. Important steps for the structuring of Coordination parameters are described. Subsequently, some examples of presently existing parameters by European airports are presented.

2. "The Slot" = "Set of Parameters"

In Germany the distribution of the Slots takes place through a governmental authority- the „airport coordinator". A slot at a fully coordinated airport must be requested by an airline at the airport co-ordinator, who is the legally representative at the IATA conference.

The assignment of slots by the airport coordinator, according to neutral, transparent and emergency-discriminating rules depends on the legal regulations and the calculated capacity of an airport. In Germany the number of available slots is proved by the ministry of transport. The definition of the number of available slots takes place on the basis of the capacity analyses and depends on different constrains:

- infrastructure constrains

  The capacities of the runway system, the terminal and the apron.

- noise restrictions

  Typically these restrictions are usually expressed for the night flight traffic of an airport. However there are also airports, for example Amsterdam-Schiphol (AMS), which are concerned by such a constrain for the day also. AMS possesses a so-called „noise capacity".

- political restrictions

  The air traffic at the airport is limited by governmental restrictions without a bottle neck present at the airport. For example cross-boarders traffic can be limited.

- economic goals

  Maximization of the profit or optimal use of existing capacities and resources can influence the structuring of coordination of parameter.

- operational goals

  A safe and punctual traffic is important for all involved ones. However an intended more ambitious goal of punctuality can lead to the reduction of the capacity at the airport.

- and others

  for example ATC capacities or in the future also emissions.

These different constrains lead to different sets of coordination parameters. The coordination parameters of an airport are the basis for the distribution of the slots (coordination capacity). The calculated capacity of an airport is limited substantially.

At the operational day the

actual capacity > coordination capacity

untimely flights cause a traffic peak, short separation by good weather conditions

or the

actual capacity < coordination capacity.

bad weather conditions, failure of equipment from ATC or airport

Picture 1 shows the valid coordination parameters for the example airport Duesseldorf/Germany (DUS).

co-ordination parameters [slots/time]			
60-min-co-ord. Parameters			
Local Time	ARR	DEP	TOT
06:00 - 20:59			38
21:00 - 21:59			35
22:00 - 22:59	25	0	25
10-min-co-ord. Parameters			
Local Time	ARR	DEP	TOT
06:00 - 22:59			8

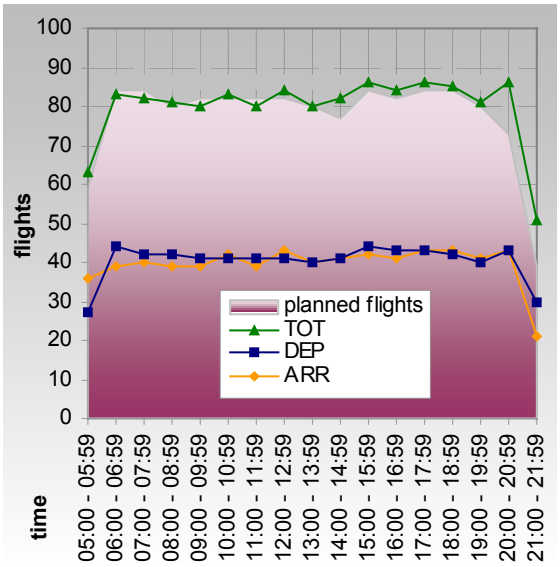
Picture 1: co-ordination parameters at airport DUS in summer season 2002

Traffic at the airport DUS is extremely limited by politically constrains. Its calculated capacity (2 independent runways) is much higher than the number of slots, which can be assigned.

3. Structuring of coordination parameters

The runway capacity is often the bottle neck of an airport. Step 1 of the structuring is the determination of the arrival/departure runway capacity of the airport.

At the airport London-Heathrow (LHR) these capacities are expressed in 10-min and 60-min-parameters (picture 2).



Picture 2: 60-min-co-ordination parameters at airport LHR in summer season 2002

The maximum number of available flight movements (TOTAL) is calculated at the airport LHR:

TOTAL = DEP + ARR.

At many airports applies however

TOTAL < DEP + ARR.

The determination of the TOTAL-parameter is a function of runway dependencies or operational schemes:

ARR/DEP and TOTAL co-ordination parameters at LHR are changing over the day.

Apart from runway capacity further constrains exist, for example constrains of terminal, apron capacities and political constrains. Then it is necessary to examine the adherence to all capacity limits (step 2).

