

The global economic recession, high fuel prices and ageing maintenance issues have led to changes in the global freighter fleet over the past 10 years. Demand for aircraft conversions is mixed. Fleet developments and the market for converted and new-build freighters are examined here.

# Freighter fleet development and the demand for aircraft

The global freighter fleet has developed over the past decade. *Aircraft Commerce* has analysed air cargo growth and fleet development trends from the past 10 years. The fastest growing markets, and the most popular conversion and new freighter programmes are identified. Forecasts for future air cargo demand are considered. The analysis identifies the aircraft types most likely to be converted or produced as purpose-built freighters in the future.

## Air cargo market

Air cargo saw positive year-on-year growth from 2004 to 2007, according to the International Air Transport Association (IATA). "There was a major slowdown at the start of the 2008 recession," says Chris Goater, manager, corporate communications at IATA. "Cargo has since bounced back, but growth has been slower."

IATA recorded a 0.7% year-on-year reduction in freight tonne kilometres (FTKs) in 2008. FTKs fell by a further 8.8% in 2009. Growth returned in 2010 and 2011, before another contraction in FTKs in 2012. Since then growth has resumed, with FTKs increasing by 0.6% in 2013 and 4.5% in 2014.

"The aftermath of the sub-prime crisis in the US during 2007/08 saw year-on-year air cargo volumes contract by 25% during 2009-2010," explains Didier Lenormand, head of freighter aircraft marketing at Airbus. "A global recession resulted in a reduction in global trade. It was only in late 2014 that total air cargo traffic, measured in FTKs, reached the volumes achieved prior to the recession.

"Most air cargo traffic is based on business-to-consumer (B2C) logistics," says Lenormand. "B2C logistics involves distributing finished products to retailers, so this traffic is the first to be affected by recession when consumer spending falls."

"The global financial crisis caused organisations to re-think their freight shipping strategies," claims Stephen Fortune, principal at Fortune Aviation Services. "There has been some shift to other forms of transport, such as ocean shipping. This is now faster, so time-definite delivery by ocean is now possible, and it is also cheaper. The cost of shipping goods by sea is about one-tenth the cost of an air cargo shipment."

"Over the past 10 years, the type of cargo flown by air has shifted to higher-value and more specialised products," claims Goater. Desktop computers and computer software used to be sent by air. This has declined dramatically. In recent years demand has risen for complex time- and temperature-sensitive shipments, like medical and pharmaceutical goods.

## Regional trends

The strongest air cargo growth has been in emerging economies. "Global economic growth is now split into two groups: developed countries with slow growth; and emerging economies with sustained GDP growth," says Lenormand. "The growth of emerging economies is increasingly self-sufficient and no longer depends on developed countries. As a result, air cargo traffic flows between emerging economies are growing more strongly than between mature markets. Cargo traffic is therefore growing at a faster rate between China and the Asia Pacific, and between the Asia Pacific and Africa, than it is between Europe and the US."

"Two of the largest markets are between the US and Europe, and the US and Asia Pacific," says Fortune. "Both these markets have been impacted by a shift to shipping, but they will always retain a certain demand for air freight.

"Intra-Asia Pacific is a strong market for air cargo," continues Fortune. In general, economies in the region are

growing. The region is also geographically suited to air travel, since there is a large number of islands separated by large stretches of ocean."

"The Asia Pacific region remains the most important market for air cargo, accounting for about 40% of shipments," claims Goater. "The Middle East has also risen as a freight hub in recent years, and Middle East airlines now carry more than 13% of global FTKs."

## Future trends

IATA estimates that air cargo will grow by 4.1% per year to 2018. "The fastest growth will be in Africa, the Middle East, and the Asia Pacific. Mature markets in North America and Europe will grow more slowly," says Goater.

Airbus anticipates a 4.5% year-on-year growth in air cargo to 2033. "Growth rates will vary," claims Lenormand. "Air cargo traffic between mature countries is forecast to grow at 2.7% per year to 2033. Cargo traffic between emerging countries is anticipated to grow at 6.2% per year.

