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FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL EXPERIMENTAL CENTRE

SIMMOD ANALYSIS FOR THE CAPACITY STUDY OF NANTES AIRPORT

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TITLE:

SIMMOD CAPACITY ANALYSIS FOR NANTES AIRPORT.

Authors	**Date**	**Pages**	**Figures**	**Tables**	**Appendix**	**References**
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Abstract:

This report describes a EUROCONTROL Airport Simulation study, using SIMMOD, to ascertain the number of IFR flights the manoevering area at Nantes Airport could sustain

EUROCONTROL

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

The Direction Générale de l'Aviation Civile Ouest wished to perform a capacity study of Nantes Airport. The STBA (Service Technique des Bases Aeriennes), acting on behalf of the Direction Générale, requested the Eurocontrol Airport Simulation Group (APT) for assistance with performing this study using the SIMMOD[1] simulation available at the Eurocontrol Experimental Centre.

This report presents Phase Three of the study, the simulation of the Basecase (Current Situation) using a new 24 hour traffic sample. The two phases leading up to Phase Three are briefly explained in 1.1.1 Simulation Study Phases below. Future study scenarios are outlined on page 8.

1.1.1 Simulation Study Phases I and II

- **Phase One:**
  Phase One of the study incorporated the following:

⇒ **Scenarios**	**Basecase (Current Situation)**		**Future One (year 2010)**	
⇒ **Runway Orientation**	03	21	03	21
⇒ **Separation Standard**	6.5nm	9nm	6.5nm	9nm
⇒ **Traffic Sample**	Time period: 11h00 to 15h00 No turnarounds were included.			

⇒ **The initial objective**: to ascertain the maximum number of IFR flights that the runway could sustain with a maximum allowed departure delay of ten minutes (calculated from the moment the aircraft enters the departure queue).

The results of this study were presented at Nantes Airport on the 4 January 1996. The following conclusions were drawn from this presentation:

* The limited number of commercial gates indicated the inclusion of turnarounds in the traffic sample to give a true representation of the current situation.
* The use of the runway was limited more by the separation standard on final approach than by the traffic size.
* The Future One traffic sample did, however, indicate that the manoeuvring area was unable to accommodate the anticipated increase in traffic.
* The simulation study was to become an airport capacity study and new traffic samples were to be provided.

- **Phase Two:**

[1] SIMMOD is the FAA's airspace and airport simulation model. See Annex A for details.

Phase Two of the study incorporated the following:

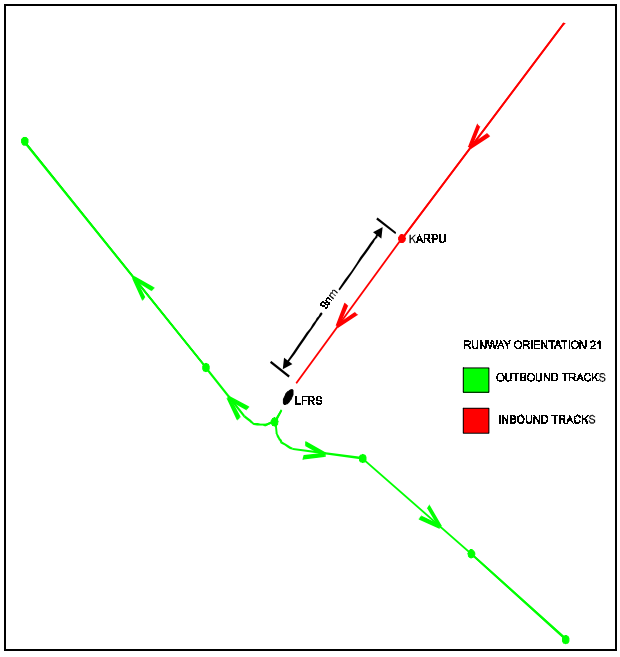
⇒ **Scenarios**	**Basecase (Current Situation)**		**Future One (year 2010)**		
⇒ **Runway Orientation**	03	21	03	21	
⇒ **Separation Standard**	6.5nm	9nm	6.5nm	9nm	8nm
⇒ **Traffic Sample**	Time period: 11h00 to 15h00 Limited turnarounds included.				

⇒ **The objective**: to ascertain the maximum number of IFR flights that the ground manoeuvring area could sustain with a maximum allowed departure delay of ten minutes (calculated from the moment the aircraft enters the departure queue).

