

The smaller Embraer have no commonality with the ERJ-170/-190, while the CRJ100/200 does have commonality benefits with the CRJ700/900. The CRJ's commonality benefits will have an influence over fleet selection, so an understanding of their value has to be analysed.

# The benefits of commonality between large regional jets

**T**he Embraer ERJ-170/190 family and the Canadair CRJ700/900 are competing for the same share of the regional market. Embraer's key advantage is its wider cabin, while Bombardier's is the CRJ700/900's commonality with the CRJ100/200. Demonstrating this commonality benefit relies on a complex analysis of the economic benefits of a single-type fleet.

An airline's regional jet (RJ) selection will ultimately depend upon a number of factors, but an existing CRJ100/200 operator cannot overlook the commonality savings that can be achieved by opting for the larger members of the Canadair RJ family. This article attempts to quantify these savings for two examples:

- 1st: An operator replacing its existing 10 CRJ200s with ten CRJ700s or 10 ERJ170s.
- 2nd: An operator growing a fleet of 10 CRJ200s by the addition of 10 CRJ700s or 10 Embraer 170s.

Both cases exploit the commonality between the CRJ200 and CRJ700, and lack of commonality between the CRJ200 and ERJ-170. Clearly, the CRJ700 is expected to have an advantage over the ERJ-170. A different situation would arise where commonality between the CRJ700 and CRJ900 or between the ERJ-170 and ERJ-190 were being compared. In the latter case, commonality between the two families would provide similar savings, but the ERJ-170 and -190 are larger aircraft with wide cabins.

## The value of commonality

There are several areas in commonality that the Canadair RJ family can offer. The most significant are related to pilot commonality; allowing the employment of fewer pilots, and parts commonality; providing savings in investment in spares. In total, savings in commonality come from:

- Pilot type rating
- Spares
- Maintenance procedures
- Ground support equipment

All Canadair RJ family variants benefit from the same pilot type rating, so a pilot moving from one variant to another only requires differences training. This requires a fraction of the downtime compared to 21-25 days of transition training between types that have no commonality. Differences training also requires less expensive types of training than transition training involves.

Differences training between the CRJ100/200 and the CRJ700/900 is limited to three days, including 16 hours of computer-based training and eight hours of training on a fixed training device. Expensive simulator time is not required.

Technical differences in the aircraft's systems have been limited to those required:

- To incorporate lessons learned from the CRJ100/200
- To take advantage of technology improvements
- Where higher loads or capacity could not be accommodated within the existing components.

The result is that spares, maintenance procedures and special-to-type ground support equipment are common, and further investment is limited when acquiring other family members.

## Pilots (initial training)

One of the biggest costs associated with introducing a new type is pilot training, which is the cost of type conversion for a pilot multiplied by the number of pilots.

Quantifying the cost is complicated, since initial type conversion training is usually included as part of the support package provided with a new aircraft. Further confusion arises where ERJ-170s/-190s are not purchased from Embraer, but leased from an operating lessor. In these cases the package of introductory training may not be as comprehensive as it would have been from the manufacturer.

In the first example, where 10 CRJ200s are replaced with 10 larger aircraft, the initial type training costs for the CRJ700 will be an absolute saving because the same pilots will be employed without the need for type conversion.

Where the 10 CRJ700s are replaced with 10 ERJ-170s new type training will be required for about 10 pilots per aircraft. At an estimated training cost of \$15,000 per pilot this is equal to a cost of \$1.5 million over the 10 aircraft (see table, page 39).

In the second example where 10 aircraft are being added, there will be no commonality benefit because initial type training costs will still be incurred for the additional pilots that have to be employed, irrespective of which type is chosen.

Although the CRJ family has a narrower cabin than the ERJ-170/190, the CRJ200 has extensive commonality with the CRJ700/900 which provides an economic benefit that can deliver considerable savings to airlines.

Even when the cost of type conversion training is covered by the manufacturer, another consideration is the loss of staff during their training. The cost of travel to the training school and hotel accommodation during the stay will not be covered by the manufacturer.

A three day course of instruction is assumed for the Canadair CRJ700/900, compared with three weeks for the ERJ-170/190.

Budget hotel accommodation might be \$100 per day and travel costs \$1000.