At Airport LHR a cross check against constrains of terminal, apron and overnight stops capacity must be accomplished. Picture 3 shows exemplarily the coordination parameter for the terminals capacity of the airport LHR.

co-ord. parameters [pass./time]			
SS02 60-min-co-ord. parameter			
Terminal	ARR	DEP	TOT
Terminal 1			
Domestic	1600	1750	
*CTA**	850	750	
International	2400	2600	
Terminal 2	1800	1800	
Terminal 3	3500	3000	
Terminal 4	3000	2500	
T1+T2+T3			14000
SS02 30-min-co-ord. parameter			
Terminal	ARR	DEP	TOT
Terminal 1			
Domestic			
*CTA**			
International	1300	1400	
Terminal 2	950	950	
Terminal 3	1850	1600	
Terminal 4	1600	1350	
SS02 120-min-co-ord. parameter			
Terminal	ARR	DEP	TOT
Terminal 2	3200	3200	
Terminal 3	6600	*8400***	
Terminal 4	5600	*6200***	
** CTA: Common Travel Area*			
*** 180-min-co.ord. parameter*			
calculation of the parameters with			
use of airplane seats			
per flight and day			

Picture 3: co-ordination parameters of terminal capacity at airport LHR in summer season 2002

Despite the multiplicity at constrains it is interesting: How many slots per time interval can the airport coordinator finally assign? Here an optimal distribution of the slots over the day is desired (Step 3).

As evident in picture 1 and 2, coordination parameters with different time intervals exist at an airport. The following organizations can be classified:

- Small time interval

  5 min/10 min/15 min

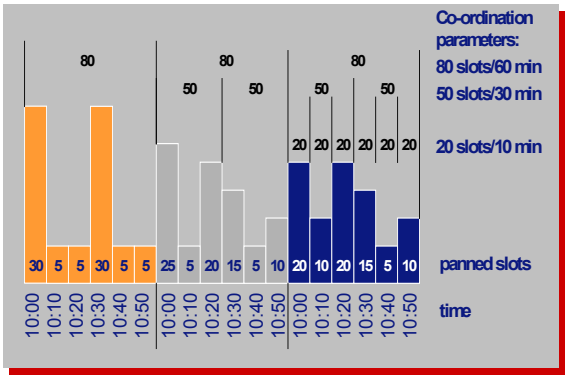
- Medium time interval

  15 min/20 min/30 min

- Large time interval

  60 min/120 min

Picture 4 shows exemplarily the use of co-ordination parameter with different time intervals.

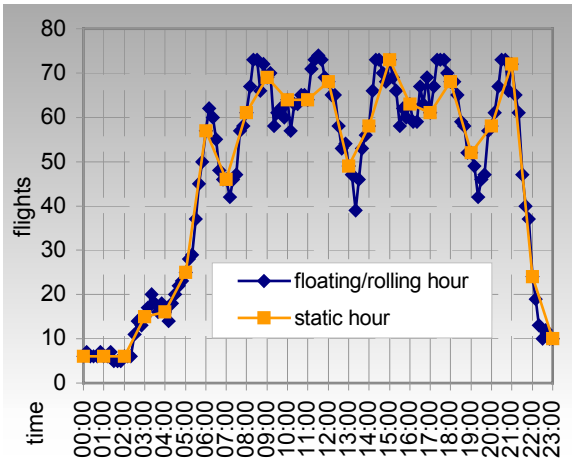


Picture 4: Possible slot distribution with use of coordination parameter with different time intervals

The optimization of these parameters permits a favourable distribution of the slots over the day, whereby a short increased slot demand by airlines can be served. For a favourable distribution of the slots a coordination parameter with a small and a large time interval is at least necessary.

Validating of the coordination parameters is possible by the application of the model of the floating (or rolling) hour. This model is based on the shift from one hour at a defined time interval. With the help of model detailed traffic, peaks and breaks can be represented outside of the static hour. Excesses of the coordination parameters become visible.

Picture 5 shows this descriptive.



Picture 5: Model „Rolling hour“

Unfortunately this model is not applicable with the coordination parameter, which changes over the day (e.g. LHR). Here a simulation of the planned flight movements could be used for validating.

4. Examples for different relevance of specific elements of co-ordination parameter

With the structuring of parameters there is a clearance for own organizations for an airport.

