

The 727 has dominated the freight fleet for many years. The prospect of higher fuel prices for the long-term raises another factor that may finally result in the 727's replacement. The major issue in the economics of replacement is still aircraft utilisation.

How do high fuel prices affect plans for 727F replacement?

The 727-100F and -200F have been in use for more than three decades, with the majority operated in North America and Europe. There are about 70 727-100Fs and 220 727-200F in service. This aircraft is ageing and fuel price, which imposes the strongest impact on an airline's variable operating costs, has increased significantly over the past two years. Is it the right time for 727-100F/-200F operators to replace them with younger aircraft that have lower fuel burns and other cash operating costs?

Fuel price impact

Over the past two years the price of oil has increased by 160%, from \$30 to \$48 per barrel. The soaring fuel price will provide cost pressure to 727F operators, since the type has a higher rate of fuel burn compared to younger generation aircraft, such as the 737-300, 737-400 and 757-200.

"High fuel prices make our work much tougher. Fortunately, the US Dollar's huge depreciation against the Canadian dollar has taken some of this operating pressure imposed by high fuel price away," says Robert Davis, president & chief executive officer at First Air. The airline operates two 727-200Fs, two 727-100 Combis and one 727-200 Combi. The 727Fs and 727 Combis generate 1,800 hours and 2,200 flight hours (FH) per year. "We are going to replace these 727s partly because of the high fuel price, and partly because of our increasing market size. We have recorded annual growth rates of 4% for cargo, and our

cargo business has accounted for 40% of our total annual revenue."

"High fuel prices have some adverse impact on our operation," says Fredrik Groth, general manager at Swift Air, which operates six 727-200Fs. "However, our operation is based on a wet-lease contract, which means our customers will pay for the increasing fuel cost. This can offset the adverse impact. We are still considering replacing the 727Fs, however."

Not all 727F operators are so badly affected by high fuel prices. "The impact of high fuel prices is limited on our 727F operation because utilisation of the aircraft is very low. This is only about two hours per day and five flights per week for our overnight operations within the USA," says Scott Roby, long-range planning manager at United Parcel Service, which has 20 727-100Fs in service and another 40 in storage. "We now mainly use trucks to transport small packages, because their operating costs are 50-70% lower than the 727-100Fs. However, if the fuel price stays high, we may have to consider replacing the 727Fs still in service."

"High fuel price has put pressure on our operation. We are considering replacing our 727s," comments Mario Abad, vice president at Custom Air Transport. The airline operates 16 727-200Fs and generates about 125FH per month, equal to about 1,500FH per year, which is relatively high for a 727F operation.

Will rising maintenance costs, together with fuel price rises, increase pressure on 727F operators to replace

their ageing fleets? "Maintenance costs of 727Fs have increased a little, so the impact has been limited. Also, the appreciation of the Canadian dollar against the US dollar has reduced the costs of replacing these aircraft's parts," says Davis.

Roby explains the impact of maintenance cost on total costs from a different aspect. "The average age of our 727Fs is 25 years, but the maintenance costs remain low because of low utilisation."

Replacement candidates

Replacement candidates should offer similar structural payloads and container volume capacity. Many operators require replacement aircraft to have the same fuselage cross-section as the 727 to maintain container commonality.

The 727F uses a 125-inch wide by 88-inch long by 82-inch tall standard maindeck container. The only aircraft with the same fuselage cross-section and similar container and freight volume capacities to the 727-100F and 727-200F are the: 737-300F; 737-400F; and 757-200SF. "We are considering replacing our 727Fs with 757s or other suitable aircraft," says Davis. "In the next two years we might purchase a used 757, if we decide to select it."

Abad also confirms an intention to replace 727Fs. "We are negotiating with GECAS to lease 737-300Fs to replace our 727Fs.

UPS may also consider replacing its 727s. "If the fuel price remains high for a long time, we may replace 727Fs with



757s or A300s," says Roby.

Besides the 737 and 757, 727F operators could consider replacing their aircraft with smaller aircraft on a one-for-two basis. "We may replace our 727Fs with ATR42s within 18 months," says Groth.

Davis has more options. "We also consider ATR42s and A300s as alternatives, especially since ATR42s already exist in our fleet. Our flight frequencies will increase by 20% if we use the ATR42 to replace the 727Fs."

Replacement candidates must be available at low enough lease rates for airlines to consider them. Market values of 737-300s/-400s, 757-200s, ATR42s, A310-300s and A300s have dropped dramatically in the past three years, thereby making replacement more economic.

