

US regional airline scope clauses have evolved periodically over the past 22 years, and are due for renegotiation in 2020. Regional aircraft sizes have increased at each stage of scope clause development, and continued growth and the drive for lower costs per seat suggests scope clauses should be expanded to allow larger types of regional jet.

US airline scope clauses & regional fleet planning

North American airline scope clauses have influenced the development of major and regional airline fleet plans for more than two decades. Scope clauses were put in place by the Allied Pilots Union (APA) and major airline pilot unions to protect their salaries by limiting the portion of short-haul operations that major airlines can transfer to their regional partners. They arguably constrain airline fleet plans by preventing the economic operation of aircraft larger than 76 seats and up to 100-120 seats, and force major airlines that pay higher pilot salary scales to operate narrowbodies at relatively high operating costs. The details of airline scope clauses, the major carriers' regional fleet, pilot salary scales, and the aircraft options available to airlines are examined.

Scope clauses

There are six US major carriers: American Airlines, Delta Airlines, United Airlines, Southwest, Alaska Airlines and jetBlue Airways. Southwest and jetBlue do not have any routes in their networks operated by regional feeder carriers or regional aircraft. Alaska Airlines has a regional subsidiary called Horizon Air. There is no scope clause agreement between Alaska Airlines and Horizon Air, so Horizon Air is free to operate any aircraft type it requires.

The three largest US carriers American, Delta and United, each have franchise and codeshare agreements with several independent regional partner airlines, including: Air Wisconsin, Commutair, Endeavor Air, Envoy Air, ExpressJet, Mesa Airlines, PSA Airlines, Republic Airways and SkyWest Airlines. Many of these regional carriers provide feeder services for more than one major airline. It previously also included airlines such as Air Midwest, Allegheny Airlines, Atlantic Coast Airlines (ACA), Atlantic Southeast Airlines (ASA), Chautauqua Airlines, and Mesaba Airlines.

The agreements between major carriers and regional feeders are for the latter to operate the shorter and lower-density routes to and from the airport hubs and terminals of their major airline partners. The regional feeder services are designated with major airline flight codes: American Eagle services are designated with AA flight numbers, and Delta Connection services and United Express flights have DL and UA flight numbers. Regional feeder carriers are paid flat-rate fees by the major airlines for providing these services.

The major airlines market all services via their reservation platforms and collect revenues through their revenue accounting systems for a group of operations on routes operated by these regional carriers.

The regional carriers have their aircraft painted with the liveries of regional feeders of their respective major airline partners. Aircraft operating as American Airlines' regional feeders are painted in American Eagle's livery, Delta's regional feeder aircraft have Delta Connection's livery, and the regional fleets that operate for United are in the colours of United Express.

Scope clause rationale

Regional airline scope clauses are based around the limits of the fleets that their major airline partners allow them to operate. US regional feeder carriers evolved in the mid-1980s. Fleets in this period were mainly 20-seat and 30- to 37-seat turboprops. This included types such as the EMB 110, EMB 120, Jetstream 31, Jetstream 41, and the Saab 340. A few US regionals started to operate larger 50-seat turboprops in the mid- and late 1980s, in particular the Dash 8-300 and ATR42, and to a lesser extent the Fokker 50. Larger turboprops, especially the ATR72, started to be operated in larger numbers from the late 1980s. This was added to by the Q400 in the case of Horizon Air in 2000.

The introduction of the first 50-seat Bombardier CRJ regional jet (RJ) by

Comair in the mid-1993 resulted in the need for major airline pilot unions to demand scope clauses. American Airlines and United Airlines first introduced their scope clauses in 1997, and Northwest ratified an agreement in 1998.

These clauses stipulated and limited the number and size of jets that major airlines allowed their regional feeders to operate. This prevented major airlines transferring an unlimited number of routes and services, together with aircraft and associated crews and equipment, from their own operations to their regional feeder carriers. The purpose of this was to protect the pilots of the major airlines, whose salaries are 2.5-3.4 times higher than those of pilots in the regional feeder partners.

Limiting the number of RJs and larger jets that a regional feeder can operate maintains the number of narrowbodies a major airline has to operate, and therefore the number of pilots that it has to employ at its higher salary scales to provide services across its route network.

With the introduction of 50-seat RJs, and the development of larger RJs by Bombardier and Embraer, major airline pilot unions feared a continuous transfer of a larger number of domestic US routes to their regional feeders. This would ultimately result in a reduction of routes and the number of narrowbody aircraft used by the majors. The effect would be to transfer a large number of pilots to the regional feeders.

Regional jets

With the advent of RJs in the US regional airline network, and the subsequent phasing out of turboprops, which were the mainstay of US regional carrier fleets during the 1980s and 1990s, major US airline pilot unions started to put scope clauses in place.

The first RJs to enter service were the 50-seat CRJ100/200. Large orders were placed in the late 1990s and into the early

American Eagle operates 150 ERJ-140s and -145s, with some being used at Miami. American Eagle has reduced the use of 50-seat RJs at Chicago and other hubs in favour of larger aircraft.

2000s. The CRJ100/200 has a standard seat capacity of 50 and a maximum take-off weight (MTOW) of up to 44,000lbs. The CRJ100/200 won more than 740 firm orders from US major and regional airlines.

The CRJ100/200 was followed by the Embraer ERJ-145, also with a standard seat capacity of 50. Its highest MTOW variant was 53,131lbs. The ERJ-145 was similarly popular, and attracted more than 480 firm orders from US carriers.

The large number of 50-seat RJ orders and the short period over which they were placed saw a fast reduction in the number of turboprops being used by US regionals. RJs were found to increase demand and passenger load factors.

The first significant scope clause limits on the number and size of RJs permitted were put in place following the rapid success of the CRJ100/200 and ERJ-145. The first restriction was a limit on the number of 50-seat aircraft. This limit was circumvented by the development of 40- and 44-seat variants of the CRJ, the CRJ440. Northwest ordered a fleet of 86.

Similarly, two shorter variants of the ERJ were launched: the 37-seat ERJ-135, and the 44-seat ERJ-140. The ERJ-135 and -140 won 85 and 74 firm orders from US regional airlines.

