

# **The potential use of consumer flight radar apps as a source of empirical data: an exploratory study of A320 utilization rates in Europe.**

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## **Abstract**

The development of smartphones, tablet computers and consumer flight radar software applications (or 'apps') has expanded the range of empirical data sources that are available to air transport researchers. Drawing on the results of an exploratory study that uses Pinkfoot's Plane Finder HD flight radar app for the iPad to document the utilisation rates of eight A320-200 airframes that were operated by four different European airlines during January 2012, the paper assesses the potential for using flight radar apps as a source of empirical data to inform academic research. The paper discusses the potential benefits and drawbacks of using consumer flight radar apps for scholarly research and makes recommendations for how these new sources of flight data might be productively employed in the future.

**Keywords:** flight radar apps, Plane Finder HD, aircraft utilisation, A320.

## **1. Introduction**

On 3<sup>rd</sup> November 2009 the UK software developer, Pinkfoot, released a new flight radar app for the apple iPhone. In exchange for a one-off installation fee (currently £2.99 or USD\$4.70), iPhone users could download the new 'Plane Finder' app to their smartphone and, provided they had a wifi or 3G internet connection, view on their handset the position of all Mode-S transponder equipped commercial (and some general aviation) aircraft, irrespective of their geographic position relative to the user, whose ADS-B (automatic dependent surveillance - broadcast) signals were being detected by a network of ground based receivers. A free 'cut down' version, with reduced functionality, was also made available. Five months later, on 1<sup>st</sup> April 2010, a



Further salient information about each individual flight, including the flight number, callsign, operator, aircraft type, squawk (aircraft transponder code), origin/destination, airspeed, altitude, and heading, as well as photographs of individual airframes and a history page that details all of the flights flown by that individual airframe within the last 8-10 months, can be accessed by touching the aircraft icon that relates to the flight of interest (Figure 2). A full list of available data fields appears in Table 1.

Figure 2 Screenshot of Plane Finder HD app with the details of DHL flight DHK971 from New York (JFK) to East Midlands Airport (EMA) displayed (image reproduced with kind permission of Pinkfoot).



Table 1 Data fields available through the Plane Finder HD app

Flight number	Airspeed (in mph and knots)
Callsign (if different)	Altitude (in feet)
Origin	Heading (in magnetic degrees)
Destination	Current date (dd/mm/yyyy)
Aircraft operator	Current time (in UTC)
Nationality of operator (denoted by national flag)	Previous flights (includes flight number, time/date, and origin/destination)
Aircraft type (B763 denotes a B767-	Geographic trace of the trajectory of all the

300, B744 a Boeing 747-400)	flights performed by that airframe since 0000UTC on the day of data acquisition
Aircraft registration	Photographs of airframe, if available (N.B. images are uploaded by users)
Approximate geographic position	Type of flight (if known) – some airlines put ‘P’ after the flight number to denote a non-revenue positioning flight

In addition to the basic display, users can impose data filters in order to positively identify and locate individual flights, particular airlines, certain aircraft types, or aircraft flying at particular speeds or altitudes. A range of additional settings controls allow users to configure the display to their personal colour and stylistic preferences and set a range of user-defined alerts.

Although security concerns and streaming delays mean that the data that is displayed is always a couple of minutes old, the systems provide a readily-available and accessible source of empirical information about all the commercial flights that are currently airborne and within range of a receiver and details of all the flights that individual airframes have performed within the last 8-10 months. Although primarily designed as a tool for aircraft enthusiasts and curious laypeople, the empirical flight information that is provided by the Plane Finder and Plane Finder HD apps has the potential to be of considerable interest not only to air transport researchers but also to aviation professionals.

## 2. Method

To assess the potential utility of these flight radar apps, Plane Finder HD was downloaded and installed on the author’s iPad and a working research hypothesis, based on the assumption that aircraft utilisation rates will vary according to whether an airline is a full-service, low-cost or charter carrier, was formulated. At 11am local time on 4<sup>th</sup> February 2012, the app was launched and a data filter set up so that only flights that were airborne over north west Europe and which were being operated with A320-200 airframes were displayed. The A320-200 was selected because it is a popular medium-range twin-engine narrowbody aircraft that is flown by a range of full-service, regional, low-cost, and charter airlines within Europe.

