Long Term Traffic Forecasts and Operating Pattern for a Regional Airport

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LONG-TERM TRAFFIC FORECASTS AND OPERATING PATTERN FOR A REGIONAL AIRPORT

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ABSTRACT

A common problem facing airport planners is to estimate the detail of the flight schedule that will be operated at an airport in future years. This is important to assess issues such as capacity requirements, noise and emission outputs and connectivity. For airline commercial analysts it is necessary to understand the competitive pressures and opportunities that will develop in different markets. This paper uses an approach adopted for the VANTAGE project, conducted for the UK Department of Trade and Industry to forecast the detail of airline operations at UK regional airports on a 10-20 year horizon. The paper considers a generalised forecast at the route level and how this can then be disaggregated into detail such as aircraft size, airline and flight schedule. The existing routes and frequencies are used as a basis. The detailed history of service to each international destination from the UK is used to model the future service. The extra frequencies created by the traffic model are then allocated to airlines and time windows using the D'Hondt method of highest averages. An example peak week schedule is presented for Aberdeen airport accompanied by a commentary on the key strategic and policy implications for the industry.

KEYWORDS

Airports, Airlines, Routes, Forecasts, Schedule

1. INTRODUCTION

One of the fundamental challenges in airport planning is to predict the pattern of airline operations at an airport in future years. This is important to assess issues such as runway, apron, terminal and airspace capacity requirements, noise and emission outputs as well as connectivity with other flights and surface modes of transport. This paper uses an approach adopted for the VANTAGE project, conducted for the UK Department of Trade and Industry to forecast the detail of airline operations at UK regional airport up to twenty years ahead. This builds upon the methods used in previous research for European airports (Dennis, 2002). Other examples of forecasts for regional airports include Brooke et al (1994).

Various models have been produced to simulate the development of the route network and schedule. Although based on the UK, the method is more widely applicable. In order to illustrate the process, the results for Aberdeen Airport will be presented. Aberdeen is the first airport alphabetically in the UK and provides an interesting example as it is of the size that puts it on the threshold of attracting more international services.

To start the model process, high-level forecasts of passenger volumes are required. A number of bodies (airports, government, CAAs) produce such forecasts from time to time (e.g. Department for Transport, 2002).

The base forecast used in this study for Aberdeen airport (which was produced for another element of this research) gives 1 308 340 international scheduled passengers in the forecast year (as against 540 061 in the base year) and 2 365 362 domestic and Ireland scheduled passengers in the forecast year (as against 1 669 623 in the base year). As a result of the economic downturn and increased real cost of air travel, growth rates have been depressed in recent times. A 'health warning' should hence be applied to the interpretation of any of these specific forecast results. The purpose of this paper however is to demonstrate the methodology adopted, so the actual numbers or timeframes involved are incidental to this objective. To maintain confidentiality therefore, the base year and forecast year are not identified.

2. GENERAL FORECASTS OF ROUTE NETWORK

2.1 Forecast of international routes served by airport

In order to forecast the size of the route network that may be expected at each UK regional airport, the number of international routes served was plotted against the number of international passengers handled by each airport for the base year. Passenger numbers were taken from the (annual) CAA statistics and the number of routes operated from the OAG data (for services operating in the first week of July - for simplicity this will be referred to in tables etc as July). This produces a strong linear relationship, $y = 0.00001x + 3.92$ where y is the number of international routes served and x is the number of international passengers at each airport ($R^2 = 0.96$).

Applying this formula to the growth in passengers forecast over twenty years, and adding the number of routes at each airport already existing in the base year, gives a potentially better forecast of the number of routes in the future: airports which thus already have an above average number of routes in relation to their passenger volumes were allowed to grow from that base. The result for Aberdeen is shown in Table 1.