During this phase the following factors came to light:

* The traffic sample included a limited number of turnaround flights. Without knowing the arrival or departure times of the other flights it was presumed that the other flights were either at the airport before the start of the simulation time or were remaining at the airport after landing for the rest of the simulation time period. This resulted in gates being blocked for a too long a period of time which was an unrealistic representation of operations at Nantes. Thus it was decided to restart the simulation study once more with a new traffic sample (including all turnarounds) covering a time period of 24 hours.

* Nantes having no approach radar receives a radar picture from Brest. Thus final approach separations were 6.5nm for runway 03 and 9nm for runway 21 (final approach separation is longer for runway 21 for security reasons as there are no ILS or Approach facilities and the approach is directed over the city).



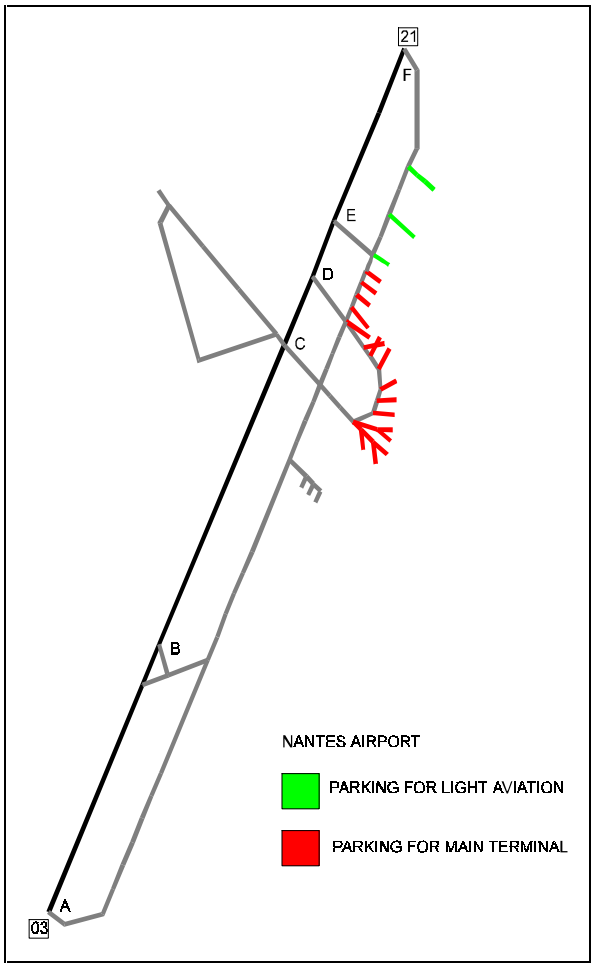
The diagram on the right illustrates the inbound and outbound tracks for runway 21. If final approach separation is 9nm, aircraft passing over Karpu block all departures. Reducing the separation to 8nm allows a departure between two arrivals, this was found to reduce Departure Delay Times for runway 21.

1.2 Simulation Objective

The objective was to ascertain the maximum number of IFR flights that the ground manoeuvring area could sustain with a maximum allowed departure delay of ten minutes (calculated from the moment the aircraft enters the departure queue).

1.3 Simulation Environment

1.3.1 Nantes Airport



The diagram on the left illustrates the ground layout for Nantes Airport, which has a single runway with a 03 or 21 orientation. The majority of operations (60%) are with the runway 21 orientation.

The commercial gates in use at the airport are in red. Taxiways to and from the runway are labelled with alpha characters (A,B,C,D,E and F).

When operating in a 21 orientation, all departures are assigned to taxiway F. Arrivals are assigned to runway exits by aircraft type.

When operating in a 03 orientation, all departing jets use taxiway A and most departing turbo props use taxiway B. Thus if a turbo prop, entering the departure queue on taxiway B, is ahead of a jet which is taxiing towards taxiway A, the turbo prop can cause the jet to be delayed.

1.3.2 Traffic Sample

The Basecase traffic sample, reflecting the current situation at Nantes of 2 million passengers/ year and covering a 24 hour time period, was provided by the STBA.

1.3.3 Simulation Scenarios

The table below illustrates the scenario used in this simulation. Eurocontrol has completed the simulation of the Basecase Scenarios and will be embarking on the simulation of the Future One Scenarios upon receiving the relevant traffic sample. Future Two Scenarios will be completed and reported on by the STBA (a desricption of scenarios Future One and Future Two can be found on page 8).