"Airbus expects the Asian air cargo market will more than double by 2033," continues Lenormand. "This is because half of the world's population lives in Asia, and there is a fast growing middle class there. Asia Pacific trade is also forecast to triple in volume. We anticipate that other emerging regions, like Africa and Latin America, will follow this path.

"This large-scale, relative redistribution of wealth from mature to emerging economies will impact air cargo flows," claims Lenormand. "New direct services will have to be opened between emerging regions, and new fleets of freighters will have to be acquired."

## Freighter fleet developments

The global freighter fleet can be subdivided into regional, narrowbody and



widebody aircraft. Developments over the past 10 years are identified here.

The fleet data used here is a snapshot from each January during 2006-2015.

Where aircraft payload is referred to, imperial tons have been used, with one ton equal to 2,240lbs.

Aircraft produced in the Commonwealth of Independent States (CIS) are not considered in this analysis.

## Regional

Regional freighters are generally used for carrying mail, newspapers, or express package feeder services.

The aircraft can be split into small jets, such as the Falcon 20, regional jets (RJs) and turboprops.

The number of small jets has fallen over the past 10 years (*see table, page 62*). Numbers declined from 198 to 95 from 2006 to 2015.

The number of RJ freighters stood at 25 in January 2015 (*see table, page 62*). The BAE 146 has dominated the RJ fleet. A large portion of the 146 fleet has been operated in Europe. The number of active 146s has declined from 27 to 19 in 2015. TNT Express has begun to replace BAE 146s larger 737 Classics.

The only other development has been the introduction of CRJ-200 Package Freighters (PFs). They do not have large cargo doors installed. Cascade Aerospace provides PF kits for CRJ-100/200s that convert them into Class E bulk freighters. There are five active CRJ-200PFs.

The regional freighter market has been dominated by turboprops, which can be sub-categorised by payload as having: less than 2 tons (t) of gross payload; 2-4t of gross payload; 5-7t of gross payload; 8t of gross payload; and

more than 8t.

Most turboprop freighters are in the two smallest categories. Their number has remained stable for the past 10 years.

The biggest change in the turboprop fleet has been the decline in 5-7t aircraft in favour of 8t aircraft, due to the replacement of ageing E.27s and HS 748s with BAe ATP and ATR72 freighters.

The 8t turboprop segment includes ATPs and ATR72s which have been converted to large-door freighters.

The number of active ATP freighters has remained stable at 33 since 2011. Most are operated in Europe. The ATR72 is now the most numerous, with 53 in service, mostly in the US and Europe.

There is a small fleet of five Q400PFs as Class E bulk freighters, modified with a kit supplied by Cascade Aerospace.

The most popular 5-7t freighters are the ATR42 (47) and the Fokker 50 (15), while 28 Convair 580s remain in service.

## Narrowbody

The active narrowbody freighter fleet declined from 2006 to 2012 (*see table, page 62*). Significant fleet reductions took place from 2009 to 2011 after the onset of the recession. The narrowbody freighter fleet has grown in the past year.

No factory-built freighters have been operated over the past 10 years.

The rate of narrowbody conversions has been increasing (*see table, page 66*). "The conversion market has swung from widebodies to narrowbodies," says Fortune. "From 2000 to 2008 most passenger-to freighter (P-to-F) conversions were for widebodies, but since 2008 narrowbody conversions have predominated. The primary demand for narrowbody freighters has come from a

*The only conversion programmes available for large widebody freighters are for the 747-400. A number of new-build and converted 747 freighters were removed from service following the global economic downturn. It remains to be seen if any further 747-400s will be converted.*

need to replace older, obsolete aircraft with higher operating costs, although some have been used for growth."

## Decline of older freighters

The number of active older narrowbodies including the 727-100 and -200, 737-200 and DC-9 series, has declined to 20% of the freighter fleet.

A 727-100F holds nine standard AAA/AAV containers or 88-inch X 125-inch pallets. A 727-200F can hold 12 of the same. The active 727-100F fleet has declined from 70 in 2006 to five in 2015, and the number of active 727-200Fs has decreased from 275 to 62, mainly due to FedEx retiring its fleet.