Table 1: Forecast of international routes

Airport	Base pax (year)	July international routes	Forecast pax (year)	July international routes
ABERDEEN	540 061	9	1 308 340	17

2.2 Forecast of domestic and Irish routes served by airport

A similar procedure to that of the previous section was conducted for the domestic and Irish routes. Unlike the previous analyses, however, the plot of routes against passenger numbers shows a maturing relationship. This is to be expected, because whereas there is a very large set of possible international destinations, a much smaller set of domestic and Irish airports exists - with about thirty domestic routes in operation, almost all the significant destinations are served.

These were fitted with a polynomial, proportional to the square root of the number of passengers. The constant term (k) was chosen so that the fitted and actual traffic summed to the same value. $y = 0.01277x^{0.5}$ where y is the number of domestic routes served and x is the number of domestic passengers at each airport ($R^2 = 0.84$ on linear transformation). The differences (residuals) between the fitted and actual traffic in the base year was *re-applied* to the forecast, such that airports which actually had ±x routes in the base year (relative to the fitted value), also have ±x routes in the forecast year (adjusted on the fitted value). The total number of domestic routes grows from 398 to only 557, much less than the growth in passenger numbers. The result applied to Aberdeen is presented in Table 2.

Table 2: Forecast of domestic & Irish routes

Airport	Base pax (year)	July domestic routes	Forecast pax (year)	July domestic routes
ABERDEEN	1 669 623	22	2 365 362	25

2.3 Forecast of international frequencies by airport

The development in the number of international frequencies (flights) was then evaluated. The relationship between (annual) passengers in the base year (CAA data) and frequencies in the first week of July (OAG data) furnished a strong linear relationship: $y = 0.000115x + 6.91$ where y is the number of international frequencies per week and x is the number of international passengers at each airport ($R^2 = 0.97$). Similarly adjusting the forecast year to take account of the actual position for each airport in the base year (see previous section), produces Table 3.

Table 3: Forecast of international frequencies

Airport	Base pax (year)	July week international frequencies	Forecast pax (year)	July week international frequencies
ABERDEEN	540 061	108	1 308 340	196

2.4 Forecast of domestic and Irish frequencies by airport

Using a similar method to the fit for the international frequencies, it is seen that the frequencies on domestic and Irish services do not increase in a linear fashion with growth in passenger numbers, as was also seen with the domestic *routes* (see Section 2.2). Frequencies, however, grow *faster* than the number of routes, as evidenced by: $y = 0.00327x^{0.8}$ where y is the number of domestic frequencies per week and x is the number of domestic passengers at each airport ($R^2 = 0.92$ on linear transformation). Similarly adjusting, as before, to reflect the base position of each airport, furnishes Table 4.

Table 4 Forecast of domestic & Irish frequencies

Airport	Base pax (year)	July week domestic frequencies	Forecast pax (year)	July week domestic frequencies
ABERDEEN	1 669 623	409	2 365 362	509

3. DETAILED AIRPORT FORECASTS BY ROUTE

We now have the headline forecasts for passengers in the forecast year [annual], number of routes [(first week of) July] and frequencies [(first week of) July] for each UK regional airport split into international, plus domestic and Ireland. We now proceed to model the operations at individual airports in terms of passengers, frequencies and aircraft type (size category), by route. Again, Aberdeen (ABZ) will be used as an example to demonstrate this.

3.1 Forecast of international passengers by route

The existing scheduled international routes are taken from the OAG data of July in the base year. There are nine such routes (AMS, BGO, CPH, EBJ, FAE, CDG, GRQ, OSL and SVG). The CAA recorded a few extra international passengers in addition to these routes (these are most likely to occur on routes which operated only for part of the year or routes with multiple stops/non-traffic stops). These passengers were thus put into an ‘Other international’ category, for the base year.