For the purposes of the exploratory research, eight individual airframes operated by four different European airlines were identified. The first two were operated by a national flag-carrier, the second two by a regional full-service operator, the third pair by a major low cost airline, and the final two by a charter carrier. All four airlines were registered in the same EU country. They are referred to in the subsequent findings and analysis as Airline A, B, C, and D respectively (see Table 2). Once the eight airframes had been identified, the past flight logs of each were interrogated and the dates, origin/destination (O/D), and timings of all of the flights that the app had

recorded that each airframe had flown between 1 January 2012 and 31 January 2012 inclusive were recorded on an Excel spreadsheet.

Table 2 Details of the four airlines

Airline	Type of operation
A	National full-service flag carrier
B	Regional full-service airline
C	Low-cost airline (LCA)
D	Inclusive tour (IT) charter airline

Once entered, the raw data was cleaned and rendered into a more user-friendly format. This involved removing flights that had been double counted and converting the 4-letter ICAO (International Civil Aviation Organisation) airport codes that the app uses to document the O/D of individual flights into the more familiar 3-letter IATA (International Air Transport Association) codes (thus EDDM became MUC (Munich) and EGLL became LHR (London/Heathrow)). ICAO codes were converted using the free-to-use website [worldairportcodes.com](http://worldairportcodes.com). A great circle distance calculator (embedded within the 'Airports' app) was used to determine the great circle distance in nautical miles (nm) between all of the origin/destination airport pairs that each of the eight airframes had flown during the month. These figures were then multiplied by a constant of 1.852 to convert the distance units from nautical miles into kilometres.

The resulting dataset contained information on the total number of individual O/D flights each airframe had flown during the month (this included both revenue passenger services and positioning flights as well as details of the origin and destination airports), information about date and time individual flights had occurred (this was recorded to eliminate double counting), a list of all the airports that the aircraft had visited, and the total distance (in nm and km) each aircraft had flown.

### 3. Results

The results of the exploratory study into the utilisation rates of A320 airframes by the four selected airlines appear in Table 3.

Table 3 Aircraft utilisation rates by airframe (the average number of flights per day, the total distance flown and the average flight length are rounded to the nearest whole number).

Airline	Aircraft	Total flights flown during Jan 2012	Average number of daily flights	Total distance flown (km)	Average flight length (km)	Number of different airports served
A	A1	164	5	128,520	982	33

	A2	154	5	150,197	975	33
B	B1	80	3	179,622	2,245	17
	B2	120	4	91,478	762	12
C	C1	118	4	212,621	1,802	22
	C2	126	4	159,467	1,266	22
D	D1	53	2	90,402	1,706	13
	D2	84	3	142,026	1,691	16

The two A320-200s belonging to Airline A, the flag carrying full service operator, flew the highest number of flights and performed the highest number of average flights each day. Aircraft A1 flew at least one revenue service every day during the month (aircraft A2 was active for 30 of the 31 days in January) and both airframes A1 and A2 visited 33 unique airports. Their average flight lengths differed by only 7km.

The airframes operated by Airline B, the full service regional airline, flew fewer flights than those belonging to Airline A. However, the average flight length of the two airframes varied considerably. The average flight length flown by aircraft B1, for example, at 2,245km, was almost three times longer than that flown by its sister airframe, B2, and over double the average length flown by the A320s operated by Airline A. As a result, aircraft B1 only flew an average of three flights a day compared with the average of four achieved by aircraft B2. Airline B's smaller route network also meant that Aircraft B1 and B2 flew to fewer airports than the aircraft operated by Airline A. Both aircraft B1 and B2 flew at least one revenue flight on 30 out of the 31 days in January.

The low cost operator, Airline C's, two aircraft averaged four flights per day and each airframe visited 22 different airports. The average length of each flight was approximately twice that of the A320s flown by Airline A. Aircraft C1 flew every day during the month. Aircraft C2 was active on 29 of the 31 days. Aircraft D1 and D2, which were operated by the charter airline, flew the lowest number of flights at 53 and 84 during the month respectively. Aircraft D1 only flew on 21 of the 31 days while D2 flew on 28 of the 31. These lower figures almost certainly reflect the lower demand for inclusive tour charter flights during the winter season in northern Europe. The results for this carrier, while interesting, cannot, therefore, be considered representative of the airline's operation over the whole year. In addition to facilitating examinations of the aerial mobility of individual aircraft, the data also enabled the utilisation rates of the four airlines' airframes to be compared. The aggregate data appears in Table 4.

Table 4 Comparison of A320-200 utilisation rates by airline (the average number of flights per day, the total distance flown and the average flight length are rounded to the nearest whole number).