A 737-200F holds up to seven of the same pallets, plus an additional smaller pallet. There were 29 active 737-200Fs in 2009, but the fleet has fallen to 16.

The number of DC-9Fs has decreased from 78 in 2006 to 24 in 2015.

The DC-8 fleet has declined from 115 in 2006 to four in 2015, following UPS's retirement.

## Current narrowbody freighters

There are active P-to-F conversion programmes for the 757-200, 737 Classics, and MD-80s.

757-200s, and 737 Classics have been converted in the largest numbers since 2006 (*see table, page 66*).

The number of active and parked 757-200 freighters increased from 118 to 250 from 2006 to 2015. The 757-200 is the most numerous active narrowbody freighter (247). Boeing delivered 80 757PFs. Most are operated by UPS (75). The remaining 169 active 757-200Fs are conversions.

All additions to the 757 freighter over the past 10 years have been converted aircraft. About 138 757-200s underwent P-to-F conversion from 2006 to February 2015 (*see table, page 66*).

757-200 P-to-F conversions are offered by Precision Aircraft Solutions and ST Aerospace (*see Cherry picking 757-200s for conversion to freighter, Aircraft Commerce, February/March 2014, page 66*).

A 757 freighter can hold 14 or 15 AAA/AAV containers on its main deck.

Fedex's decision to replace its 727s with 757s is a main factor in the 757-200F's success. The 757 offers extra capacity and reduced operating costs.

## ACTIVE FREIGHTER FLEET JAN 2006 - JAN 2015

Aircraft Type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Small Jet	198	186	161	129	116	102	100	97	96	95
RJ	24	26	27	30	31	31	27	29	27	25
Turboprop	1,152	1,140	1,158	1,150	1,133	1,115	1,119	1,116	1,106	1,104
<b>Regional Total</b>	<b>1,374</b>	<b>1,352</b>	<b>1,346</b>	<b>1,309</b>	<b>1,280</b>	<b>1,248</b>	<b>1,246</b>	<b>1,242</b>	<b>1,229</b>	<b>1,224</b>
<b>Narrowbody Total</b>	<b>759</b>	<b>728</b>	<b>693</b>	<b>669</b>	<b>599</b>	<b>568</b>	<b>554</b>	<b>557</b>	<b>525</b>	<b>560</b>
Medium Widebody	390	424	456	468	432	438	442	447	447	455
Large Widebody	475	507	547	513	488	534	537	531	519	520
<b>Widebody total</b>	<b>865</b>	<b>931</b>	<b>1,003</b>	<b>981</b>	<b>920</b>	<b>972</b>	<b>979</b>	<b>978</b>	<b>966</b>	<b>975</b>
<b>Total freighter fleet</b>	<b>2,998</b>	<b>3,011</b>	<b>3,042</b>	<b>2,959</b>	<b>2,799</b>	<b>2,788</b>	<b>2,779</b>	<b>2,777</b>	<b>2,720</b>	<b>2,759</b>

Notes: Excludes combi aircraft - Turboprop category includes some smaller piston-engined types.

Fedex operates the largest fleet of active 757-200Fs (91). All are conversions.

The 737 Classic freighter fleet consists of -300s and -400s, and grew from 59 to 197 active aircraft from 2006 to 2015.

There are three conversion programmes for the 737-300 and -400, offered by Aeronautical Engineers Inc (AEI), IAI Bedek and Pemco World Air Services (see *Narrowbody freighter replacements: the market for 737 Classics & MD-80s, Aircraft Commerce, April/May 2014, page 53*).

There are QC and dedicated freighter options available for the 737-300. There is only a full freighter option for the 737-400.

In January 2015 there were 133 active 737-300Fs, of which 100 were dedicated freighters and 33 were QC aircraft. There were also 64 active 737-400Fs.

In the 12 months to January 2015, the 737-300F and 737-400F fleet grew by 32 aircraft. Some of this growth was due to parked aircraft being reactivated, but most was the result of new conversions.