By the forecast year, the number of international routes is projected to grow from nine to seventeen (see Table 1), the number of international passengers from 540 061, to 1 308 340 (the base input forecast) and the number of international frequencies from 108 to 196 (see Table 3). We therefore add eight new routes to the international network at Aberdeen, taking the next ones working down the hierarchy of destinations that are not already served (this methodology can be subsequently adopted to introduce an element of variation/probability in the routes added). These are selected from an international league table (Table 5) of destinations served by UK regional airports (departures from UK regional airports with arrivals at non-UK, non-Irish airports; excludes London airports; first week of July in the base year), giving us the destinations from Malaga, down to Barcelona (Amsterdam and Paris CDG being already served). The ranking in Table 5 is by routes, then by frequencies.

However, in order to assess how much of the growth should be accommodated by new routes rather than existing routes, another model was built. We looked at the proportion of growth in frequencies that was accommodated on new routes as opposed to existing routes, over the previous equivalent time period. Routes that operated in the past, but were discontinued in the base year, were ignored, as our model assumes that all existing routes will continue (this can also be adjusted in the final procedure). This yielded: $y = (1+x)^{-0.125}$ where y is the proportion of frequency growth on new routes and x is the number of international routes served for each of the 25 airports with international operations.

As explained, international routes not served from ABZ in the base year, but modelled to be operated from ABZ in the forecast year, are drawn from the UK regional airports' international league table. The *frequencies* that are new for ABZ in the forecast year are then divided in the ratios derived above. The ratio formulas are applied to determine how the new frequencies should be divided between existing and new routes. Nice, for example, has a lot of routes in the base year, but at relatively low frequencies - it is the eighth most likely destination to be served (in general, i.e. before taking into account existing routes at a given airport) and frequencies (for ABZ-NCE) are only forecast as four per week (data in Table 7). This is fewer than for Brussels, which is less likely to be operated (ninth in the hierarchy) but will have higher frequencies when it is.

Table 5: International league table for UK regional airports, base year (showing first 20 routes out of 128 destinations served in total)

Rank	Airport code	Airport name	International routes	International frequencies
1	*AMS*	*Amsterdam*	*19*	*488*
2	*CDG*	*Paris Charles de Gaulle*	*19*	*380*
3	**AGP**	**Malaga**	**18**	**229**
4	**ALC**	**Alicante**	**17**	**172**
5	**PMI**	**Palma Mallorca**	**17**	**138**
6	**FAO**	**Faro**	**13**	**86**
7	**PRG**	**Prague**	**12**	**133**
8	**NCE**	**Nice**	**11**	**71**
9	**BRU**	**Brussels National**	**10**	**158**
10	**BCN**	**Barcelona**	**10**	**76**
11	MJV	Murcia	9	66
12	CIA	Rome Ciampino	7	53
13	PSA	Pisa Galileo Galilei	7	49
14	CGN	Cologne/Bonn KA	7	44
15	YYZ	Toronto Lester B Pearson Intl	7	35
16	LCA	Larnaca	7	13
17	CPH	Copenhagen	6	74
18	EWR	Newark Liberty International	6	63
19	GVA	Geneva	6	45
20	GRO	Gerona	6	38

Routes in bold are forecast new routes for Aberdeen

3.2 Forecast of domestic and Ireland passengers by route

A similar procedure was applied for the domestic routes. The corresponding league table is shown as Table 6 and the calculation regarding the proportion of frequency growth to be accommodated on new routes gives $y = (1+x)^{-0.32}$ where y is the proportion of frequency growth on new routes and x is the number of domestic routes served for each of the 32 airports with domestic operations. It is to be noted that when adding new domestic or Ireland routes, airports less than 150 miles apart were not used to generate a new route, unless separated by a mass of water.

With the domestic forecast, it was necessary for the projected traffic data to agree from both ends of the routes. Therefore, the domestic network was built up starting from the smallest airport, allocating the residual forecast demand among the remaining airports, moving up the hierarchy. As the London airports (and those in Ireland) are not explicitly part of our output forecasts for the UK regional airports, these destinations provide some scope to absorb ‘discrepancies’ (e.g. by allowing new routes to operate to them).