In the first example, the savings in the cost of travel and hotel accommodation by selecting the CRJ700 over the ERJ-170 will be: (Days X daily cost + travel) X pilots X aircraft numbers:  $((21-3) \times \$100) + \$1000) \times 10 \times 10 = \$280,000$  (see table, page 39).

There will be no saving in the second example, since additional crews will have to be trained in either case.

In the US, type conversion training costs have become a significant issue as the result of the large numbers of pilot furloughs. Pilots higher on the seniority list or furloughed by the mainline carrier have been taking over the positions held by their more 'junior' colleagues on their airlines' regional subsidiaries. The existing type rated pilots have been furloughed and the operators have been forced to pay for expensive type conversion training for the more 'senior' pilots.

A less direct benefit of commonality with the CRJ100/200 is that there are already a large number of Canadair RJ qualified crews around the world. In contrast, the probability of recruiting ERJ-170 qualified pilots, 'off the street' is highly remote. This factor has not been included in our calculations, but it could significantly affect the second example.

## Pilots (headcount savings)

The biggest cost savings would come from an overall reduction in the number of pilots required. Total pilot work time is composed of the following:

- Effective flying time
- Standby time
- Training time
- Management time



With a single-type fleet the amount of standby time can be significantly reduced. When an aircraft is grounded for technical reasons, the same crew can simply take a spare aircraft. In a mixed fleet the company would need to have spare aircraft of both types, and spare crews for both types.

Similarly, in a single-type fleet therefore simplifies standby capacity and substantially reduces the complexity of aircraft and crew scheduling. The absolute benefit is difficult to quantify, since it depends on the network being flown. As well as increased crew utilisation, a single-type fleet can also reduce the number of positioning flights and overnight stopovers, thereby reducing hotel costs.

Training time savings are the result of pilots progressing through the fleet and never needing transition training to a new type. As the ultimate demonstration, in our second example a pilot starting as an entry level first officer on a CRJ200 will not require conversion training throughout their gradual progression through the airline up to being a captain on a CRJ700.

Management time is fundamentally an infrastructure issue within the airline. As a simple demonstration, a two-type fleet is likely to have a chief pilot for each type managing the day-to-day operations for each fleet. A single-type fleet would save this expense.

For the purposes of our calculations it has been assumed that a pilot working within a single-type fleet will be 5% more productive than one in a two-type fleet.

For the US, annual aircraft utilisation is assumed to be 2,250FH, crew utilisation is 800FH for a two-type fleet

and 840FH for a single-type fleet. The annual cost of employing a crew of captain and first officer is \$135,000.

For Europe annual aircraft utilisation is assumed to be 2,050FH. Crew utilisation is 600FH for a two-type fleet and 630FH for a single-type fleet. Annual crew cost of \$175,000.

The saving in reduced pilot numbers only applies to the second example because single type and two type fleets are being compared. The saving for an all-CRJ fleet, compared to introducing the ERJ-170 is equal to a monthly cost saving of \$15,000 for a US operator and \$23,750 for a European operator.

## Maintenance staff

The costs of training maintenance staff are significantly lower than those for pilots, at about \$5,000 per mechanic.

In the first example, new-to-type training costs for the CRJ700 will be an absolute saving, since the same mechanic will be employed without the need for lengthy additional training.

In contrast, the ERJ-170 option will require new-to-type training for four mechanics per aircraft which equates to a cost of \$200,000 over the 10 aircraft fleet (see table, page 39).

In the second example, since the 10 70-seaters are simply complementing the existing aircraft then there will be no commonality benefit, because initial type training costs will be incurred for the additional mechanics employed for either type chosen.

Again, these costs are likely to be covered by the manufacturer under the terms of the initial purchase agreement, but there will still be a need to cover the



costs of travel and accommodation while they are training. Making the same assumptions as those used for pilots, but for four technicians per aircraft, the higher cost of training mechanics for new 10 ERJ-170s compared to 10 CRJ700s equates to: (Days X daily cost + travel) X mechanics X aircraft:  $((21-3) \times \$100) + \$1000) \times 4 \times 10 = \$112,000$  (see table, page 39).

Acquiring staff experienced on the Canadair RJ will also be a lot easier than for the ERJ-170.

A further commonality benefit that has not been quantified here is the learning curve. An operator selecting the CRJ700 should experience fewer introductory problems, since staff are already familiar with the CRJ200. In contrast, a new ERJ-170 operator will have a settling down period as staff get to know the aircraft.