In investigations of coordination parameters of European airports some interesting elements could be found. For example the airports Amsterdam-Schiphol and Munich (MUC) support the slot demand consciously by the application of special parameters. These parameters permit more ARR- or DEP-traffic, adapted to the demand in the peak traffic. Outside of the peaks other co-ordination parameters (picture 6) apply.

SS02 60-min-co-ord. parameters				
	Local Time	ARR	DEP	TOT
night time	00:00 - 05:59	15	25	40
Morning	06:00 - 06:59	25	25	50
traffic break	07:00 - 07:59	35	37	72
traffic peak	08:00 - 20:19	68	36	104 (1)
traffic peak	08:00 - 20:19	34	74	108 (2)
traffic break	20:20 - 22:59	35	37	72
night time	23:00 - 23:59	15	25	40
	(1) ARR peak (2) DEP peak			

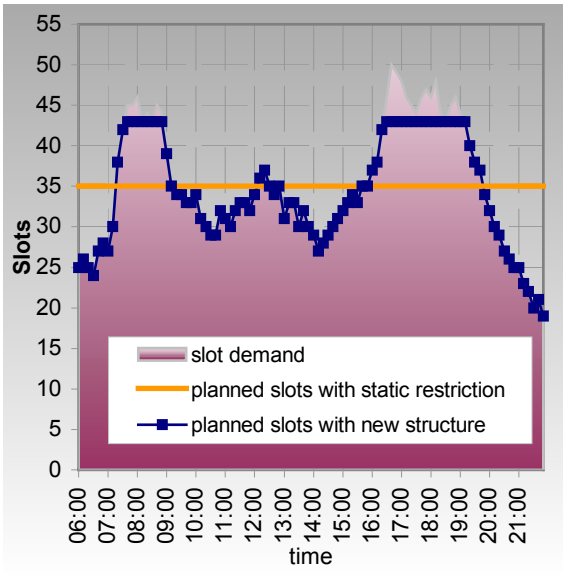
Picture 6: Co-ordination parameters of runway capacity at airport AMS in summer season 2002

The advantage of such parameters is the support of the hub-function of the airport. Many transfer connections can be created. But it comes to high stress in the traffic peak. In the traffic breaks it is possible that the existing capacities and resources are badly used.

A further interesting element is the contingent of the flights. Hereby policy specifies the maximum number for the assigned slots per time (season, year). This number of slots can be assigned flexibly and adapted to the demand over the season. This form exists already at the airport AMS and for the night flights at the airport Frankfurt/Main (AMS) and Brussels (BRU).

For an airport with political restrictions this form of the slot assignment offers a more flexible solution than the past static restriction, e.g. in slots/60 minutes. Despite existing capacity here no slots can be assigned at times with higher slot demand, while in the times with lower demand the slots are not used. With the definition of the number of available slots per season the airport coordinator can assign more slots in times with higher demand, those it in times with lower demand.

Picture 7 tries to illustrate this.



Picture 7: Example of contingents of flights

5. Summary

The number of available slots depends on the capacity of an airport, on the legal regulations and on further major factors (e.g. infrastructure constrains, noise restrictions, economic goals etc.). All these factors lead to the necessary creation of different coordination parameters, which are the basis of the distribution of the slots.

The structuring of these coordination parameters should be a result of

Step 1: determination of ARR/ DEP/ TOTAL capacity

Step 2: Cross-check against capacities constrains

Step 3: Optimisation – use of parameters with different time intervals

Step 4: Validation – use the model “floating/rolling hour”.

Additional special coordination parameters (e.g. contingents of flights or coordination parameters of traffic peaks) can be used.

Background

The description is a result of a diploma thesis „Investigation of structuring of coordination parameters at an airport and assessment of effect to the operational process” (from Franziska Meier, Dresden University of Technology, Institute of Aviation).

One goal of the in 2002 undertaken study was to point out and to evaluate fundamental possibilities to structure coordination parameters. Apart from theoretical questions, already existing co-ordination parameters at European airports (AMS, ARN, BRU, CDG, CPH, DUS, FRA, HEL, LHR, MAN, MUC, TXL) are dealt with. Special elements of the structure, which could be used for the design of airport and constrains adapted coordination parameters are identified. For different trends in airport development suitable structures of parameters have been derived. A special goal of the thesis was to make a suggestion for the ideal structuring of coordination parameters for the German airport Frankfurt/Main.