A converted 737-300 can hold up to eight AAA/AAY containers or 88-inch X 125-inch pallets, plus additional smaller containers. Depending on the conversion programme, a typical 737-400F will accommodate nine or 10 of the same containers, plus additional smaller units.

The -300QC fleet has declined slightly to 33 aircraft. They are utilised on mixed passenger and postal services in Europe.

From 2006 to 2010, a large number of 737-300s were converted to dedicated -300 freighters. Since 2011, however, 737-400s have been converted in larger numbers than -300s (see *table, page 66*). The active 737-400 freighter fleet has grown from 12 to 64 aircraft since 2011.

737-400s are more attractive freighter conversion candidates because of their higher payload capacity. The -300's lower acquisition costs initially drove more conversions. "737-400 feedstock prices were too high initially," explains Fortune. "As prices fell, most operators switched to converting -400s."

737-300 and -400 freighters have been used for several purposes, including replacement of 727Fs, 737-200Fs and RJ freighters. An example is TNT Express steadily replacing its BAe 146s freighters with 737-400 freighters.

737-300 and -400 freighters have also replaced ageing Russian aircraft, like the An-12, and provided growth for operators of smaller aircraft. Some airlines that specialised in turboprop freighter operations have begun to add converted 737-300 and -400s to their fleets. One example is West Atlantic.

The most recent entrant to the narrowbody conversion market is the MD-80 family. AEI provides the only conversion programme, which covers all MD-80 variants, except the MD-87.

The MD-80 has a smaller fuselage cross-section than the 737 and 757, so it cannot hold the standard containers used by express package operators. A converted MD-80 freighter can hold up to 12 88-inch X 108-inch containers, and will appeal to general freight operators.

There are four active MD-80Fs. Two MD-80F operators already had DC-9Fs. The MD-80F has more capacity than a DC-9F.

## Widebody

Widebody freighters can be split into medium and large categories, according to their gross payload capacities.

## Medium widebodies

The main types in this category over the past 10 years have been the 767, A300, A310 and DC-10-10/MD-10-10. These freighters have gross structural payloads of 38-69 tons.

The number of active medium-widebody freighters increased from 390 in 2006 to 468 in 2009 (see *table, this page*). The global economic downturn of 2008 saw active aircraft numbers fall to 432 in 2010 with a number of older A300, A310 and DC-10-10/MD-10-10

freighters being parked. Since 2011, the number of active medium-widebody aircraft has gradually risen to 455.

The number of A300B4, A310 and DC-10-10 freighters declined from 2006 to 2015, although some DC-10-10s were converted to MD-10-10s during this time. The number of active MD-10-10s peaked at 61 in 2009, but has fallen to 43.

There are two new-build medium widebody freighter options: the 767-300PF and the A330-200F. The main medium widebody P-to-F programmes are for the 767-300ER and the A300-600. A P-to-F programme for the A330-200 and -300 has been launched, but a prototype has yet to be completed.

The A300-600, 767-300ER and A330 freighter fleets have seen the strongest growth in this category.

Airbus produced 109 new-build freighter variants of its A300-600 series, with a maximum structural payload of 54t. The last new-build A300-600 freighter was delivered in 2007. Since then, additions to the fleet have been conversions.

EFW in Dresden offers P-to-F conversions for A300-600s. These have a maximum structural payload of 48t.

The combined new-build and converted A300-600 freighter fleet increased from 112 to 168 active aircraft from 2006 to 2015. About 57 A300-600s were converted to freighter from 2006 to 2014 (see *table, page 66*), mostly by EFW. European Air Transport and Fedex were the largest A300-600 conversion customers.

The active 767 freighter fleet rose from 84 to 176 from 2006 to 2015.

A 767-300ER freighter will have a structural payload of up to 54-57t. Boeing's new-build freighter is designated the 767-300PF. The 767-300ERF fleet increased from 43 to 96 from 2006 to 2015. UPS and Fedex have both added 767-300ERFs over the past 10 years. UPS is the largest operator (59). It has used 767s for growth and to replace DC-8Fs.