Operators also need to consider the 727F's technical characteristics. The 727-100F carries nine of its standard maindeck containers, giving it a volume of 3,960 cubic feet. Additional underfloor volume takes total freight volume to 4,860 cubic feet. At a packing density of 7.0lbs per cubic foot, the 727-100F has a volumetric payload of 34,000lbs.

The 727-200F carries 12 of the same containers. Total freight volume is 6,715 cubic feet and volumetric payload 47,000lbs.

737-300F/-400F

The 737-300 has a structural payload of 41,300-43,600lbs. Its fuselage accommodates eight 125-inch by 88-inch by 82-inch containers on its maindeck. These are the same containers used on the 727's maindeck, as well as on the 757's.

The 737-300F, however, can also accommodate one smaller half container which provides another 150 cubic feet of freight capacity.

The 737-300's nine maindeck containers provide a volume of 3,672 cubic feet. It also has some underfloor volume, taking the total volume to about 4,740 cubic feet. A packing density of 7lbs per cubic foot generates a volumetric payload of 33,100lbs, making the 737-300 almost identical in capacity to the 727-100F.

The 737-400F accommodates nine standard maindeck containers, which give it the same containerised maindeck freight volume of 3,960 cubic feet as the 727-100F. When the 737-400's underfloor capacity is added its total freight capacity is 5,500 cubic feet, taking volumetric payload up to 38,500lbs. This is 4,500lbs higher than the 727-100F.

The 737-300F and -400F therefore provide 727-100F operators with a combination of almost identical and larger replacements. The 737-400F would provide some extra capacity for growth. The 737-400F's capacity is about 8,500lbs less than the 727-200F's volumetric payload.

757-200

The 757-200 is the next largest aircraft to the 727-200F. There are two passenger-to-freighter modifications for the 757-200, which are offered by Precision Conversions and Alcoa-SIE Cargo Conversions (ASCC).

This aircraft has a gross structural payload of 66,000-74,000lbs after conversion, depending on the final operating empty weight (OEW) and

Most 727 operators have been adversely affected by increased fuel prices. Rates of aircraft utilisation are low for most operators, however, and so replacement with younger aircraft cannot be justified.

maximum zero fuel weight (MZFW) of the individual aircraft after modification.

Aircraft converted by Precision Conversions will accommodate 15 of the same 125-inch by 88-inch containers used by the 727F. The maindeck containerised volume of this aircraft is thus 6,600 cubic feet. The aircraft has an additional 1,790 cubic feet of underfloor freight capacity, which takes total capacity to 8,390 cubic feet.

The aircraft has a net structural payload of 59,300-66,400lbs, and with freight packed at a density of 7.0lbs per cubic foot it has a volumetric payload of 58,730lbs.

The ASCC-converted aircraft has a smaller maindeck container volume, since it uses 14 standard containers plus one smaller type. This gives the aircraft a maindeck volume of about 6,540 cubic feet, and when added to underfloor space, gives the aircraft a total volume of 8,330 cubic feet. Freight packed at 7.0lbs per cubic foot gives the aircraft a volumetric payload of 58,310lbs.

The volumetric payload of the 757-200SF is therefore 11,300-11,700lbs higher than the 727-200F's. This can only be utilised if 727-200 operators experience high load factors and freight volumes, and need extra capacity to accommodate consistent traffic growth. "Our annual cargo growth rate has been 4% in recent years, which justifies replacing our 727Fs," says Davis.

The 757-200SF could also be considered by 727-100 operators as a two-for-one replacement where an exact doubling of capacity is not required. The 757-200SF has 70% more volumetric payload than the 727-100F. The 757-200SF could thus efficiently replace two 727-100Fs that operate with average load factors of about 80%.

A310-300F

The A310-300F is the next largest aircraft airlines could consider as a replacement on a two-for-one basis. The aircraft has a net structural payload of about 81,300lbs and containerised freight capacity of 9,660 cubic feet.

The A310-300's volumetric payload packed at 7.0lbs per cubic foot is



67,600lbs (exactly twice that of the 727-100F). The A310-300 could therefore be used to replace two 727-200Fs for operators with load factors of up to 75%, if schedules allow.

Airlines could also consider the 767-200SF. After conversion the aircraft has a containerised volume of 12,600 cubic feet and volumetric payload of 84,000lbs.