Table 6: Domestic league table for UK regional airports, base year (showing first 20 routes)

Rank	Airport code	Airport name	Domestic routes	Domestic frequencies
1	DUB	Dublin	25	429
2	GLA	Glasgow International	22	453
3	JER	Jersey	20	242
4	EDI	Edinburgh	19	491
5	ABZ	Aberdeen	17	290
6	BRS	Bristol	15	251
7	BFS	Belfast International	15	243
8	MAN	Manchester International	14	422
9	BHD	Belfast City	14	277
10	ORK	Cork	14	112
11	LGW	London Gatwick	13	470
12	SOU	Southampton	13	327
13	BHX	Birmingham International	12	323
14	STN	London Stansted	12	254
15	NCL	Newcastle	11	165
16	LPL	Liverpool	10	169
17	LBA	Leeds Bradford	10	144
18	INV	Inverness	10	124
19	KOI	Kirkwall	10	75
20	LHR	London Heathrow	9	611

The domestic passenger numbers were divided up in a similar fashion and the ‘other’ category of passengers (see previous discussion) redistributed amongst the forecast routes. From CAA data we have found that 2.2% of total base year traffic was carried during the first full week in July (Mon–Sun). This can be used to produce a *weekly* traffic forecast (from our airport annual forecasts) and matched with the frequency data, in two directions. Calculating passengers per one-way flight, and applying average load factors for July (which are taken to be: 70% domestic and Ireland, 80% short-haul international, 90% long-haul international; based on CAA data) means that the passengers per flight can be converted into aircraft capacities and finally grouped into aircraft size categories. The final data for ABZ (Aberdeen) are presented in Tables 7 and 8.

3.3 Route table for Aberdeen in the forecast year

Table 7 shows the detailed route-by-route forecast (international) for Aberdeen in the forecast year while Table 8 presents the equivalent information for domestic routes.

Table 7: Detailed international service for Aberdeen, forecast year

Destination	Freq Base	Freq Forecast	Pax Base	Pax Forecast	Pax/flight	AcftCap	AcftType
Amsterdam	21	25	240087	329781	143	179	151 -200
Bergen	11	13	41049	56385	47	59	51 - 100
Paris (CDG)	20	24	69521	95493	44	55	51 - 100
Copenhagen	7	8	24508	33664	44	55	51 - 100
Esbjerg	6	7	8635	11861	18	23	21 - 50
Vagar	2	2	4075	5597	26	32	21 - 50
Groningen	5	6	10921	15001	27	34	21 - 50
Oslo (Gardermoen)	11	13	8948	12291	10	13	1 - 20
Stavanger	25	30	125320	172138	63	79	51 - 100
Other			6997				
Malaga	n/a	14	n/a	147615	114	143	101 - 150
Alicante	n/a	11	n/a	117789	121	152	151 - 200
Palma de Mallorca	n/a	9	n/a	70637	91	113	101 - 150
Faro	n/a	5	n/a	49399	102	127	101 - 150
Prague	n/a	8	n/a	71374	95	119	101 - 150
Nice	n/a	4	n/a	32549	81	102	101 - 150
Brussels	n/a	10	n/a	35498	40	50	21 - 50
Barcelona	n/a	5	n/a	51267	120	149	101 - 150

FreqBase - Weekly frequency in July of base year (actual)
FreqForecast - Weekly frequency in July of forecast year (forecast)
PaxBase - Route traffic in base year (actual)
PaxForecast - Route traffic in forecast year (forecast)
Pax/flight - Average passengers per flight in forecast year
AcftCap - Aircraft capacity required
AcftType - Aircraft size category required