Scope clause limits were extended in the early 2000s for the first time to allow larger RJs. The CRJ700 was the first stretch variant of the CRJ100/200, and has a standard seat capacity of 66-78 seats. Various scope clause limits on aircraft seat numbers have, however, seen US regionals configure their aircraft with 63-70 seats. The aircraft therefore had to be configured in many cases with a lot of space for galleys, toilets and closets. The limit on a maximum of 70 seats compared to a maximum possible capacity of 78 seats, means the aircraft would suffer a cost per available seat mile (ASM) penalty.

The CRJ700 is operated by several US carriers, including SkyWest (101 aircraft), PSA (49), Endeavor Air (5), Envoy Air (12), GoJet (41), and Mesa Air (20).

As a continuation of complying with scope clauses and the number of aircraft in each group of seat capacities, Bombardier launched a 50-seat variant of the CRJ700 called the CRJ550 in February 2019. A single order for the CRJ550 has been placed by United Airlines for 50 aircraft. The CRJ550 will keep the United Express fleet compliant with its scope clause limit,



and has been launched as a replacement for some of the ageing CRJ100/200 aircraft in service. The CRJ550's MTOW is 10,000lbs lighter than the CRJ700's.

The Embraer E-Jets were launched in the late 1990s, and the first aircraft entered service in 2004. The two smallest members of the family were the E-170 and E-175, with a standard seat configuration of 70-78 and 78-86 seats respectively.

Some scope clause limits were introduced for a period, however, that placed an upper limit of 70 seats on the seat capacity of all RJs in US regionals. As a result, similar to the CRJ700, the E-170 is operated in a 70-seat configuration. This compares with a single class layout of 70-78 seats, so the aircraft can also suffer from a relatively high cost per ASM because of scope clause limitations.

The E-170 is operated by Republic Airways in a fleet of 60. It operates the E-170 at DTW as Delta Connection; and at Denver (DEN), Newark (EWR) and Houston (IAH) as United Express.

The E-175's fuselage is nearly six feet longer than the E-170's. It has a standard single-class interior of 78-88 seats, and a MTOW of up to 89,000lbs.

The E-175 is operated by: Compass Airlines in a 76-seat configuration for American Eagle in a fleet of 56; Envoy Air for American Eagle services in a fleet of 60; Republic Airways in a fleet of 128 for all three majors; SkyWest in a fleet of 89 for Delta and United; and Mesa Air in a fleet of 70 for United. These were introduced when the scope clauses changed to allow a specified number of aircraft with 76 seats and a MTOW of up to 86,000lbs.

The aircraft will suffer a unit cost per ASM penalty with this capacity when considered against its 88-seat maximum capacity in a single class.

The E-175 is also operated with an interior layout of 70 seats, and in this configuration is referred to as the E-175SC. This variant is used by airlines to comply with scope clauses, by not exceeding the number of aircraft permitted with 76 seats.

This version of the E-175 is operated by SkyWest for Delta Connection in a fleet of 30, and by ExpressJet for United Express in a fleet of seven. In this configuration the aircraft will suffer an even larger penalty in cost per ASM performance.

In both 70- and 76-seat cabin layouts, the E-175 will be limited to a MTOW of 86,000lbs.

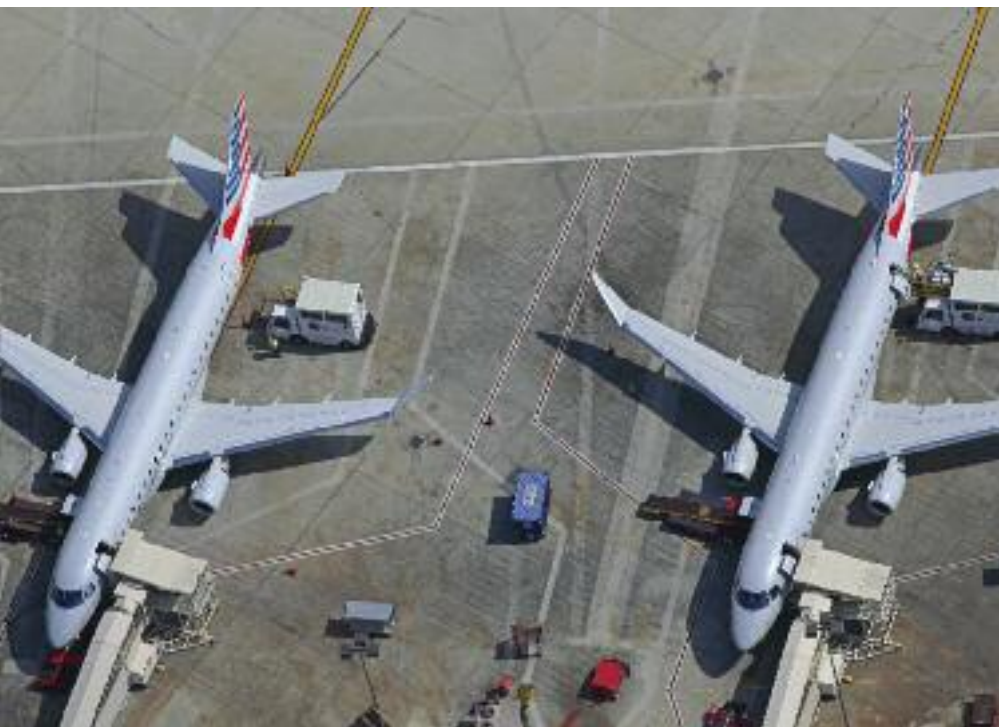
The CRJ900 is a stretch of almost 13 feet over the CRJ700, and has a standard single-class layout of 76-90 seats, 12 more than the CRJ700. The CRJ900 has a MTOW up to 84,500lbs.

The CRJ900 is operated by Mesa Air and PSA for American in a 76-seat layout in fleets of 64 and 59. It is also operated by Endeavor Air, GoJet and SkyWest with 76 seats for Delta in fleets of 109, 10 and 31. SkyWest also operates a fleet of 100 CRJ900s in a 70-seat configuration.

Regional feeder fleets

Regional airline scope clauses and fleets have continued to evolve since the late 1990s and early 2000s as 50-seat RJs and then larger RJs started to come into service.