A300-600

The A300-600 has a net structural payload of 97,327lbs. The containerised volume of maindeck and lowerdeck container is 13,200 cubic feet. Packed at a density of 7.0lbs per cubic foot, the A300-600RF has a volumetric payload of 92,456lbs, almost twice that of the 727-200F's.

This aircraft may be used if 727-200 operators have high load factors and require extra capacity. The A300-600RF can alternatively be used as a two-for-one replacement if schedules allow. "The A300-600RF is an option for us because of the high growth rates we have been experiencing in cargo," says Davis.

Economic analysis

Although the fuel price has fluctuated and generally risen over the past two years, the economic performance of the 727-100F/-200F in terms of absolute trip cost and cost per ton-mile is determined by several factors. The most important of these are: aircraft utilisation; average route length; aircraft finance or lease charges; total aircraft maintenance costs; and cost of flightcrew.

The two most important factors are aircraft financing and leasing charges, and rate of aircraft utilisation.

Since all 727Fs are used aircraft, the financing or leasing charges will vary widely between individual aircraft and operators. Some aircraft will be fully depreciated and have zero financing charges. Other aircraft may be owned, but have debt outstanding. Some operators will lease their aircraft, and lease rates will vary widely according to agreements with lessors.

The nature of 727F operations varies widely, affecting rates of utilisation and average route length. Some operations will be limited to 10 flights per week and only 500-700FC per year. High rates of utilisation will be 15-20 flights per week and up to 1,500FC per year.

The other two main factors are maintenance and flightcrew costs, which are both higher for 727s than the 737 or 757, but account for a relatively small percentage of total trip costs. The biggest factors which decide each aircraft's trip and ton-mile costs are utilisation and financing charges.

The differing combinations of possible aircraft utilisation and finance or lease charges can be analysed together with different fuel prices.

Assumptions

Before the detailed economic analysis, some assumptions have to be made for styles of operation and different costs.

Since aircraft achieve their lowest cost per ton-mile and overall economics when they are full, freight operators need to match aircraft size with freight demand to avoid flying excess capacity.

The economic performance of an aircraft is its gross profit: that is, the revenue for a given freight volume less the aircraft's trip cost, or the cost of several

The 757-200SF is an attractive replacement candidate for the 727-200F. The 757-200 offers 25% more freight capacity and has proportionately higher trip costs than the 727-200F in most operating scenarios.

trips required to carry a particular amount of freight.

The cost for each trip hardly changes as freight volume rises, but revenue increases in proportion with freight volume. When volumes over the long term increase beyond the aircraft's capacity the airline has to fly a second trip with the same type, or change to a larger type. Further trips or capacity are more likely to be added when aircraft are operating with a load factor of about 90%. This is about 31,000lbs in the case of the 727-100F, and 42,000lbs in the case of the 727-200F.

Although many aircraft will already be owned, fully depreciated or on existing lease terms, assumptions have to be made for lease rates based on typical market rates.

A monthly lease rates of \$30,000 is used for the 727-100F and of \$50,000 for the 727-200F, compared with likely lease rates of \$150,000 for the 737-300, \$170,000 for the 737-400, \$200,000 for the 757-200SF and \$230,000 for the A310-300F.

Airlines that acquired 727Fs four to eight years ago will have started leases with rates higher than this. They may, however, have since renegotiated lower lease rentals. Aircraft that were purchased and converted directly by airlines will be locked into the same book depreciation rates. These, and debt repayments, could be higher or lower than the lease rates used here.

Younger types will have high hull insurance costs, which are assumed to be 1% per year of hull value. Hull values are based on \$1 million for the 727-100F, \$2 million for the 727-200F, \$12 million for the 737-300F, \$14 million for the 737-400F, \$22 million for the 757-200SF and \$23 million for the A310-300F.

Besides utilisation and lease rates, there are inherent differences in the cost structures of European and US carriers. Pilots' salaries, which are generally higher in the US, are a significant difference. The 727Fs should have a cost disadvantage compared to their replacement candidates, since the 727 operates with a three-man crew.

Pilots' salaries are increased by the additional crew costs of allowances, transport, training and subsistence. Annual flightcrew productivity has an impact, and is generally lower compared to daytime passenger operations.