⇒ **Scenarios**			**Basecase**
Runway Orientation	03	⇒ **Code**	**N03**
		⇒ **Separation**	6.5nm
	21	⇒ **Code**	**N21**
		⇒ **Separation**	9nm

1.3.4 Ground Operations

- Gate Handling: push-backs.
- Gate Restrictions: Aircraft were allocated to gates according to the maximum aircraft size allowed at a gate. This can cause an occupied gate to block adjacent gates due to the size of the aircraft occupying the gate, which in turn reduces the capacity of the manoeuvring area.

1.3.5 Measurements

The following measurements were taken:

Arrival/Departure Flow:	Number of aircraft landing or taking off at Nantes Airport.
Average Air Travel Time:	Average time an aircraft spent in the air.
Average Ground Travel Time:	Average time an aircraft spent taxiing after completing its landing roll.
Average Gate Time:	Average time an aircraft spent at its gate.
Average Total Travel Time:	Average time an aircraft spent in Air Travel and Ground Travel.
Average Air Delay Time:	Average time an aircraft was delayed in the air.
Average Ground Delay Time:	Average time an aircraft was delay between completing its landing roll and arriving at its gate.
Average Gate Delay Time:	Average time an aircraft is delayed at its gate.
Average Total Delay:	Average time an aircraft is delayed in the Air and on the Ground.

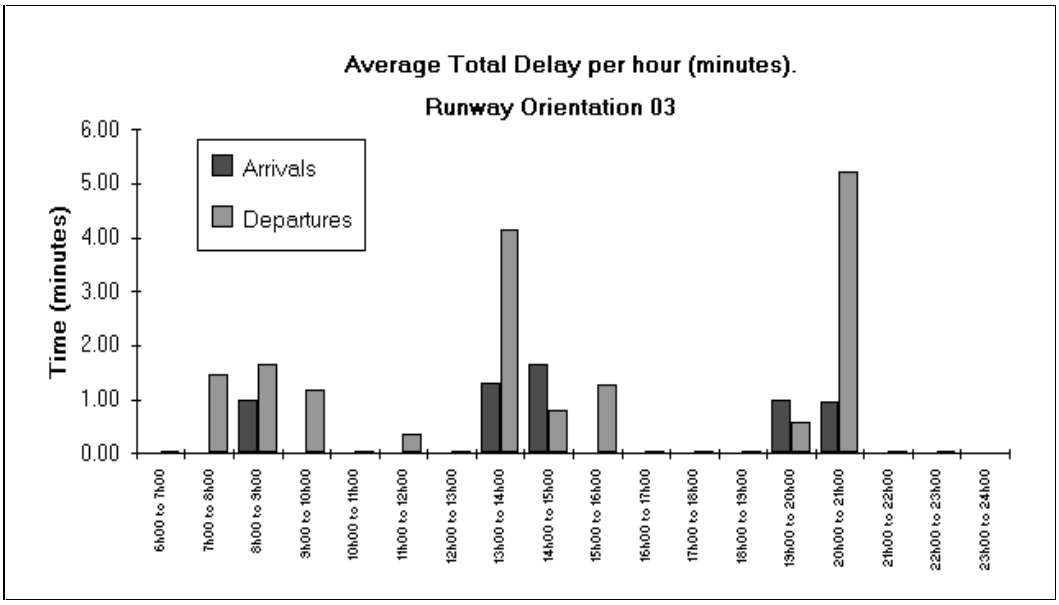
2. RESULTS

As the objective of this investigation was to ascertain the number of IFR flights the ground manoeuvring area at Nantes could sustain with minimum delay; we looked at the delay results reported by SIMMOD in detail, especially the Average Total Delay. Complete statistical tables can be found in Annex B, reporting on all the measurements detailed in section 1.3.5

Basecase Statistics (Time Period = 24 hours)				
⇒ **Runway Orientation**	**03**		**21**	
⇒	**Arrivals**	**Departures**	**Arrivals**	**Departures**
⇒ **Total Traffic Flow**	46	56	46	56
⇒ **Average Total Delay per a/c**	0.50 minutes	1.27 minutes	0.32 minutes	2.37 minutes

The table above illustrates the Basecase statistics. The Average Total Delay time for Arrivals is less than for Departures. This is due to arrivals having priority over departures, arrivals block departures when they are in final approach. The final approach separation standard for runway 21 is 9nm, which is greater than the 6.5nm separation used for runway 03. This would explain why the Departures for runway 21 reflect the highest Average Delay Time (2.37) but this is well within the maximum allowed delay time of ten minutes.