The consolidation among US majors has seen America West merge with USAirways in 2005, followed by USAirways being absorbed into American Airlines in 2015. Northwest Airlines then merged with Delta Airlines, and United Airlines merged with Continental. From 2005 to 2015, seven major airlines consolidated into three. America West,



USAirways, Northwest, and Continental all had regional feeder partner airlines.

American Eagle

American Airlines now operates a mainline fleet of about 930 aircraft, which includes 775 narrowbodies, accounting for 83% of the fleet. The smallest aircraft in its fleet is the E-190, configured with 99 seats. American's next largest aircraft is the A319, configured with 128 seats, in a fleet of 132 aircraft.

American has an extensive intercontinental network, which is supported by its widebodies and 757s.

The absorption of airlines during the 1980s and 1990s, and in particular the merger with USAirways in 2015, has resulted in American operating at 10 major hub airports for domestic services:

Charlotte (CLT), Chicago O'Hare (ORD), Dallas/Forth Worth (DFW), Los Angeles (LAX), Miami (MIA), New York JFK (JFK), New York La Guardia (LGA), Philadelphia (PHL), Phoenix (PHX) and Washington National (DCA). American has more hubs than any other US carrier.

American has seven regional feeder airlines operating American Eagle services for American with AA flight numbers. Collectively, these airlines operate 615 of their aircraft in American Eagle livery.

The American Airlines scope clause allows its regional partners operating as American Eagle to have an unlimited number of 50-seat RJs. Envoy Air operates at ORD, DFW, MIA and JFK; and overall has 50 44-seat ERJ-140s and 60 50-seat ERJ-145s. Piedmont Airlines operates at CLT and PHL with a fleet of 60 ERJ-145s. PSA Airlines operates at CLT with 35 50-seat CRJ-200s. This totals 205 aircraft up to 50 seats (see table, page 16).

In the case of larger RJs, the American Airlines scope clause allows the number of aircraft up to 76 seats to be equal to 40% of the narrowbody fleet. The narrowbody fleet is 775 units in 2019, so up to 310 aircraft would be permitted.

Compass Airlines, Envoy Air, Mesa Air, PSA Airlines and Republic Airways all operate 65- to 76-seat aircraft. These include 20 E-175s operated by Compass Airlines in a 76-seat configuration at LAX. Envoy Air operates 19 65-seat CRJ700s, and 60 76-seat E-175s at ORD, DFW, MIA and JFK (see table, page 16).

Mesa Air operates 64 CRJ900s in a 76-seat configuration at DFW and PHX. PSA Airlines operates 41 CRJ700s with 65 seats, and 59 CRJ900s with 76 seats.

SkyWest operates 41 CRJ700s configured with 65 seats and 21 CRJ700s with 70 seats.

In total, American Eagle feeder carriers operate 410 E-175, CRJ700 and CRJ900 aircraft with 65-, 70- and 76-seat configurations (see table, page 16). This compares to the scope clause limit of 310. The scope clause can be renegotiated after 31st December 2019.

Delta Connection

Delta absorbed Western Airlines in the 1980s and so acquired a hub at Salt Lake City (SLC). It later established a hub at Cincinnati. Its largest hub for US domestic operations is Atlanta (ATL). Before its merger with Northwest in 2009, Delta was also operating hubs at Boston (BOS), JFK, Seattle (SEA) and LAX. The merger with Northwest in 2009 added Minneapolis/St Paul (MSP) and Detroit (DTW). Overall, Delta operates from nine hubs, including the East and West Coast gateways of BOS, JFK, EWR, SEA and LAX.

Under its scope clause agreement, American Eagle can operate up to 320 70- to 76-seat RJs. These are a mixture of E-175s in a 76-seat configuration, and CRJ700s and CRJ900s with 65 to 76 seats.

Delta has the second largest fleet in the US of 940 aircraft, and its regional partners provide another 452 aircraft (see table, page 16). Narrowbodies account for 84% of the mainline fleet. The smallest aircraft type is the A220-100 in a 109-seat configuration. The next largest type is the A319 at 132 seats. Delta has also ordered 50 A220-300s in a 130-seat configuration.

Delta has five regional airlines providing feeder services as Delta Connection with DL flight numbers. Delta's scope clause allows up to 348 50-seat aircraft and RJs. In the case of larger aircraft, the scope clause limits MTOW at 86,000lbs, and allows up to 102 aircraft with a 70-seat capacity and 223 aircraft with a 76-seat capacity. The scope clause is due for renegotiation from 2020.

Aircraft up to 50 seats are the 43 CRJ200s operated by Endeavor Air at the ATL, DTW, LGA, MSP and EWR hubs; and the 87 CRJ100/200s operated by SkyWest at the DTW, LAX, MSP, JFK, SLC and SEA hubs (see table, page 16).

Endeavor Air, GoJet, Republic Airways, and SkyWest all operate 69- and 70-seat aircraft. Endeavor Air operates five CRJ700s, GoJet operates 17 CRJ700s in a 70-seat layout; Republic Airways operates 22 E-170s with 69 sets; and SkyWest operates 15 CRJ700s in a 69-seat layout, 30 E-175s with 70, seats, and 10 CRJ900s in a 70-seat configuration (see table, page 16). These fleets total 99 aircraft, which is three aircraft less than the scope clause limit of 102. SkyWest, however, has 10 CRJ900s and four E-175s on order.

All five regional partner airlines operate aircraft with a 76-seat capacity, including: 36 E-175s operated by Compass Airlines at LAX; 109 CRJ900s by Endeavor Air; seven CRJ900s by GoJet; 16 E-175s by Republic Airways; and 31 CRJ900s and 24 E-175s operated by Sky West. The fleet of 76-seat aircraft totals 223 units. This is equal to the scope clause limit.