VOLUMETRIC PAYLOADS & RELATIVE TRIP COSTS OF 727-100F, 737-300F & 737-400F; AND 727-200F, 757-200SF & A310-300F

Aircraft type	727-100F	737-300F	737-400F	727-200F	757-200SF	A310-300F
Volumetric payload-lbs	34,000	33,000	38,500	47,000	58,000	67,600
Relative trip costs-\$						
Low utilisation & low fuel price	Base	+\$2,948	+\$3,877	Base	+\$3,743	+\$6,960
Low utilisation & moderate fuel price	Base	+\$2,764	+\$3,717	Base	+\$3,587	+\$6,952
Low utilisation & high fuel price	Base	+\$2,488	+\$3,477	Base	+\$3,353	+\$6,940
High utilisation & low fuel price	Base	+\$537	+\$1,065	Base	+\$1,179	\$3,802
High utilisation & moderate fuel price	Base	+\$353	+\$905	Base	+\$1,023	+\$3,794
High utilisation & high fuel price	Base	+\$77	+\$665	Base	+\$789	+\$3,782

Assumptions for maintenance costs are \$1,360/FH for 727-100F/-200F, \$950/FH for 737-300/-400, \$1,070/FH for 757-200SF and \$1,800/FH for A310-300.

Annual engine inventory costs are \$15,500 for 727-100F/-200F, \$50,000 for 737-300/-400, \$69,000 for the 757-200SF and \$101,000 for A310-300F. These are high for younger types. Engine inventory costs are a mixture of depreciation for owned spare engines and lease rentals and reserves for short-term leased engines for a fleet of 10 aircraft. Although these are high for modern types, the cost of engine inventory is small as a portion of total trip costs.

To simplify the comparison of different scenarios, a price of 140 cents per US Gallon is used to analyse the different aircraft with a high fuel cost. This is the expected fuel price for 2005. A price of 110 cents per US Gallon is used as the moderate fuel price, and was the average fuel price of 2004 for some US legacy airlines. A price of 90 cents per US Gallon has been used as a low fuel price.

Annual utilisation of 650 flight cycles (FC) is representative of a low rate of utilisation, while a higher rate of utilisation is about 1,300FC. These are equal to about 1,200FH and 2,400FH per year when average route length is about 700nm.

In each case, the costs of replacement candidates are compared to the 727-100F and 727-200F. Trip costs and ton-mile

costs are analysed when fuel, maintenance, spare engine, flightcrew, lease and aircraft insurance charges are considered.

Low utilisation & low fuel price

In the scenario of a low fuel price and low rate of aircraft utilisation, the 727-100F has a trip cost of \$6,250, which is lower than the 737-300F and 737-400F. Although the 737-400F can provide a 10% higher volumetric payload than the 727-100F, the 737-300F's & -400F's trip costs are \$2,900-3,900 higher (*see table, this page*).

The 727-200F is the most economic aircraft for higher freight volumes. It has a volumetric payload of 47,000lbs and trip costs of \$8,694. It also has the lowest unit cost of 19 cents per pound, compared to 22 and 23 cents per pound for the 757 and A310-300.

The 757-200SF, however, has an almost proportionately higher trip cost compared to its payload advantage over the 727-200F. Therefore, when freight volume exceeds the 727-200F's capacity, replacing the 727-200F with the 757-200SF can be justified.

Low utilisation & moderate fuel price

With the fuel price increasing by 22% to 110 cents per gallon, trip costs for the 727-200F, 737-400F and 757-200SF increase about 6.5%, 3% and 2%,

respectively. The higher fuel price narrows the gap in total trip costs between the 727-200F and 757-200SF to \$3,587 from \$3,743 (*see table, this page*), because of the 727's high fuel consumption. This illustrates the relatively small effect that an increase in fuel price has on the difference in economics of the aircraft at a low rate of aircraft utilisation. Replacement of the 727-200F cannot be justified when freight volumes are static. If the fuel price stays high, but freight volumes grow, the 757-200 then becomes a good option for 727-200F replacement.

The rise in fuel price to 110 cents per US Gallon also narrows the difference in trip costs between the 727-100F and 737-300F from \$2,948 to \$2,764. The gap between the 727-100F and 737-400F is closed to \$3,717 (*see table, this page*).

Low utilisation & high fuel price

With a rise in fuel to 140 cents per US Gallon, the 727-100F's and 727-200F's fuel costs both increase by about 27% to \$3,360 and \$3,780 respectively for the trip.

The 727-100F's fuel cost accounts for 42% of total trip costs and the 727-200F's for 37% of total trip costs.

At the same fuel price, fuel accounts for 19-22% of modern aircraft types' total trip costs.

The gap in total trip costs between the 727-200F and 757-200SF is reduced to



\$3,353 (see table, page 47). Since the 757-200SF has a 25% higher payload volume, the decrease in trip costs may justify the replacement of the 727-200F with the 757-200SF where more capacity is required by the operator.