The first 767-300ER P-to-F





conversion took place in 2008. A total of 24 aircraft had been converted by the end of 2014. IAI Bedek and Boeing offer freighter conversions for 767-300ERs, and have each modified 12 aircraft.

IAI Bedek offers the only P-to-F programme for 767-200s and -200ERs, and has converted more than 60. It also offers conversions for non-ER 767-300s, although has converted none so far.

A converted 767-200 freighter has a structural payload of 41t. This increases to 45t for a -200ER. About 44 767-200s underwent P-to-F conversions during 2006-2014. Some 23 of ABX's 767-200s were modified from bulk PC to full freighter status during 2009-2012.

The first A330-200F was delivered in 2010. By January 2015 there were 30 A330-200Fs in service. An A330-200F has a structural payload of up to 69t.

Demand for new-build rather than converted freighters appears to have been stronger over the past few years. Deliveries of new-build 767-300ERFs and A330-200Fs have outpaced conversions.

The active fleets of new-build 767-300ERFs and A330-200Fs increased by 31 and 20 respectively from January 2012 to January 2015. In contrast, only 10 767-300ER and 19 A300-600 conversions took place during the same period (see table, page 66).

## Large widebodies

The most numerous larger widebody freighters over the past decade have been the 747, MD-11, 777-200, and DC-10-30/MD-10-30; with payloads of 79-130t.

The number of active large widebody freighters increased from 475 in 2006 to 547 in 2008 (see table, page 62). The onset of the global financial crisis saw

active freighter numbers decline to 488 by 2010. A number of older freighters were parked during this period, including 747-200s, and DC-10-30s. Growth has returned, with the fleet reaching 534 by 2011. Since then the fleet has remained fairly stable, witnessing a marginal contraction to 520 aircraft in 2015.

Ageing 747-200s and DC-10-30s were phased out of service during 2006-2015.

A number of DC-10-30s were modified to MD-10-30 status through avionics upgrades during the same period. The MD-10-30 fleet increased from five to 17 aircraft, while the DC-10-30 fleet fell by 44 aircraft to just four. A small number of DC-10-40 freighters were also retired.

Only 21 747-200Fs remain in service. The largest operators had all ceased operating 747-200s by 2015.

The 747-400 and MD-11 dominated the large widebody freighter market during most of the past decade.

The 747-400 series took over from older -200s as the most popular 747 freighter during this period. There were two production freighter variants: the 747-400F and 747-400ERF, with a structural payload of 116-117t.

There are two conversion programmes for the 747-400, offered by IAI Bedek and by Boeing. A converted 747-400 freighter will have a maximum payload of 111-113t.

The new-build 747-400 freighter fleet increased each year from 2006 to 2011, reaching 162 in 2011. Boeing delivered its final new-build 747-400 freighter in 2009.

The fleet of converted 747-400s increased from two active aircraft in 2006 to a peak of 67 in 2012. Some of

No P-to-F conversions have taken place in the large widebody market since 2012. In the near future large widebody freighter deliveries will be dominated by new-build aircraft, and the 777-200F in particular.

the demand for 747-400 freighters came from 747-200 replacements.

The number of new-build 747-400 freighters has declined since 2012, as has the fleet of converted aircraft, when operators began parking them in large numbers.

The active MD-11 freighter fleet peaked at 171 aircraft in 2011, but has since been in gradual decline. There were new-build and converted variants of MD-11 freighters, offering a structural payload of 90-95t. The final new-build MD-11 freighter was delivered in 2001. The last P-to-F conversion of an MD-11 took place in 2012 (see table, page 66). The largest operators are Fedex (60) and UPS (38).

The only freighter options available in the large widebody market are new-build 777-200Fs and 747-8Fs, and converted 747-400s.

Boeing delivered its first 777F in 2009. The active fleet has since grown to 100 aircraft. The 777F has a structural payload of 102t. The largest operators are Fedex (25) and Emirates (12).

The first 747-8F was delivered in 2011, and by January 2015 there were 52 in service. The 747-8F has a maximum structural payload of 130-131t. The largest 747-8F operators are Cathay Pacific (13), Cargolux (9) and Nippon Air Cargo (8). Each of these airlines has used 747-8Fs to replace 747-400Fs.