United Express

United Airlines had five main hubs established at San Francisco (SFO), LAX, DEN, ORD and Washington Dulles (IAD) before its absorption of Continental Airlines in 2001. Continental's main hubs were IAH and EWR; these now comprise two of United's seven hubs. United is the third largest major airline, with 816 mainline aircraft, split between 619

US AIRLINE REGIONAL PARTNER FLEETS & SCOPE CLAUSE LIMITS

Major airline	Regional partner	Aircraft up to 50 seats	Seat size	Fleet size	Aircraft more than 50 seats	Seat size	Fleet size
American	Compass Airlines				E-175	76	20
	Envoy Air	ERJ-140 ERJ-145	44 50	50 60	CRJ700 E-175	65 76	19 60
	Mesa Air				CRJ900	76	64
	Piedmont Airlines	ERJ-145	50	60			
	PSA Airlines	CRJ200	50	35	CRJ700	63/70	42
	Republic Airways				E-175	76	84
	SkyWest				CRJ700 CRJ700	65 70	41 21
Total				205			410
Scope clause limit				None			320
Delta	Compass Airlines				E-175	76	36
	Endeavor Air	CRJ200	50	43	CRJ700 CRJ900	69 76	5 109
	GoJet				CRJ700 CRJ900	70 76	17 7
	Republic Airways				E-170 E-175	69 76	22 16
	SkyWest	CRJ100/200	50	87	CRJ700 CRJ900 E-175SC CRJ900 E-175	69 70 70 76 76	15 10 30 31 24
Total				130	Up to 70 seats 71-76 seats		99 223
Scope clause limit				up to 348	Up to		325
United	Air Wisconsin	CRJ200	50	65			
	Commutair	ERJ-145	50	32			
	ExpressJet	ERJ-145 CRJ200	50 50	101 14	E-175	70	7
	GoJet				CRJ700	70	25
	Mesa Air				CRJ700 E-175	70 76	20 60
	Republic Airways				E-170 E-175	70 76	38 28
	SkyWest	CRJ100/200	50	93	CRJ700 E-175	70 76	19 65
	Trans States	ERJ-145	50	45			
Total				350	Up to 70 seats 71-76 seats		109 153
Scope clause limit				up to 557	Up to		255

narrowbodies and 197 widebodies. Narrowbodies account for 76% of the fleet. United's smallest narrowbody is the 737-700 in a 126-seat configuration, followed by the A319 in a 128-seat layout.

United's regional partner airlines are Air Wisconsin, Commutair, ExpressJet, GoJet, Mesa Air, Republic Airways, SkyWest and Trans States Airlines. These operate a fleet of 612 aircraft in United Express livery with UA flight numbers.

United Airlines' most recent scope clause was ratified in 2012. It allows a fleet of 50-seat RJs equal to a maximum of 90% of the narrowbody fleet, so 557 50-seat RJs would be permitted. The actual fleet is 350 aircraft. These are a mix of ERJ-145s and CRJ100s/200s operated by five of the seven regional partner airlines: Air Wisconsin with 65 CRJ200s; Commutair with 32 ERJ-145s; 101 ERJs and 14 CRJ200s with ExpressJet; 93 CRJ100s/200s with SkyWest; and 45 ERJ-145s with Trans States Airlines (*see table, this page*). There are also 50 CRJ550s on order with GoJet.

The scope clause also permits up to 255 aircraft configured with up to 75 seats. In total, 109 aircraft are operated by five of the regional feeder carriers with 70-seat configurations (*see table, this page*), including: seven E-175s operated by ExpressJet; 25 CRJ700s by GoJet; 20 CRJ700s by Mesa Air; 38 E-170s by Republic Airways, and 19 CRJ700s by SkyWest. This totals 109 aircraft.

In addition to this active fleet, ExpressJet has another 18 E-175s on order that will take its fleet up to 25 aircraft. United placed an order for a further 20 E-175s in June 2019, which will be configured in a 70-seat layout. They will replace older 70-seat aircraft.

The scope clause further permits the operation of up to 153 aircraft with a 76-seat capacity, split between Mesa Air (60); Republic Airways (28), and SkyWest (65). This totals 153 aircraft.

The scope clause also, however, allows one more aircraft between 70 and 76 seats for every 1.25 narrowbodies added to the mainline fleet.

The United Airlines scope clause is due for renegotiation in 2020.

Pilot salary scales

The development of regional airline fleets, as determined by pilot union scope clauses, restricts these airlines to small types. As described, the largest permitted aircraft types have 76-seat capacities and an upper MTOW limit of 86,000lbs. The smallest aircraft types operated by the major carriers have at least 110 seats.

Smaller aircraft types have an inherently high unit cost per ASM because many cost elements of larger types do not increase proportionately with seat capacity. Regional carriers are under pressure to

Delta Connection is permitted to operate up to 325 70- to 76-seat aircraft. It also has 130 smaller RJs.

maintain competitive unit costs per ASM, including through lower salary scales for groups of personnel, including pilots.

Pilot salaries of regional feeder airlines are disproportionately smaller than the salary scales of their major airline counterparts. Most major and regional airlines in the US guarantee basic salaries of 75 hours per month for pilots, although a minority guarantee 70 hours. The main element of total annual pilot remuneration is the basic hourly rate, which increases with each year of service, and is fixed for the year. The hourly rates for captains and first officers during the first five years of service on regional and mainline carriers can be compared to illustrate the difference between basic annual salaries.

The basic hourly rates paid to first officers of regional carriers are \$36-50 per hour, and average \$42 per hour during the first year of service. These rise to \$38-52 per hour and an average of \$45 per hour in the second year of service. They reach \$49 per hour by the fifth year of service. These rates are for all aircraft types operated, in most cases with 50-76 seats.

With 75 monthly hours guaranteed by most airlines, average basic salaries are \$3,118 per month in the first year, \$3,391 in the second year and \$3,680 in the fifth.

By comparison, basic salaries for first officers at major airlines for 737 and A320 family aircraft average \$92 per hour in the first year, and \$111 per hour in the second. They then rise significantly in the third year of service to \$158 per hour, and to \$167 per hour in the fifth year. These translate to monthly salaries of \$6,870 in the first year, \$8,355 in the second, \$11,850 in the third, and \$12,540 in the fifth. Basic salaries by the fifth year of service therefore increase by 82% over the first year of service.

First officer basic salaries at major airlines are therefore 2.2 times higher in the first year, 2.5 times higher in the second, and then 3.4 times from the third year of service compared to regional airlines.

A similar differential between majors and regionals is seen with captains' basic salaries. Regional airline average hourly rates are \$73 for the first year and \$76 for the second, and climb to \$82 per hour by the fifth. These equate to basic monthly salaries of \$5,486 in the first year, \$5,663 in the second and \$6,150 in the fifth.