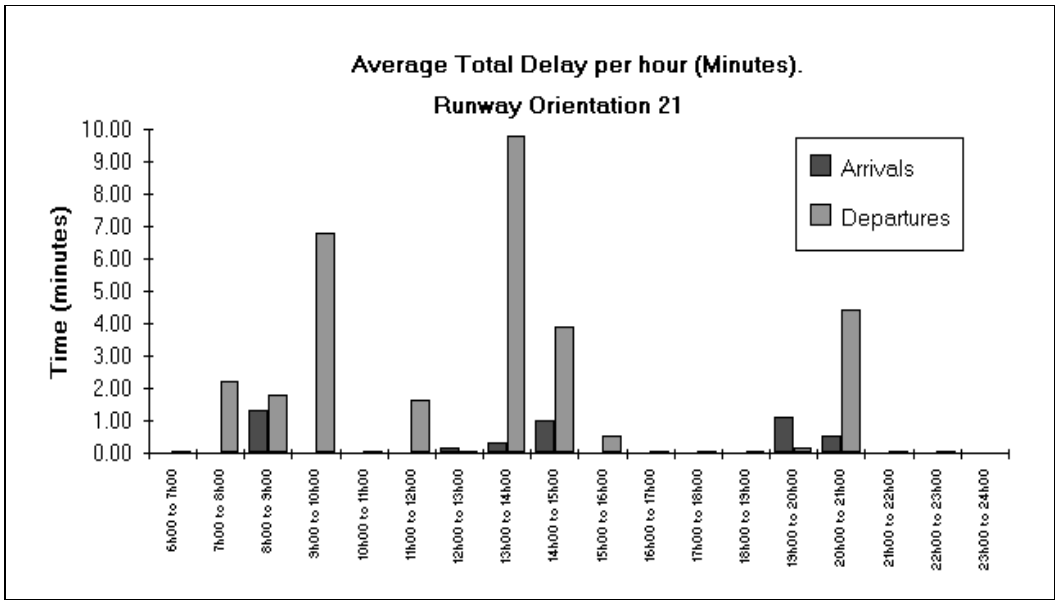
Average Total Delay per Hour (minutes) for Runway Orientation 03



The graph to the above illustrates the Average Total Delay per hour for Runway Orientation 03.

It can be seen that the Average Total Delay for most hours is below two minutes with the exceptions of the hour 13h00 to 14h00 and 20h00 to 21h00 where the Average Delay Times were 4.16 minutes and 5.23 minutes respectively. During these two particular hours a few consecutive arrivals blocked the runway to departing aircraft who were already in the departure queue awaiting take-off.

Average Total Delay per Hour (minutes) for Runway Orientation 21



The graph to the above illustrates the Average Total Delay per hour for Runway Orientation 21.

The Average Total Delay Times for Arrivals are minimal, all being below two minutes. The Average Total Delay Times for Departures are slightly more varied with the hour 13h00 to 14h00 having an average delay of 9.81 minutes which is just within the maximum allowed delay of ten minutes. Once again, this is due to arrivals blocking the runway to departures. Turbo props landing on runway 21 are finishing their landing roll just beyond exit point C (see diagram on page 3) and are then forced to taxi down to exit point B (see diagram on page 3), thus causing departing aircraft to be held in the departure queue.

Note: It is proposed, that in order to minimise runway occupancy time and so decrease departure queue delay, that the possibility of a new taxiway in-between exit point C and point B (see diagram on page 3) be investigated.

3. THE FUTURE ?

Eurocontrol will shortly be provided with the traffic sample for use in the simulation of the Future One Scenarios. However, with current operating conditions (viz. the limited number of gates and their associated restrictions) Nantes Airport will be unable to handle the anticipated future traffic demand.

Thus, in order to simulate the Future One traffic demand, we have two options:

(1) to 'force' the gate capacity to be greater than in reality, or

(2) to include Nantes' new proposal of an extension to the parking area in the simulation.

The decision on which option to use will be taken in consultation with the STBA and Nantes Airport.

Future One Scenario

Traffic Sample: The Future One traffic sample will be provided by the STBA and will reflect the traffic expected for the year 2010, when it is expected that 3 million passengers/ year will pass through Nantes.