Table 8: Detailed domestic and Ireland service for Aberdeen, forecast year

Destination	**Freq Base**	**Freq Forecast**	**Pax Base**	**Pax Forecast**	**Pax/flight**	**AcftCap**	**AcftType**
Belfast Int	5	6	2506	3167	6	9	1 - 20
Belfast City	6	7	24154	30528	48	69	51 - 100
Birmingham	18	21	60538	76513	40	58	51 - 100
Bristol	11	13	19535	24690	21	31	21 - 50
Dublin	7	8	76311	96449	131	187	151 - 200
Nottingham East Mid	21	24	21163	26748	12	17	1 - 20
Humberside	20	23	29917	37812	18	26	21 - 50
Inverness	5	6	1	1	0	0	1 - 20
Kirkwall	19	22	39119	49442	25	35	21 - 50
Leeds Bradford	16	18	16637	21027	13	18	1 - 20
London Gatwick	21	24	217287	274627	124	178	151 - 200
London Heathrow	78	90	664018	839246	102	146	101 - 150
Liverpool	11	13	13658	17262	15	21	21 - 50
Sumburgh	31	36	63004	79630	24	35	21 - 50
London Luton	12	14	156719	198076	157	224	201 - 250
Manchester	37	43	119370	150871	39	55	51 - 100
Durham Tees Valley	21	24	24301	30714	14	20	1 - 20
Newcastle	26	30	21152	26734	10	14	1 - 20
Norwich	28	32	57551	72738	25	35	21 - 50
Southampton	5	6	29968	37876	72	103	101 - 150
Wick	10	12	9863	12466	12	17	1 - 20
			2851				
Jersey	n/a	12	n/a	31240	30	43	21 - 50
Cork	n/a	5	n/a	20024	41	59	51 - 100
London Stansted	n/a	12	n/a	185861	169	241	201 - 250
Isle of Man	n/a	9	n/a	21619	28	40	21 - 50

FreqBase - Weekly frequency in July of base year (actual)
FreqForecast - Weekly frequency in July of forecast year (forecast)
PaxBase - Route traffic in base year (actual)
PaxForecast - Route traffic in forecast year (forecast)
Pax/flight - Average passengers per flight in forecast year
AcftCap - Aircraft capacity required
AcftType - Aircraft size category required

4. THE ROUTE SCHEDULING PROCEDURE

A flight schedule is next built for each new route forecast to operate in the forecast year. Additional frequencies on existing routes are treated in a similar fashion to new routes. Existing services are assumed to continue at their current *time* of operation, although they may sometimes use a larger aircraft type to match capacity to demand.

Although the output is given on an airport-by-airport basis, this is achieved by forecasting each destination (e.g. Brussels) in turn. All the new and additional (i.e. added to existing routes) frequencies between the UK regional airports and this point (making up a number of different ‘UK regional airport – e.g. Brussels’ routes) are then forecast, before moving on to the next destination.

The method begins by considering the schedule distribution of all existing (base year) flights between UK airports (*including* London airports) and the destination (e.g. Brussels). This gives us a ‘UK – Brussels’ overview. We use the most common arrival time at the destination end to ‘seed’ the first rotation, all calculations being in GMT. If flights are operated by a UK airline they will then turn around and fly back to the UK point of origin. If flights are operated by a foreign airline they must fly out to the UK immediately prior to their journey to the (foreign) airport in order to make the first rotation ‘seed’ arrival time. Flights which cannot complete this sequence (due to an arrival late at night or early in the morning at the 'wrong' end of the route) are assumed to make an overnight stay, as appropriate. The rest of the schedule for the day is calculated according to the method presented in Section 4.4.

To allocate airlines to routes, and frequencies to schedules, the d’Hondt (or highest averages) method is used (Gallagher, 1991; BBC, 1999). This has the advantage of producing a broadly proportionate result overall. This also has the advantage of producing more realistic sets of results, e.g. with schedule bunching, rather than perfectly smoothed operations. This procedure follows a rota, rather than a randomisation, so that the results will be the same each time the simulation is run with the same input parameters.