### Maintenance staff numbers

There are several technical departments that will see almost twice the workload with a two-type fleet compared with a single-type fleet.

Assuming that a single-type fleet requires four technical staff per aircraft, then 10 aircraft would require 40 staff. Expanding this fleet to 20 aircraft would not automatically double the staff requirement, whereas a two-type fleet almost certainly would.

The number of 'duplicate' staff is difficult to quantify, but for the purposes of our calculations it has been assumed that one mechanic could be saved in a single-type fleet. Based on a salary of \$36,000 this equates to a saving of \$3,000 per month.

### Spares investment (airframe)

The scale of investment required for spares is a function of the desired protection level and fleet size. Larger fleets require more overall investment, but less investment per aircraft.

Manufacturers' recommendations for spares to achieve a specified reliability level are high and most operators, in particular smaller airlines, will not invest in this level.

For the first example, a new single-type fleet of 10 ERJ-170s will require a new spares stock of about \$10 million.

In contrast, a new single-type fleet of 10 CRJ700s will only require a further \$8.5 million to cover the 85% of spares that are not common with the CRJ200. This lower investment of \$1.5 million (see table, page 39) at a monthly lease rate factor of 1.5% is equivalent to a monthly saving of:  $\$1.5 \text{ million} \times 0.015 = \$22,500$ .

For the second example, a two-type fleet of 10 CRJ200s and 10 ERJ-170s will require two separate spares stocks, each of about \$10 million.

In contrast, a single-type fleet comprising 10 CRJ200s and 10 CRJ700s will only require an additional \$8.5 million to cover the spares that are not common between the two variants (see table, page 39). As with the first example, this is equivalent to a monthly saving of \$22,500.

There are no engine commonality benefits in either example.

### GSE/tooling investment

The investment required for special-to-type tooling and ground support

The CRJ700 has both commonality benefits with the CRJ200 and lower direct operating costs than the ERJ-170 that can provide a North American operator a saving of up to \$130,000 per month and a European airline a saving of up to \$210,000 per month.

equipment (GSE) depends more on the maintenance capability required, than on the number of aircraft in the fleet.

It is assumed that our operators will be carrying out their own base maintenance. For the first example, the existing CRJ200 equipment would be immediately applicable to the larger members of the family. In contrast, an operator electing to acquire ERJ-170/-190 aircraft will need to invest about \$140,000 (see table, page 39) in a whole new complement of GSE.

For the second example the CRJ700's advantage would be reduced to \$120,000 (see table, page 39), since it would still have to invest in a small amount of additional GSE.

### Vendor savings

The savings that can be negotiated with vendors as a result of economies of scale are difficult to quantify. This does not apply to the first example, but for the second example it has been assumed that component commonality will allow the operator to achieve a 1% lower maintenance cost. This is assumed to be equivalent to a monthly saving of \$11,250 per month (see table, page 39).

### Critical mass

Once a fleet size has increased to a certain 'critical mass', there will be opportunities to bring certain tasks in-house. Typical examples include base maintenance and simulators. For smaller operators, base maintenance will almost certainly be carried out by third-party contractors. Costs are difficult to control in such situations, and when a second dissimilar type is added the same would apply.

If, however, an existing CRJ100/200 fleet is expanded with CRJ700/900 aircraft, the type can largely be considered as common for base maintenance purposes, thereby granting the operator greater control. As well as reducing costs versus third-party facilities, revenue-generating opportunities with other operators may also be created. This effect has not been included in our analysis.

The level of investment required for a modern simulator is beyond all but the

largest regional operators, like Lufthansa CityLine and Swiss. Even if the investment required to purchase a simulator is not available, the commonality within the Canadair RJ family means there are more simulators available. This should also result in more competitive simulator training and improve the chances of a simulator being local to the operator. This in turn will reduce travel and hotel costs and the time spent away for training. This effect has not been included in our analysis.

## Commonality benefits

The overall monthly savings to be obtained from commonality are summarised as follows in our examples: the additional investment for 10 new ERJ-170s compared to 10 CRJ700s would be in the region of \$3.7 million for the first example; and \$1.6 million for the second example (see table, this page).