The table below illustrates the scenarios that will be used in the Future One simulation.

Future Two Scenario (Future Two Scenarios will be completed by STBA.)

⇒ **Scenarios**			**Future One**	
Runway Orientation	03	⇒ **Code**	**NF3**	
		⇒ **Separation**	6.5nm	
	21	⇒ **Code**	**NF2**	**NF8**
		⇒ **Separation**	9nm	8nm

Traffic Sample: The Future Two traffic sample will be provided by the STBA and will reflect the possibility of an expected 4 million passengers/ year passing through Nantes.

ANNEX A: SIMMOD DETAILS

I. What is SIMMOD ?

SIMMOD, the FAA Airport and Airspace Simulation Model, is a comprehensive planning tool for airport designers and managers, air traffic planners, and airlines. Analysts use the model to study and improve enroute and terminal-area air traffic, as well as airport and airline ground operations.

EUROCONTROL Experimental Centre has extended the basic SIMMOD package by creating a pre- and post-processor program. The pre-processor, called PREPMAIN, inputs airspace points (e.g. navaids), aircraft flight plans, and sector boundaries. Based on aircraft performance, PREPMAIN outputs airspace and event (flight) data in SIMMOD format. The post-processor, called STATMAIN, inputs the basic SIMMOD output file of aircraft movement and produces results of sector workload index, sector level/climb/descent analysis, geographical route, sub-route, and point loadings, and point loadings analysis by flight level.

II. How are the end results achieved ?

SIMMOD represents the air and ground system as a series of nodes (or points) connected by links. Airport nodes describe airfield locations such as gates, departure queues, or runway and taxiway intersections. Airspace nodes describe airspace locations such as navigational fixes, hold stacks, or merge points for aircraft. Airport links can represent taxiways or runways. Airspace links can represent routes. SIMMOD is extremely flexible with regard to the level of detail: the model can be applied to a specialised problem with a gate or runway structure, or to more complex problems involving several airports and a large volume of airspace.

The simulation module is the core of the SIMMOD system. The module realistically simulates the movement of every aircraft, step by step, resolving conflicts and monitoring travel and delay times. Specific rules such as overtaking in the air, shuffling aircraft in the departure queue as well as many other ATC procedures and actions either on the airfield, in the approach/departure environment or in en-route airspace can be simulated by careful selection of the input parameters.

SIMMOD is limited with respect to airspace conflict resolution in that airspace conflicts are not resolved by change of an aircraft’s flight level. Also, no detail is given regarding individual air traffic controllers or operating positions.

III. Input requirements

The SIMMOD input is constructed in a number of files and the correctness of the input data is crucial for the accuracy and realism of the simulation. The SIMMOD files constructed will contain detailed information including some or all of the following:

- Airfield data, and restrictions, (e.g. gate restrictions by airline and aircraft model, taxiway movement restrictions, departure queue logic),
- Aircraft data, and restrictions, (e.g. wake turbulence separations),
- Airspace data, and restrictions, (e.g. speeds on links by aircraft type),
- Airspace/ground interface data, (e.g. arrival and departure procedures, runway utilisation),
- Geographical boundaries of sectors, and restrictions, (e.g. sector capacity),
- Scheduling of events, (e.g. flight data), and
- Weather considerations, (e.g. wind speed and direction).

IV. Output

Standard results are output by SIMMOD and the EEC post-processor, STATMAIN. In addition to these standard reports, raw SIMMOD output files (such as the OUTCOME file, which tracks each aircraft's movement) may be used to create customised results.

Standard output data is produced in a tabular report format which may also be converted into charts and graphs. The standard report data available includes:

A. Airfields

A variety of the airfield results can be used depending on the type of study performed. SIMMOD airfield results are arranged by arrival/departure operations and time interval (hour, half hour, or quarter hour), and for a selected set of airlines, airports, or iterations.

- Airport/Runway Operations by Aircraft Type,
- Airport/Runway Operations, Demand, and Cumulative Difference,
- Airport/Runway Ground and Air Travel and Delay Times,
- Iteration Air and Ground Delay Time,
- Airport Operations by Gate,
- Airport Operations by Airline,
- Taxiing Travel and Delay Time by Gate,
- Taxiing Travel and Delay Time by Airline,
- Number of Flights with delay within specified ranges by Airport, and
- Departure Queue Length Summary.