Major airline pay rates per hour for 737 and A320 family types increase steadily at \$1-3 per hour with each year of service. Hourly rates for captain's basic



salaries at four major US carriers are \$226-261 per hour, and average \$251 per hour in the first year. They average \$259 per hour in the fifth year of service.

The multiple of annual basic captain salaries between major and regional airlines is 3.4 in the first year of service, and falls slightly to 3.2 in the fifth.

The multiples in captain and first officer salaries between the major and regional carriers are higher than the multiples in seat numbers between the average-sized 737 and A320 family members at 150-160 seats versus the 70- and 76-seat regional jets. Pilots operating smaller narrowbodies for majors are being paid more than 3.2 times than their regional counterparts flying the 70- and 76-seat CRJ700/900 and E-170-175, while the capacity of narrowbodies operated by the majors is 2.0 times that of these larger RJs. The implications are that the major carriers will have a pilot basic salary cost per ASM about 50% higher than their regional partner airlines when the aircraft are operated on the same average route length.

In the case of the smaller regional aircraft, the difference in cost per ASM for pilot salaries with the major airlines will be small, and possibly even close or equal, because the mid-sized 737 and A320 family members have about three times the seat capacity of 50-seat RJs.

The major airlines have a small advantage in cost per ASM for the smallest aircraft types operated by the regionals. That is, while major airline pilot salaries are more than three times higher than the regionals, mid-sized 737 and A320 family types have four times the seat capacity of types such as the ERJ-135 and ERJ-140. The number of these aircraft in operation is small, and they are due to be phased out.

Network development

Analysis of the deployment of different aircraft types by the major carriers reveals the portion of seats and ASMs provided by their own mainline operations and by their regional partner carriers. This analysis has been made for the full years of 2008 and 2018 for American, Delta and United from seven major hub airports.

The capacity data reveals the aircraft types used on each route; and the total number of flights, seats, ASMs, average route lengths and average aircraft seat numbers provided by each group of aircraft. The differences between 2008 and 2018 show how the major airlines have developed their fleet and capacity across their route networks, and how their regional partner airlines have evolved. It also reveals how average route length has changed following the phasing out of turboprops and the move to larger RJs.

American Airlines

The analysis at American's activities at DFW reveals that overall there has only been an increase in annual seats and ASMs of about 7%. Over the 10-year period, American Eagle has completely phased out turboprop operations, reduced activity with 50-seat RJs and added 76-seat RJs. Overall, the average length of routes operated by American Eagle has actually shortened by 32 miles.

American Eagle's portion of seats and ASM capacity have increased by 5% and 3%. Average aircraft size at American Eagle has increased from 50 seats in 2008 to 66 in 2018.

A similar development has occurred at American's ORD hub. Annual seats and ASMs were 5% and 4% higher in 2018



than in 2008. American Eagle has reduced the capacity provided by 50-seat RJs by 57%. Capacity from 70-seat RJs has increased by a factor of four, and 76-seat RJs have been introduced. American Eagle's average aircraft capacity has increased by 10 seats to 61.

Delta Airlines

Delta Airlines has seen an increase in ASM capacity at DTW by 12.2% since 2008, although the number of DL flights has actually declined. Delta Connection carriers have phased out the use of small turboprops, and have also reduced the capacity of 50-seat RJs by more than 50%. In the meantime, 70-seat RJs have been introduced, while 76-seat RJ activity has more than doubled. Average aircraft size for Delta Connection's operation has increased by 13 seats to 64 in 2018.

Delta Connection has seen its portion of seats for operations at ATL actually decline from 27% in 2008 to 9% in 2018, and its portion of ASMs move down from 18% in 2008 to 5%.

At ATL, Delta Connection has seen large reductions in operations with 50-seat RJs, turboprops and 70-seat RJs. Meanwhile, the size of operation with 76-seat RJs has also slightly reduced.

Delta's mainline operations in the meantime have seen a 55% increase in the number of flights, and a 35% increase in the number of ASMs. The average size of aircraft in Delta's operation at ATL has also reduced by eight seats to 159.

United Airlines

At DEN, United Express has phased out operations of small turboprops. It has increased activity with 50- and 70-seat RJs,

and has also introduced 76-seat RJs.

Average aircraft size at United Express has only increased by six seats. United Express has also increased its share of ASMs by 6% over the 10-year period.

IAH is a fifth hub that has seen the portion of flights and ASMs increase in relation to those provided by the major carriers. United Express has increased its portion of total flights with UA flight numbers by 3% and ASMs have increased by 4%. Like several other hubs, the use of small turboprops was phased out after 2008. The use of 50-seat RJs has also been reduced by about 65%. In the meantime the use of 70-seat RJs has increased threefold and 76-seat RJs have been introduced. These now account for more than half the flights and about half the ASM capacity in 2018. Average aircraft size at United Express for IAH has increased from 47 seats to 63, by 16 seats, over the 10-year period.

United's operation at EWR has seen little change in the portion of flights operated and ASM capacity provided by the mainline carrier and United Express. The use of small turboprops has been phased out and operation of 50-seat RJs has been cut back. As with all others, the capacity provided by 70- and 76-seat RJs has increased. Average aircraft size provided by United Express overall has increased by seven seats to 59 in the 10 years to 2018.

Relative operating costs

The relative operating costs of a range of regional types can be analysed on a relatively simple basis. The four main operating cost elements, and the ones that make the largest differences in overall total unit cost in terms of cents per ASM

Despite the CRJ700 being able to accommodate 76 seats, the longer CRJ900 is also used extensively by US regional feeder airlines. Scope clauses limit the CRJ900's capacity to 76 seats, meaning it will operate with a cost per ASM penalty.

(CASM), are fuel burn, maintenance, flight crew and aircraft financing or lease payments. The overall CASM for each aircraft type is also influenced by the route lengths it operates on, the pattern of operation, and the resulting rates of annual utilisation in terms of flight hours (FH), flight cycles (FC) and FH:FC ratio.

In all cases, regional and mainline aircraft operate a hub-and-spoke system, with aircraft operating from outstations to a major hub, and then operating back to an outstation. This simple rotation is repeated several times per day.

Analysis of these four main cost categories can be made on a range of routes operating from a major airline hub. Using ORD as an example, the economic performance of aircraft can be compared on eight routes with tracked distances of 146-813 nautical miles (nm). These are from ORD to Moline (MLI), Cedar Rapids (CID), Des Moines (DSM), MSP, Duluth (DLH), Fargo (FAR), Oklahoma City (OKC) and DEN (*see table, page 19*).