4.1 Distribution of routes to airlines

The forecast new and additional frequencies are taken from Section 3 above. For each destination, routes are allocated to UK and foreign airlines starting with the route with the largest number of new frequencies first, and applying the d’Hondt formula. This ensures that the distribution of carriers across the new routes broadly replicates the existing pattern to that destination from the UK. Some destinations, such as Malaga, will thus continue to be dominated by UK carriers, while others, such as Amsterdam or Dubai, will be mostly operated by foreign carriers.

4.2 Distribution of frequencies to days of the week

To allocate the forecast frequencies on an individual route (e.g. Aberdeen – Brussels) to days of the week, Monday-Friday is treated as one group, with a different pattern for Saturday and for Sunday. Frequencies are allocated in proportion to the total existing UK flights to each destination in turn, e.g. using the ‘UK – Brussels’ overview we have already mentioned. This captures the distribution of some (business type) destinations being weekday-focused and other (holiday) destinations being more concentrated on the weekend.

The frequencies forecast for Monday-Friday are then grouped into blocks of (multiples of) five flights (e.g. daily, Monday-Friday) with a remainder. The remainder is allocated to the most popular days of the week based on the existing services, using the ‘UK – Brussels’ overview, with a rotating allocation between ‘tie-break’ days. This rotating allocation is reset at the end of the process of building all routes to a given destination. (Depending on any bias this may produce in the more refined model, this may be rebuilt using the d’Hondt method). Similarly, but separately, the Saturday and Sunday frequencies are then allocated between those days, based on their total frequencies.

4.3 Schedule by time of day

The schedule, by time of day, is also built separately for Monday-Friday, for Saturday and for Sunday. The Monday-Friday frequencies are treated as blocks of (multiples of) five, plus the residual block.

The basic principle of allocating the first rotation seed times, on a route-by-route basis, is as follows. The UK airport with the highest number of new frequencies to the destination (e.g. Brussels) is assigned first choice of the most common arrival time for UK flights at that destination. As these destination-end first choice slots are taken up by the larger UK regional airports, those lower down the list (e.g. with fewer, total flights to Brussels in the forecast year) are assigned ‘next best’, first seed arrival times.

The first rotation (block) is allocated to the most popular arrival hour of the day. The d’Hondt formula is then applied and the second rotation (block) is allocated to the hour with the new highest score (with appropriate constraints on minimum intervals between flights on the same route). Saturday and Sunday are computed similarly, but using the different base distributions pertaining to those days. If the independently derived timings produced are close to those of the weekday operations, they are adjusted to be the same time, reflecting operators’ preferences to run simpler schedules across the week, where appropriate.

To allocate the minutes within each hour (flights are assumed to be scheduled in units of five minutes) a rotating list of minutes past the hour is applied (in the order: 00, 30, 15, 45, 05, 35, 20, 50, 10, 40, 25, 55). This rotating list is maintained for all routes to that destination (e.g. Brussels) and is then reset to 00 when the next destination is built.

A flight is assigned a turnaround time, which is dependent upon the aircraft size and the operator type (low-cost carriers may be assigned with shorter turnaround times, for example). Various detail was applied to estimate the scheduled flight times, taxi-times and other elements of the operational process. Further research on optimising the timing of flights can be found in Warburg et al (2008).

4.4 Simulated schedule for Aberdeen in the forecast year

Table 9 shows the sample output for the hour 0600-0700 at Aberdeen in the forecast year.

Table 9: Aberdeen (ABZ) departure schedule from 0600-0700, first week of July in the forecast year