B. Sectors

- Total number of aircraft that crossed the sectors within a specified time period,
- Maximum number of aircraft in each sector's area of responsibility at any one time within a specified time period,
- Average flight times for the sectors,
- A workload index for the sectors, and
- Number of aircraft in level flight, climbing or descending for each sector within a specified time period.

C. Points

- Rate of traffic flow over points,
- Number of aircraft climbing, descending or in level flight at a point, and Number of potential conflicts that will require ATC intervention.

A. Routes

- Average flight times on each route and
- Number of aircraft on each route.

II. Simulation Animation

In addition to the output data, the SIMMOD post-processor module produces an animated high resolution colour display of the simulation. The animation graphics show all aircraft moving through the modelled airport and/or airspace.

The animation facilitates:

- Verification and validation of simulation, Debugging input data,
- Analysing the simulation visually, Pinpointing problem areas, and
- Demonstrating simulation validity, Presenting briefings.

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ANNEX B: SIMULATION MEASUREMENTS

SIMMOD Reporter Measurements for Arrivals on Runway 03

Time Interval	Arrival Flow	Overall Arrival Times				Average Arrival Times							
		Travel		Delay		Travel				Delay			
		Total	Std. dev.	Total	Std. dev.	air	ground	gate	total	air	ground	gate	total
0h00-1h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1h00-2h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2h00-3h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3h00-4h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4h00-5h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5h00-6h00	1	16.40	0.0	0.00	0.00	14.10	2.27	7.00	23.37	0.00	0.00	0.00	0.00
6h00-7h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7h00-8h00	4	69.10	1.13	0.00	0.00	13.71	3.57	11.75	29.03	0.00	0.00	0.00	0.00
8h00-9h00	4	69.20	.79	4.00	1.72	14.98	2.33	6.75	24.06	0.00	0.00	0.00	0.00
9h00-10h00	3	51.90	1.88	0.00	0.00	15.19	2.12	7.67	24.98	1.00	0.00	0.00	1.00
10h00-11h00	3	47.90	0.64	0.00	0.00	13.58	2.41	8.00	23.98	0.00	0.00	0.00	0.00
11h00-12h00	3	56.10	2.78	0.00	0.00	16.03	2.66	7.33	26.02	0.00	0.00	0.00	0.00
12h00-13h00	3	48.70	1.05	0.00	0.00	14.04	2.20	8.00	24.24	0.00	0.00	0.00	0.00
13h00-14h00	5	80.30	1.35	6.50	1.95	13.28	2.79	10.40	26.47	1.29	0.00	0.00	1.29
14h00-15h00	3	47.80	1.30	4.90	1.50	13.52	2.41	9.00	24.93	1.64	0.00	0.00	1.64
15h00-16h00	2	31.00	1.02	0.00	0.00	13.32	2.17	8.50	23.98	0.00	0.00	0.00	0.00
16h00-17h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17h00-18h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18h00-19h00	2	31.20	0.77	0.00	0.00	13.32	2.29	8.50	24.11	0.00	0.00	0.00	0.00
19h00-20h00	4	70.30	1.76	3.90	1.70	15.45	2.11	7.25	24.81	0.98	0.00	0.00	0.98
20h00-21h00	4	65.20	0.39	3.80	1.65	14.00	2.30	7.75	24.05	0.95	0.00	0.00	0.95
21h00-22h00	2	33.00	0.08	0.00	0.00	14.10	2.38	7.00	23.48	0.00	0.00	0.00	0.00
22h00-23h00	3	50.50	0.68	0.00	0.00	14.57	2.28	7.00	23.85	0.00	0.00	0.00	0.00
23h00-24h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
⇒ **TOTAL**	46	768.60	1.54	23.10	1.29								
⇒ **AVERAGE**						14.25	2.46	8.30	25.01	0.50	0.00	0.00	0.50