These eight route lengths cover a range of distances where in some cases turboprops have an advantage in CASM over jets, and in others where jets have a clear advantage because their faster speed and ability to generate a larger number of ASMs lead to lower cost per ASM.

Nine regional aircraft types have been analysed and compared on these eight routes: the ATR42-500 (48 seats); the ATR72-500 (70); the Q400 (76); the CRJ200 and ERJ-145 (50); the CRJ700 and E-170 (70); the CRJ900 and E-175 (76); and the E-190 (100) (*see table, page 19*). All of these aircraft are, or could be, operated by US regionals within the scope clause limits of major airlines. The E-190 has been included to illustrate the relative economics of larger types. It is possible that scope clauses could eventually be renegotiated to allow aircraft of this size.

While turboprops have a clear CASM advantage on shorter routes, and fast aircraft are becoming increasingly competitive on longer mission lengths, each aircraft type has been analysed on the basis that it operates all eight routes for a single-type fleet. The average route length for all aircraft is thus a tracked distance of 411nm and an equivalent still air distance (ESAD) of 464nm. The corresponding flight times and ASMs generated for this average route length are summarised for each aircraft type (*see table, page 19*). The resulting block time is the flight time plus an average taxi time of 36 minutes.

The annual utilisations likely to be achievable in FC, FH and block hours (BH) for each aircraft for this average route length are also summarised (*see table, this page*).

Aircraft with fast speeds can generate more FC per year, and so generate more FC, FH and BH per year. The ATR42 and 72 therefore have the lowest rates of utilisation. The Q400, completing a 411nm mission in 25 minutes less time than the ATR42/72, is able to achieve higher rates of 1,500FC per year. The ERJ-145, the slowest of all RJs, achieves about 1,650FC per year, while the remaining RJs achieve 100-250FC per year more, up to 1,900FC per year.

Each aircraft's annual ASM productivity is determined by the ASMs for the average route length multiplied by the annual FC utilisation (*see table, this page*). Aircraft with faster speed and larger seat capacity are therefore able to generate more ASMs per year, which has a positive effect of diluting cash costs to produce lower cost per ASM. The higher ASM productivity of jets is required to offset their higher capital and financing cost, and higher maintenance reserves and fuel burn.

Fuel burn & cost

The flight and block times and fuel burns of these nine aircraft types on the eight routes have been analysed, on flights conducted from ORD, and using standard US domestic flight rules. The resulting ASMs generated by each aircraft type, the fuel burn per ASM and the fuel cost per ASM are summarised (*see table, this page*). The fuel cost per ASM is based on a spot fuel price of \$2.10 per US Gallon (USG).

The three turboprops have a clear advantage in fuel cost over similar-sized RJs on all routes. The E-190 is the most efficient jet on account of its 100-seat capacity.

The Q400 is the most efficient of three turboprops up to the fourth route with a tracked distance of 327nm, after which the ATR72-500 has a fractionally lower cost. These two have the lowest fuel cost per ASM of all nine types on all eight routes.

The ATR42-500 is at a disadvantage to the two larger turboprops, but has a fuel burn cost about 1.25 cents lower than the CRJ200 and 1.70-2.00 cents lower than the ERJ-145 on the two shortest routes. The ATR42-500 then has a marginally higher fuel cost per ASM than the E-190 on the six longer routes from 260nm.

The E-190 has a clear fuel burn cost per ASM advantage over the ATR42-500 from 370nm onwards. This demonstrates the relative fuel efficiency of turboprops over RJs, given that the ATR42-500 here has less than half the number of seats that the E-190 has. The E-190 is the most efficient of the six jet types, which is expected because of its size and seat

ECONOMIC ANALYSIS - ROUTES & FLIGHT & TAXI TIMES - ATR42/72

Route	Great circle dist - nm	Tracked dist - nm	Flight time - mins	Taxi time - mins	Block time - mins
ORD-MLI	121	146	49	37	86
ORD-CID	170	190	61/62	39	100/101
ORD-DSM	260	259	77/80	37	114/117
ORD-MSP	290	327	95/98	45	140/143
ORD-DLH	345	369	103/109	34	137/143
ORD-FAR	484	520	141/151	34	175/185
ORD-OKC	602	662	167/178	37	204/215
ORD-DEN	722	813	210/222	42	252/264

ECONOMIC ANALYSIS - ROUTES & FLIGHT & TAXI TIMES - Q400

Route	Great circle dist - nm	Tracked dist - nm	Flight time - mins	Taxi time - mins	Block time - mins
ORD-MLI	121	146	33	37	70
ORD-CID	170	190	42	39	81
ORD-DSM	260	259	57	37	94
ORD-MSP	290	327	71	45	116
ORD-DLH	345	369	79	34	113
ORD-FAR	484	520	113	34	147
ORD-OKC	602	662	135	37	172
ORD-DEN	722	813	172	42	214

ECONOMIC ANALYSIS - ROUTES & FLIGHT & TAXI TIMES - REGIONAL JETS

Route	Great circle dist - nm	Tracked dist - nm	Flight time - mins	Taxi time - mins	Block time - mins
ORD-MLI	121	146	28-36	37	65-73
ORD-CID	170	190	34-44	39	73-83
ORD-DSM	260	259	45-57	37	82-94
ORD-MSP	290	327	56-68	45	101-113
ORD-DLH	345	369	62-74	34	96-108
ORD-FAR	484	520	87-99	34	121-133
ORD-OKC	602	662	102-114	37	139-151
ORD-DEN	722	813	129-141	42	171-183

AIRCRAFT TYPES & ECONOMIC ANALYSIS

Aircraft type	Seats	Average route length - nm	Annual FH	Annual FC	Annual ASMs	Monthly lease rental - \$
ATR42-500	48	411	1,805	950	18,741,600	84,000
ERJ-145	50	411	2,261	1,650	33,907,500	115,000
CRJ200	50	411	2,400	1,750	35,962,500	120,000
ATR72-500	70	411	1,805	950	27,331,500	160,000
Q400	76	411	2,250	1,500	48,854,000	185,000
CRJ700	70	411	2,185	1,900	54,663,000	180,000
CRJ900	76	411	2,400	1,750	54,663,000	210,000
E-175	76	411	2,400	1,750	54,663,000	200,000
E-190	100	411	2,400	1,750	71,925,000	231,000