Embraer can mitigate the cost associated with a new type, however. In most cases where Embraer sells an aircraft direct to an airline the contract will include the training of a specific number of pilots and technicians. Similarly, the large investment necessary in spares can be mitigated, by Embraer offering them through some form of lease. These two factors combined could reduce the ERJ-170's commonality cost disadvantage from \$3.7 million to \$532,000 for the first example, and \$120,000 for the second example. They would also have the effect of transferring the spares investment into a monthly cost.

To put the savings available from commonality into perspective, it is necessary to compare these savings with the direct operating cost savings available between the CRJ700 and the ERJ-170.

The lease rate is assumed to be the same for both aircraft. Fuel consumption highlights an advantage for the CRJ700. Maintenance and crew costs are assumed to be identical. Landing and en-route charges show an advantage for the CRJ700 given the type's lower maximum take-off weight (MTOW).

A fleet of 10 CRJ700s has lower direct operating costs than a fleet of 10 ERJ-170s. The CRJ700's fleet advantage is about \$80,000 per month for a US operator and \$150,000 per month for a European operator.

For a US operator the monthly savings from commonality effect added to the lower direct operating costs increase the CRJ700's cost advantage from \$80,000 per month to \$100,000-130,000 per month. The commonality effect increases the CRJ700's direct operating cost advantage from \$150,000 per month to \$170,000-210,000 per month for a European operator.

## COMMONALITY SAVINGS POSSIBLE BETWEEN 50-SEAT AND 70-SEAT REGIONAL JETS

Cost item	Replacing 10 CRJ200 with 10 CRJ700 compared to 10 ERJ-170s	Complementing 10 CRJ200s with 10 CRJ700s compared to 10 ERJ-170s
	\$	\$
Initial pilot training	1,500,000	N/A
Pilot travel & hotels	280,000	N/A
Initial maintenance training	200,000	N/A
Mechanic travel & hotels	112,000	N/A
Airframe spares	1,500,000	1,500,000
GSE tooling	140,000	120,000
<b>Total</b>	<b>3,732,000</b>	<b>1,620,000</b>
<b>Monthly operating cost savings</b>		
Pilot headcount	N/A	
US operator		15,000
European operator		23,750
Mechanic headcount	N/A	3,000
Airframe spares	22,500	22,500
Vendor savings	N/A	11,250
<b>TOTAL</b>		
<b>US operator</b>	<b>22,500</b>	<b>51,750</b>
<b>European operator</b>		<b>60,500</b>

## Simplified fleet planning

Bombardier's commonality advantage with the CRJ700 and CRJ900 has obviously proven popular with its existing CRJ100/200 operators. Of the 12 CRJ700 and CRJ900 customers, nine are existing CRJ100/200 operators.

Embraer has an impressive list of ERJ-170/-190 customers, but only one is an existing CRJ100/200 operator. Air Caraibes, Alitalia, Cirrus, LOT Polish Airlines and Swiss are all ERJ-145 customers. JetBlue is a new RJ operator and US Airways has ordered the ERJ-170 and CRJ700 all ordered the ERJ-170/-190. Air Canada is the only airline to have ordered the CRJ700 and ERJ-190. This is arguably more to do with Canadair not offering a large enough aircraft.

Commonality is making it easier for Bombardier to place aircraft compared to Embraer. The CRJ700 is selling well to the existing CRJ100/200 operators, probably due to the relative ease of introduction. ASA, Brit Air, Comair, Delta Connection, Lufthansa CityLine, Maersk Air, Mesa, Shandong Airlines and Skywest all added fleets of CRJ700s/900s to existing CRJ100/200 fleets.

In comparison, several prospective ERJ-170 operators have simply

postponed their decisions. Examples include Air France whose regional subsidiary had placed commitments for 10 ERJ-170s. Not only has this commitment been allowed to lapse, but the airline has extended the leases on its existing fleet of Fokker 100s and also leased an additional three examples.

One of the biggest opportunities for the Canadair CRJ700/900 and ERJ-170/-190 families was to meet the requirements of the STAR alliance. The STAR fleet co-ordination working group, led by Austrian Airlines chief executive officer Vagn Sorensen was looking to acquire a common fleet of 70- to 120-seat RJs for Air Canada, Austrian Airlines, Lufthansa and SAS. The expected order for 100 with 100 options has all but collapsed.