EUROCONTROL

SIMMOD Reporter Measurements for Departures on Runway 03

Time Interval	Dep Flow	Overall Departure Times				Average Departure Times								
		Travel		Delay		Travel				Delay				
		Total	Std. dev.	Total	Std. dev.	air	ground	gate	total	air	ground	gate	queue	total
0h00-1h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1h00-2h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2h00-3h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3h00-4h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4h00-5h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5h00-6h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6h00-7h00	3	29.00	0.03	0.00	0.00	6.20	3.46	10.22	19.87	0.00	0.00	0.00	0.02	0.02
7h00-8h00	5	58.30	2.73	7.30	1.81	5.81	5.85	8.20	19.86	0.00	0.03	0.00	1.43	1.46
8h00-9h00	7	90.90	2.82	11.50	1.90	5.89	7.10	23.59	36.59	0.00	0.40	0.00	1.24	1.64
9h00-10h00	2	24.70	2.52	2.30	1.14	5.72	6.65	65.79	78.16	0.00	0.00	0.00	1.16	1.16
10h00-11h00	3	29.30	0.26	0.00	0.00	6.44	3.33	36.44	46.22	0.00	0.00	0.00	0.02	0.02
11h00-12h00	4	46.80	2.11	1.50	0.60	6.33	5.36	19.36	31.05	0.00	0.00	0.00	0.36	0.36
12h00-13h00	2	21.00	1.32	0.00	0.00	6.93	3.58	6.00	16.51	0.00	0.00	0.00	0.02	0.02
13h00-14h00	5	64.00	1.85	20.80	4.77	6.25	6.54	32.03	44.83	0.00	0.09	0.00	4.07	4.16
14h00-15h00	6	71.20	2.43	4.80	1.36	5.96	5.91	31.88	43.76	0.00	0.00	0.00	0.81	0.81
15h00-16h00	3	40.30	2.77	3.80	1.77	5.56	7.87	49.58	63.01	0.00	0.00	0.00	1.27	1.27
16h00-17h00	3	33.20	2.33	0.00	0.00	5.56	5.52	228.77	239.84	0.00	0.00	0.00	0.02	0.02
17h00-18h00	1	14.30	0.00	0.00	0.00	5.23	9.12	141.53	155.88	0.00	0.00	0.00	0.02	0.02
18h00-19h00	1	9.80	0.00	0.00	0.00	6.20	3.60	176.55	186.35	0.00	0.00	0.00	0.02	0.02
19h00-20h00	5	60.00	2.77	3.00	1.15	5.96	6.05	105.70	117.71	0.00	0.00	0.00	0.59	0.59
20h00-21h00	3	29.30	0.29	15.70	3.77	6.44	3.32	26.87	36.63	0.00	2.26	0.00	2.98	5.23
21h00-22h00	2	25.40	2.90	0.00	0.00	6.20	6.50	25.61	38.31	0.00	0.00	0.00	0.02	0.02
22h00-23h00	1	9.70	0.00	0.00	0.00	6.20	3.47	23.22	32.88	0.00	0.00	0.00	0.02	0.02
23h00-24h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
⇒ **TOTAL**	56	657.20	2.52	70.90	2.50									
⇒ **AVERAGE**						6.04	5.70	49.20	60.94	0.00	0.18	0.00	1.08	1.27

EUROCONTROL

SIMMOD Reporter Measurements for Arrivals on Runway 21.

Time Interval	Arrival Flow	Overall Arrival Times				Average Arrival Times							
		Travel		Delay		Travel				Delay			
		Total	Std. dev.	Total	Std. dev.	air	ground	gate	total	air	ground	gate	total
0h00-1h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1h00-2h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2h00-3h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3h00-4h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4h00-5h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5h00-6h00	1	12.60	0.00	0.00	0.00	9.23	3.33	7.00	19.57	0.00	0.00	0.00	0.00
6h00-7h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7h00-8h00	5	59.50	0.59	0.00	0.00	8.59	3.30	10.80	22.70	0.00	0.00	0.00	0.00
8h00-9h00	3	37.70	0.30	0.00	1.88	9.76	2.82	6.67	19.24	1.33	0.00	0.00	1.33
9h00-10h00	3	36.20	0.46	4.00	0.00	9.47	2.61	7.67	19.74	0.00	0.00	0.00	0.00
10h00-11h00	3	36.90	0.46	0.00	0.00	8.94	3.37	8.00	20.31	0.00	0.00	0.00	0.00
11h00-12h00	3	37.60	0.62	0.00	0.00	10.00	2.54	7.33	19.88	0.00	0.00	0.00	0.00
12h00-13h00	3	36.60	0.24	0.00	0.00	8.94	3.37	8.00	20.22	0.15	0.00	0.00	0.15
13h00-14h00	5	59.40	0.46	1.60	0.65	8.48	3.39	10.40	22.27	0.32	0.00	0.00	0.32
14h00-15h00	3	36.30	0.33	3.00	0.72	8.66	3.44	9.00	21.09	1.02	0.00	0.00	1.02
15h00-16h00	2	24.20	0.59	0.00	0.00	8.80	3.31	8.50	20.61	0.00	0.00	0.00	0.00
16h00-17h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17h00-18h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18h00-19h00	3	36.00	0.46	0.00	0.00	8.66	3.33	9.00	20.98	0.00	0.00	0.00	0.00
19h00-20h00	3	36.90	0.10	3.30	1.57	10.29	2.00	6.33	18.62	1.11	0.00	0.00	1.11
20h00-21h00	4	49.70	0.53	2.10	0.93	9.02	3.41	7.75	20.18	0.54	0.00	0.00	0.54
21h00-22h00	2	25.40	0.08	0.00	0.00	9.23	3.45	7.00	19.68	0.00	0.00	0.00	0.00
22h00-23h00	3	37.80	0.17	0.00	0.00	9.23	3.36	7.00	19.59	0.00	0.00	0.00	0.00
23h00-24h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
⇒ **TOTAL**	46	562.80	0.51	14.60	0.87								
⇒ **AVERAGE**						9.10	3.13	8.30	20.54	0.32	0.00	0.00	0.32