The gap in total costs between the 727-100F and 737-300F is reduced to \$2,488 (see table, page 47). This is still too high to justify replacing the 727-100F. The gap between the 727-100F and 737-400F is also narrowed to \$3,477. This is also too high to justify the new aircraft.

High utilisation & moderate fuel price

Doubling rates of utilisation dilutes the lease cost per trip, and an aircraft's total trip costs decline by a high percentage.

Compared with trip costs in the scenario of low aircraft utilisation and a moderate fuel price, the trip costs of all aircraft decrease by about 10%. The 727-100F/-200F's trip costs decline much less than other types, however. This is because of their low lease rates compared to younger types. Aircraft with the highest lease rates experience the largest decline in trip cost from an increase in utilisation.

The gap between the 727-100F and 737-300F and -400F reduce to a small level where a swap to the younger aircraft can be justified.

The gap in total trip costs between the 727-200F and 757-200SF is narrowed to \$1,179 (see table, page 47). The reduced trip costs plus a 25% higher payload volume provided by the 757-200SF may justify it replacing the 727-200F.

The A310-300F's total trip costs also drop dramatically, to \$11,246 from \$15,924. The difference in trip costs

between an A310-300F and 727-200F drops \$3,802 in this scenario.

The biggest saving could be realised, however, by replacing a 727-100F with an A310-300F on a two-for-one basis. By doing this, an operator could save up to \$1,330 in trip costs and gain an extra volumetric payload of 2,268lbs.

High utilisation & moderate fuel price

In this scenario, the lease cost as a percentage of trip cost for all aircraft decreases by 50%. This causes total trip costs to decline substantially, although fuel cost increases by 25%.

Total trip costs of the 727-200F, 737-400F and 757-200SF decline by about 13%, 30% and 30% respectively. The younger the aircraft type is, the more the lease cost declines. If an operator's trip freight volumes are no more than 38,000lbs, it may consider replacing a 727-200F with a 737-400F, since its trip costs are \$363 lower than the 727's.

The gap in trip costs between the 727-200F and 757-200SF reduces to \$1,023 (see table, page 47). This small difference means the 757-200SF's trip cost is just 13% higher, which would justify replacement of the 727-200Fs because of the 757's 25% higher capacity.

The difference in trip costs between the 727-200F and A310-300F also shrinks. The A310-300F's trip costs are only \$3,784 higher than the 727-200F's. The unit costs of the two aircraft are both 17 cents per lb. Since the A310-300 can provide 50% more payload volume, in a business environment of high growth and high utilisation, the replacement of the 727-200 with the A310-300, or 767-200, should be considered. A high rate of utilisation can also justify the replacement

The finance charges of the 727-100F are low compared to modern replacement candidates. This fact makes it hard to replace the 727-100F on economic grounds, even with relatively high rates of utilisation.

of 727-100Fs with A310-300Fs on a two-for-one basis. The trip cost of two 727-100s are \$1,654 higher than that of one A310-300.

High utilisation & high fuel price

In this scenario, the 727-100F's trip costs are virtually identical to the 737-200F's and only about \$700 less than the 737-400F's.

The gap in total trip cost between the 727-200F and 757-200SF narrows to just \$789 (see table, page 47). Since the 757-200 has 25% more payload, 727-200 operators cannot ignore it.

Summary

Aircraft utilisation has a greater impact on trip and unit costs than fuel price. This is because lease charges per trip account for the highest percentage of total cost, and are also a function of aircraft utilisation.

Lease rentals for the A310-300 and 757-200 account for more than 15% of trip costs in low utilisation operations, while they account for less than 9% of the 727F's trip cost.

Lease rentals of younger aircraft types decrease more than those of the 727F when utilisations increase. This makes younger aircraft more attractive.

An increase in fuel cost by itself is unlikely to justify the replacement of 727Fs with younger types when aircraft utilisations are low. The economics of replacing 727Fs with younger aircraft for higher rates of utilisation, however, are hard for operators to ignore.

The 727Fs are assumed to be leased from lessors, but many 727Fs are owned by the operators. The operating costs of fully depreciated 727Fs would be much lower than those discussed, and so will remain economic aircraft to operate.

Eventually, if fuel prices remain high, and freight volumes continue to grow, even fully depreciated 727 operations will be hard to sustain in the long-term. The market values of young aircraft, and so costs of preparing them for service as freighters, will reduce over time, making them more attractive candidates for acquisition. **AC**