Air Canada has opted for commitments to the Canadair CRJ700 and ERJ-190, and is apparently also considering orders for the A318.

Austrian Airlines has just announced its acquisition of nine Fokker 100s to replace its MD-87s and complement its Fokker 70s.

Lufthansa Cityline has not replaced its order for the cancelled Fairchild Dornier 728s, but has simply decided to continue with its 18 BAE RJ85s and 20 CRJ700s.



Sister company Eurowings has also recently extended its leases on five BAE 146 aircraft for operation under the new Lufthansa Regional banner.

There are still 17 CRJ100/200 operators that have not selected a new-generation 70-seater. These include the second and third largest CRJ customers, Atlantic Coast and Northwest (Comair is the largest), and Air Nostrum and Austrian Arrows, which were the original launch customers for the CRJ900, but never followed up their commitments with firm orders.

## Embraer's commonality

Although Embraer is not offering the advantage of commonality between its 50-seat ERJ-145 and the larger ERJ-170/190, the latter do share almost absolute airframe commonality, although the engines are different. This level of commonality will be very useful to an operator trying to span the 70-110 seat capacity gap.

This may be a hollow advantage in the US, since the chances of a regional operator being allowed to operate 110-seaters appears remote, and likewise for a mainline operator operating a 70-seater. Commonality with a 110-seater may therefore be of little benefit to an existing 50-seat RJ operator.

## Conclusion

There are two principal economic benefits with a single-type fleet: the reduction in the start-up investment associated with new aircraft; and the ongoing cost savings.

This article has only examined two

examples, but clearly the scale of the commonality benefits will be a function of fleet size. If, for example, an operator with 20 CRJ200s wanted to add just two more CRJ900s, then the cost of investing in an ERJ-170 amortised over just two aircraft will probably be unrealistically high. Equally, if 50 ERJ-170s were being added to five CRJ200s then maybe the commonality benefit could be overlooked.

Even where a large fleet of 70-seaters is ordered, economics may still favour the incremental addition of small numbers of common aircraft.

This article has also only examined the issue of commonality between the CRJ200 and alternative 70-seat RJs; the CRJ700 and ERJ-170. A different result would be made if a different comparison, such as the commonality between the CRJ700/900 and ERJ-170/-190 were examined.

Although the absolute value of commonality savings may be the same for a North American or European operator, its relative importance compared with direct operating costs will be higher for a North American operator because direct operating costs are lower than for a European operation. The CRJ700/900 will thus have a natural advantage in North America where the CRJ100/200 already have a large market presence.

With Bombardier's commonality advantage in the 50- to 70-seat range, and scope clauses largely limiting the US market to 70 seats, Embraer will have an uphill struggle to place its aircraft within the US.

Embraer's strong presence in Europe shows that the lower relative importance of commonality, compared to direct

*Although the ERJ-170 may have a direct operating cost and commonality disadvantage against the CRJ700, this effect can be minimised through direct support from Embraer. The ERJ-170 has the advantage of a wider cabin, making it appropriate for larger markets than the CRJ700, and extensive commonality with the ERJ-190/195.*

operating costs, and the higher comfort standards of the Embraer family combine to give Embraer more of an advantage.

In contrast to Bombardier, Embraer sees three principal market opportunities for the ERJ-170/190 family: larger aircraft to meet growth opportunities for regional operators, smaller aircraft to better match capacity with demand for mainline operators and low-cost operators.

So far the ERJ-170/190 have sold principally to traditional regional operators. Swiss and US Airways are the only two mainline operators, but given that Swiss is the old Crossair reborn this is hardly a true example of a mainline operator consciously electing to downsize.

US Airways aircraft will be operated by their regional partners/subsidiaries.

JetBlue's order is from a low-cost carrier. This is hardly typical of these companies which, for their own commonality benefits, have always had single-type fleets.

Commonality within the Canadair RJ family is only an issue with the regional operators.

Running an airline is a complex business, which is simplified by having fewer aircraft types. Where a regional operator does not already operate CRJ100/200s, selection of a new 70-seater will be based on the merits of the aircraft alone, thereby levelling out the playing field for Embraer. For an existing Canadair RJ operator where commonality benefits are available, however, it would be a brave step for an airline manager to ignore them and select the Embraer option. **AC**