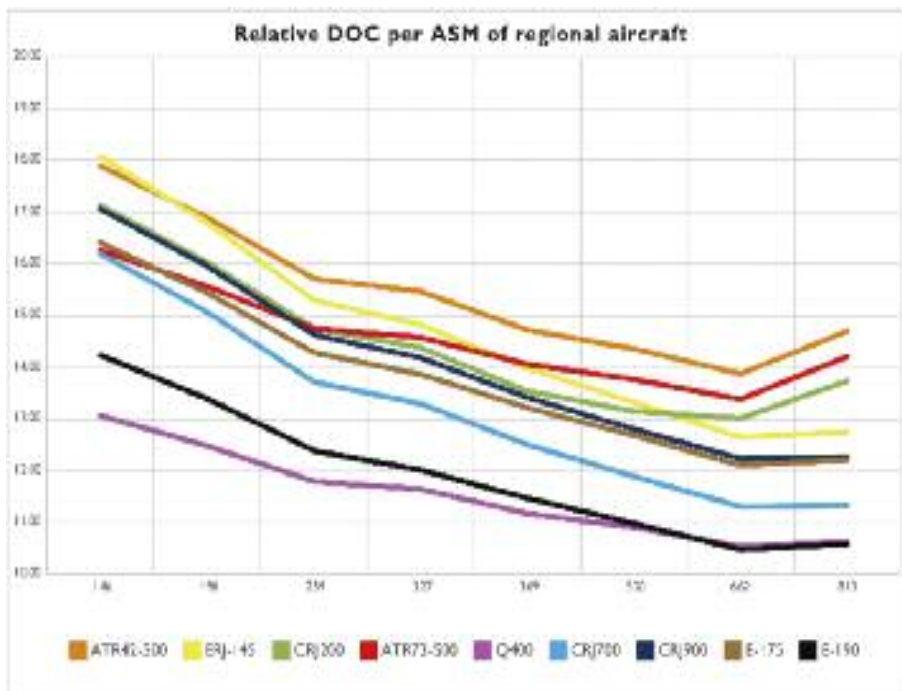
number advantage.

The fuel efficiency of turboprops is clearly illustrated by the ATR42-500 against the equal-sized CRJ200 and ERJ-145. The ATR42's fuel cost per ASM is a clear 2.0 cents lower over the ERJ-145 on the shortest 146nm route, but declines to a

1.1 cents advantage on the 327nm route, and 0.5 cents on the 662nm route.

When compared with the CRJ200, the ATR42's advantage is 1.25 cents on 146nm route, and is still as much as 0.95 cents on the 662nm sector.

The ATR 72-500 and Q400 fare well



against the equal and similar-sized CRJ700, E-175 and CRJ900. The ATR72-500's advantage over the three RJs is 3.0-3.5 cents per ASM on the shortest route, 2.1-2.2 cents per ASM on the medium length route of 369nm, and 0.75-1.00 cents per ASM on the longest route.

The Q400 is more fuel-efficient on the shortest routes, but the two converge on routes longer than 200nm, so the Q400 has an advantage of 3.2-3.6 cents per ASM over the RJs on the shortest route, a 2.1-2.2 cents advantage on the medium-length route, and a 1.3-1.5 cents per ASM lower cost on long routes of 800nm.

Engine reserves

The second main element of operating cost per ASM is maintenance costs. This has many elements. Although not all elements of maintenance costs have been analysed here, engine maintenance reserves account for a large percentage of total maintenance costs. Engine reserves are per engine flight hour (EFH) for core engine performance restorations and overhauls, and per engine flight cycle (EFC) for replacement of life-limited parts (LLPs). These reserves account for a high percentage of aircraft maintenance costs.

The interesting effect of the RJs' faster speed and consequently higher ASM productivity is that while they have more complex engines that incur higher costs per EFH for shop visit maintenance, and have higher reserves per EFC for LLPs, their overall engine reserve costs per ASM are comparable to turboprops. That is, while turboprops have lower cash operating costs, including maintenance, any advantage is lost due to their lower speed and ASM productivity.

The Q400 is the one turboprop that benefits, since its engine reserves per EFH

for shop visits and per EFC for LLP replacement are low compared to the CF34-8Cs, -8Es and -10Es of the various CRJ and E-Jet family members. The Q400, however, gains in costs per ASM because it has high speed and ASM productivity. Overall therefore, it has engine costs per ASM 0.30-55 cents lower than the large RJs, and 0.75 cents per ASM lower than the smaller RJs and turboprops.

Pilot salaries

Total costs of pilot employment will include basic salaries, per diems and allowances, transport and hotel accommodation, training, pension contributions and other elements. Basic salaries account for the largest portion of total employment cost, so they can be used to give an indication of the relative differences in cost per ASM for the nine regional aircraft types. Some assumptions have to be made about the typical number of years that pilots operate with regional carriers before joining major airlines, attracted by salaries that are 2.2-3.4 times higher. Assumptions also have to be made about the years of service with an airline and the aircraft types flown. First officers may operate with the smallest types for the first two years of service before upgrading to 70- and 76-seat jets.

Average annual basic salaries for first officers will be \$39,000 for the first two years, and \$43,000 for years three to five. Salaries average \$42,000 for the first five years of service. Captains' salaries average \$70,000 per annum.

The resultant cost of these basic salaries per ASM will depend on actual pilot productivity. Salary scales guarantee payment for a minimum of 75 hours per month, equivalent to 900 hours for a 12-month period, the legal maximum a pilot

can fly for. Despite the monthly guarantees of 75 hours, the number of crews per aircraft have been based on 850 completed BH per year.

The resulting cost of pilot salaries per ASM therefore depend on the aircraft's annual ASM productivity. The use of uniform salaries for all types therefore favours the faster aircraft types. Crew costs per trip have been calculated on average crew cost per BH, multiplied by the block time. The cash cost has then been apportioned over the ASMs for each route length. This factors in the effect of speed on resulting cost per ASM.