Airline	Average number of flights flown during month	Average flights per day	Average distance flown (km)	Average flight length (km)	Number of different airports served
A	159	5	139,359	979	33
B	100	4	135,550	1,504	17
C	122	4	186,044	1,534	22
D	69	3	116,214	1,699	16

Airline A, the flag-carrying full-service operator flew the highest number of flights during the calendar month. The airline flew 37 more O/D services during January 2012 than the low cost operator did and also averaged one more flight per day. This finding appears to contradict some of the literature that states that low cost airlines record higher rates of aircraft utilisation than full-service operators. Owing to the relatively high number of flights performed, the average total distance flown by both aircraft was high, although the average flight length, at 979km, was the shortest of the four operators. The airline's two aircraft served a combined number of 33 different airports. The data shows that Airline A used its two A320-200 aircraft intensively between a large number of different airports that are all located within a relatively short distance of each other.

The A320-200s operated by Airline B, the regional full-service carrier, flew an average of 100 flights, or approximately 4 per day, during the month. The average total distance flown and the average flight length were the second shortest in both categories. The aircraft served a combined total of 17 different airports. The low-cost operator, Airline C's, two aircraft flew 122 flights, an average of 4 per day, during the study period. The average distance flown and the average flight length for Airline C's two aircraft were both higher than those recorded Airlines A and B. This indicates that while the aircraft were used quite intensively, the routes they were flying (as measured by the distance between the origin and destination airports) were longer.

The two airframes operated by Airline D, the charter carrier, flew an average of 69 flights (3 a day) during the month. However, while the total average distance flown was the smallest of any of the operators, the average flight length, 1,699km, exceeded that of all the other operators and reflects the fact that the winter sun destinations the aircraft served (which necessitated flying to airports in the Canary Islands and North Africa) were much further away than the airports served by the other three airlines.

## 5. Discussion and conclusion

This exploratory study, though only focusing on one specific area of inquiry, has shown that there is significant potential to exploit the spatial and temporal flight data that is contained within consumer flight radar apps. By identifying and then contrasting the aircraft utilisation rates of A320-200 aircraft that are operated by four different European airlines, the research has indicated the potential utility of this new data source for academic research. Unlike other potential sources of flight data, consumer flight radar apps represent a cheap and cost effective way to gather large quantities of empirical data on commercial flights that are actually being (and have been) flown, as opposed to merely scheduled, and their potential uses are extensive.

Data derived from them could, for example, be used compare and contrast the operating characteristics of different airlines, assess how aircraft types are used, monitor the global mobility of individual aircraft, identify the effect of disruptive events (including, but not limited to, thunderstorms and convective weather activity, volcanic ash, snow and ice, dust storms, equipment failures, industrial action, and terrorist activities), and track how aircraft use the airspace above or around a particular location or airport. In addition to being of potential value to air transport researchers, flight radar apps also represent a cost effective way for airline employees, operations departments, airline passengers, travellers' friends and relatives, and local airport communities, to monitor flows of aircraft and identify the location and status of flights irrespective of their geographic location relative to the aircraft concerned.

Challenges associated with the use of flight radar apps include the fact that the software can only track Mode-S equipped commercial aircraft, an internet connection is required, and the data is not streamed live. Furthermore, coverage is dependent on aircraft being equipped with Mode-S transponders and the provision of an adequate network of ground stations to receive the signals. This has the potential to be problematic in countries where the use of such equipment is prohibited. While the software's developers emphasise that they 'work very hard to continually increase our global coverage' and that it is 'improving all of the time' (pinkfroot, 2012), information on the proportion of flights which are not captured by their existing network of ground stations is not available. As a result, it is possible that coverage of air traffic in certain parts of the world, as well as coverage of certain (particularly smaller) aircraft types will be less comprehensive than it is for others. Potential users will, therefore, need to exercise caution.

In addition to these logistical and administrative issues, occasional software or connection glitches can result in some aircraft not being displayed all of the time they are airborne and, occasionally, the flight logs attribute services to the wrong aircraft (during the course of the exploratory research, the flight number of one carrier was attached to an aircraft belonging to another, wholly unrelated, airline). Users must

also employ discretion to filter out 'ghost' returns, airfield operations vehicles (which are transponder equipped and so sometimes appear on the display), and certain types of military aircraft, as all of these can be identified by the system. In conclusion, although they are still a relatively new technology, flight radar apps represent an innovative and welcome source of empirical data which has the potential to reinforce, if not eventually revolutionise, conventional understandings of aircraft and airline operations by making once 'hidden' information available to anyone who has an internet-enabled smartphone or tablet computer and is prepared to use the free version or pay the one-off installation fee.

### **Reference**

Pinkfroot corporate website (2012) *Coverage* Retrieved from <http://planefinder.net/about/coverage/> on 11/07/2012

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