EUROCONTROL

SIMMOD Reporter Measurements for Departures on Runway 21.

Time Interval	Dep Flow	Overall Departure Times				Average Departure Times								
		Travel		Delay		Travel				Delay				
		Total	Std. dev.	Total	Std. dev.	air	ground	gate	total	air	ground	gate	queue	total
0h00-1h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1h00-2h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2h00-3h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3h00-4h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4h00-5h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5h00-6h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6h00-7h00	3	33.50	0.27	0.00	0.00	6.57	4.60	10.14	21.31	0.00	0.00	0.00	0.02	0.02
7h00-8h00	5	60.60	2.59	11.10	2.79	6.15	5.98	8.20	20.32	0.00	0.86	0.00	1.36	2.22
8h00-9h00	7	96.20	2.61	12.70	2.13	6.31	7.43	23.61	37.34	0.00	0.47	0.00	1.35	1.81
9h00-10h00	2	26.30	2.03	13.60	0.71	6.12	7.01	65.26	78.39	0.00	1.92	0.00	4.91	6.83
10h00-11h00	3	33.10	0.19	0.00	0.00	6.85	4.18	36.22	47.25	0.00	0.00	0.00	0.02	0.02
11h00-12h00	4	47.10	2.44	6.70	2.85	6.66	5.10	19.15	30.92	0.00	0.00	0.00	1.66	1.66
12h00-13h00	2	20.30	0.30	0.00	0.00	7.42	2.72	6.00	16.13	0.00	0.00	0.00	0.02	0.02
13h00-14h00	5	60.90	2.75	48.80	8.04	6.64	5.54	33.19	45.37	0.00	4.70	0.05	5.06	9.81
14h00-15h00	6	72.50	2.42	23.40	6.59	6.34	5.74	32.33	44.41	0.00	0.59	0.00	3.31	3.89
15h00-16h00	3	43.10	2.21	1.50	0.69	5.98	8.39	48.76	63.12	0.00	0.00	0.00	0.51	0.51
16h00-17h00	3	33.70	2.16	0.00	0.00	5.85	5.40	228.52	239.77	0.00	0.00	0.00	0.02	0.02
17h00-18h00	1	14.60	0.00	0.00	0.00	5.68	8.95	140.53	155.17	0.00	0.00	0.00	0.02	0.02
18h00-19h00	1	11.50	0.00	0.00	0.00	6.57	4.93	178.30	189.80	0.00	0.00	0.00	0.02	0.02
19h00-20h00	5	63.50	2.29	1.00	0.35	6.31	6.40	105.77	118.48	0.00	0.00	0.00	0.19	0.19
20h00-21h00	3	32.20	0.42	13.40	3.22	6.85	3.90	27.19	37.94	0.00	1.75	0.00	2.71	4.46
21h00-22h00	2	26.90	2.35	0.00	0.00	6.57	6.87	25.43	38.87	0.00	0.00	0.00	0.02	0.02
22h00-23h00	1	11.40	0.00	0.00	0.00	6.57	4.80	22.42	33.78	0.00	0.00	0.00	0.02	0.02
23h00-24h00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
⇒ **TOTAL**	56	687.40	2.40	132.40	4.60									
⇒ **AVERAGE**						6.42	5.85	49.26	61.54	0.00	0.78	0.00	1.58	2.37