The largest and fastest type, the E-190, has the lowest crew cost per ASM. The ATR42-500 has the highest on this basis, although the two types have equal pilot salaries which may not apply in all airline types. The ATR42-500's cost per ASM is 1.65 cents higher on the shortest 146nm route, and this difference reduces to about 1.05 cents on the longest 813nm route. All other seven aircraft types have costs per ASM between these two extremes.

Aircraft financing

Aircraft financing charges account for the highest portion of all aircraft-related operating costs. Monthly lease rentals for the nine types are summarised (*see table, page 19*). These are based on all aircraft being acquired new in 2018/19. This is not possible, since the two smaller RJs are no longer built. The list prices for these have been extrapolated. A 40% discount has been applied to aircraft list prices, and then a 0.7% monthly lease rate factor has been applied.

The annual financing costs for each type are thus amortised over the number of ASMs generated by each aircraft.

Similar to other operating cost categories, while turboprops have lower cash costs, the RJs gain overall through their higher speed and ASM productivity. As with other costs, the Q400 benefits from its high speed and ASM productivity, and has finance costs per ASM close to the CRJ900 and 2.25 cents lower than the ATR72-500.

The CRJ900 is penalised by its seat numbers being limited to 76. The same applies but to a lesser degree to the E-175.

Overall costs per ASM

The two aircraft that have the overall lowest costs are the Q400 and E-190 (*see chart, this page*). The paradox of this is that neither is operated by a US airline regional partner that is subject to a scope clause. Horizon Air is the only US regional to operate the Q400. The E-190 is currently too large with respect to scope clause limits.

Of the 50-seat types, the ATR42-500 only has an advantage over the RJs on the

United Express is permitted to operate up to 350 smaller RJs and a maximum 255 70- to 76-seat RJs.

shortest route (see chart, page 20). This analysis is based on an average route tracked distance of 411nm. Different costs per ASM and differences would be seen between aircraft types for shorter and longer routes. That is, the ATR42-500 would have the lowest costs overall if the average route length were in the region of 200nm. This is because annual utilisations would be lower for all types, and this would favour aircraft types with lower cash operating costs.

The CRJ200 has up to a 0.95 cent per ASM advantage over the ERJ-145, and the CRJ200 is still 0.45 cents per ASM lower to operate on the medium length sectors. The CRJ200's main benefit is its faster cruise speed, and so its ability to generate more FCs per year.

Of the three larger RJs, the CRJ700 has the best performance, being 0.22 cents lower than the E-175 on the shortest route, and up to 0.80 cents lower ASM on the longest routes.

The CRJ900 is at a disadvantage because its seat numbers are limited at 76. The E-190, analysed here with a 100-seat arrangement, has costs 1.70-2.00 cents per ASM lower than the E-175. This is an important consideration for possible future developments.

The overall issue is that turboprops would be the most competitive aircraft on the shortest routes. Aircraft types and route lengths have gradually both increased as regional airline networks have evolved for more than 30 years. Smaller aircraft are thus gradually becoming less important, and average route length is now at a level where RJs provide an airline with an overall lower cost per ASM.

Larger types are clearly more desirable. Not only has continual traffic growth seen average aircraft size used by regional partner carriers steadily increase, but the larger 70- to 76-seat RJs have costs per ASM that are 0.33-0.77 cents lower than the 50-seat RJs.

Future developments

Continual traffic growth has led to the periodic developments in scope clauses. The scope clause agreements all three large US major airlines are due for renegotiation at the start of 2020.

Not only has the increase in average aircraft size used by regional partner airlines in the case of most major hubs

increased over the past 10 years, but the mainline carriers have also continually transferred routes and a portion of capacity on particular routes to their regional partners.

While the APA and pilot unions sound defiant when suggestions are made that more 76-seat RJs or larger aircraft will be permitted when scope clauses are renegotiated, it seems likely that in the long term this will indeed be the case.

The current limits of 76 seats and an MTOW of 86,000lbs may remain at the next agreed scope clause contracts, but the number of aircraft may be increased. It may be that larger types are permitted in the subsequent negotiations. In the meantime, Delta has taken the strategy of operating relatively small jetliners. It has 20 A220-100s in operation, with a 109-seat configuration, and has a further 25 on firm order.

There are several larger aircraft types that are suitable candidates for operation by US regional partner carriers. First, the CRJ900 has a standard single class capacity of up to 90 seats, so existing fleets could be reconfigured to increase seat numbers by up to 14.

Similarly, the E-175 has a standard single-class seat capacity of 88, which is 12 more than that allowed by some scope clauses. These aircraft could also have their interiors re-configured.

The CRJ1000 has a standard single class capacity of up to 104. It is no longer relevant, however, due to the sale of the CRJ programme to Mitsubishi. No more orders for the aircraft will be taken.

The E-190, as analysed, has a standard capacity of 100. It could be configured with fewer seats, for example 90, to comply with a new scope clause agreement.

The Embraer E175-E2 has a standard single class capacity of 88, but an MTOW of 98,767lbs. Increasing the MTOW limit by more than 12,000lbs would allow the E175-E2, and so provide airlines with the potential for lower fuel costs.

Other manufacturers that offer aircraft with seat capacities up to 15 seats more than the current 76-seat limit of most scope clauses are Mitsubishi and Sukhoi.

Mitsubishi has rebranded and made some configuration changes to its MRJ. The MRJ70 was 109 feet long. The new M100 Spacejet is three feet seven inches (about 107 centimetres) longer. The MRJ70 had a standard single-class capacity of 76 seats in a four-abreast layout and 31-inch pitch. The Spacejet has retained the fuselage cross-section, and the M100's longer fuselage and reconfigured cabin has taken single-class seat capacity to 84. The M100 also has an MTOW of 86,000lbs, complying with current US scope clause limits.

The larger series of the MRJ was the MRJ90. The M90 Spacejet is the same fuselage length, and has the same 88 seat capacity at 31-inch pitch as the MRJ90. This aircraft has an MTOW of 94,358lbs. This could only be reconsidered in future renegotiated scope clause agreements.

The Sukhoi Superjet SSJ100 has a standard single-class capacity of 108 seats at a pitch of 31 inches, making it more than 30 seats larger than current scope clauses allow. There is a variant under development with a shortened fuselage and smaller seating capacity of 75-seats. This could be an aircraft for US regional carriers to consider. [AC](#)



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