Exist/ New	DOM/ INT	ARR/ DEP	Flight	Dep	Dep Ctry	Arr	Arr Ctry	AO Dom	AO For	Local Dep Time	Local Arr Time	M	Tu	W	Th	F	Sa	Su	Aircraft
Exist	INT	DEP	X9101	ABZ	GB	OSL	NO	1	0	0610	0905	1	2	3	4	5			D38
Exist	INT	DEP	AF5555	ABZ	GB	CDG	FR	0	1	0620	0920	1	2	3	4	5	6	7	ER4
Exist	DOM	DEP	BA8780	ABZ	GB	LSI	GB	1	0	0620	0730					5			F50
Exist	DOM	DEP	BA8780	ABZ	GB	LSI	GB	1	0	0620	0730	1	2	3	4				SF3
Exist	INT	DEP	KL1440	ABZ	GB	AMS	NL	0	1	0620	0900	1	2	3	4	5	6	7	737
New	INT	DEP	[-]	ABZ	GB	NCE	FR	1	0	0620	1000	1			4	5	6		[101-150]
Exist	DOM	DEP	BD671	ABZ	GB	LHR	GB	1	0	0635	0815	1	2		4				319
Exist	DOM	DEP	BD671	ABZ	GB	LHR	GB	1	0	0635	0815							7	ER4
Exist	DOM	DEP	BA2921	ABZ	GB	LGW	GB	1	0	0635	0815	1	2	3	4	5	6	7	737
Exist	DOM	DEP	BD671	ABZ	GB	LHR	GB	1	0	0635	0815			3		5			319
Exist	DOM	DEP	T34501	ABZ	GB	BRS	GB	1	0	0640	0825	1	2	3	4	5			J41
Exist	DOM	DEP	T34091	ABZ	GB	NCL	GB	1	0	0640	0725	1	2	3	4	5			S20
Exist	DOM	DEP	BA1301	ABZ	GB	LHR	GB	1	0	0645	0825		2						319
Exist	DOM	DEP	BA1301	ABZ	GB	LHR	GB	1	0	0645	0825	1		3	4	5			320
Exist	DOM	DEP	BA8830	ABZ	GB	KOI	GB	1	0	0650	0745	1	2	3	4				F50
Exist	DOM	DEP	BA8830	ABZ	GB	KOI	GB	1	0	0650	0745					5			SF3
New	INT	DEP	[-]	ABZ	GB	BRU	BE	1	0	0655	0930	1		3		5			[21-50]

Source: Base year schedules from OAG
EXIST/NEW - Existing route or new route
DOM/INT - Domestic or international
ARR/DEP - Arrival or Departure
Flight - Flight number (existing services)
Dep - Departure airport, Dep Ctry - Departure country, Arr - Arrival airport, Arr Ctry - Arrival country
City codes - ABZ:Aberdeen, AMS:Amsterdam, BRS:Bristol, BRU:Brussels, CDG:Paris Charles De Gaulle, KOI:Kirkwall, LGW:London Gatwick, LHR:London Heathrow, LSI:Lerwick, NCE:Nice, NCL:Newcastle, OSL:Oslo
AO - Airline operator (UK/Foreign)
Aircraft - Aircraft type D38:Dornier 328, ER4:Embraer 145, F50: Fokker 50, J41:Jetstream 4, SF3:Saab 340, S20:Saab 2000, 319:Airbus 319, 320:Airbus 320, 737:Boeing 737, size category for new aircraft - [101-150]:101-150 seats, [21-50]:21-50 seats

5. CONCLUSION

The above process has been applied in semi-automated format to produce forecasts and a simulated flight schedule for the UK regional airports at a considerable level of disaggregation. The route and frequency modelling aims to replicate the way that these develop at a different pace from that of passenger volumes. The schedule modelling then attempts to reflect airline behaviour by clustering flights at popular times of the day and through the use of the D'Hondt method, the existing schedule is taken into account in determining the timings of additional services that are added on a route. There are clearly further refinements that can be adopted and some of these were incorporated at later stages of the research project. As with all simulation work however the balance is between making each flight a special case - and forecasting it individually - versus creating a sufficiently realistic approximation that can be applied in a procedural or automated fashion. Behind all of this was a wish to keep as close to industry practice as possible rather than developing theoretically sophisticated models that became completely divorced from reality. It is hoped that this paper has at least provided some ideas for airport planners and policy makers to address this complex topic.

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