Demand has been stronger for new-build rather than converted freighters in the large widebody market over the past few years. No large widebody aircraft has undergone a P-to-F modification since 2012 (see table, page 66). The fleet of new-build large widebody freighters has grown by 54 since the beginning of 2013.

## Future freighter demand

The potential demand for freighters is addressed here. The regional, narrowbody and widebody aircraft most likely to undergo P-to-F conversion are identified, along with the demand for new-build freighters.

### Regional

The ATR42 and Fokker 50 are the most likely 5-7t turboprops to be converted in the near future.

In the 8t turboprop category, the ATR72 will be the main conversion

## NARROWBODY &amp; WIDEBODY P-TO-F CONVERSIONS 2006-2015

Aircraft Type	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<b>Narrowbody</b>										
727-200	2	-	-	-	-	1	-	-	-	-
737-200	1	5	3	-	1	-	-	-	-	-
737-300QC	1	1	2	-	-	-	-	-	-	-
737-300	12	18	6	5	10	5	4	6	11	-
737-400	1	3	1	4	4	9	10	20	23	3
MD-82	-	-	-	-	-	-	1	-	3	-
MD-83	-	-	-	-	-	-	-	1	1	-
757-200	5	9	9	16	16	23	20	20	20	-
<b>Total</b>	<b>22</b>	<b>36</b>	<b>21</b>	<b>25</b>	<b>31</b>	<b>38</b>	<b>35</b>	<b>47</b>	<b>58</b>	<b>3</b>
<b>Medium Widebody</b>										
767-200/200ER	7	8	6	4	7	7	5	-	-	-
767-300ER	-	-	2	3	6	3	3	2	5	-
A310-300	6	5	4	3	-	-	-	-	-	-
A300-600	8	13	8	3	-	6	13	6	-	-
DC10-10	4	1	-	-	-	-	-	-	-	-
<b>Total</b>	<b>25</b>	<b>27</b>	<b>20</b>	<b>13</b>	<b>13</b>	<b>16</b>	<b>21</b>	<b>8</b>	<b>5</b>	<b>0</b>
<b>Large Widebody</b>										
MD-11	17	12	8	4	4	-	1	-	-	-
747-400	11	26	17	7	5	8	7	-	-	-
<b>Total</b>	<b>28</b>	<b>38</b>	<b>25</b>	<b>11</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>

## Notes:

1). Excludes combi conversions.

2). 767-200/200ER conversions include 23 aircraft converted from PC to full freighter status between 2009-2012.

candidate. A full freight conversion is not yet available for the Q400.

ATR believes there will be a need for up to 400 regional freighter conversions over the next 10-20 years. "We expect some slight growth in the regional freighter fleet, but also a strong replacement market as some aircraft are exposed to obsolescence issues," explains John Moore, head of global sales at ATR.

The most likely RJ to be converted in the near future is the CRJ-100/-200. AEI offers the only active standard P-to-F conversion for the CRJ-100/-200, and for any RJ. A converted CRJ-100/-200 freighter will have a structural payload of 6.6t. "The prototype aircraft is currently in conversion, and we expect to receive a supplemental type certificate (STC) in late 2015," says Robert Convey, senior vice president sales & marketing at AEI.

AEI has already received 26 orders for CRJ-100/-200 conversions, and Convey believes there could be a market for 145.

## Narrowbody

There are no new-build narrowbody freighter programmes available or being developed. The narrowbody freighter market therefore depends on conversions.

P-to-F conversions are available for 737-300s, 737-400s, MD-80s, and 757-200s. Conversion programmes for 737 Next Generation (NG) variants and the A320 and A321 are in development.

Airbus estimates a demand for 600 all-cargo conversions in this market from 2014 to 2033.

In the near term, the majority of narrowbody conversions is likely to be for 737-300s, 737-400s and 757-200s.

There may be a fall in the rate of 737-400 conversions. "The number of suitable 737-400 feedstock aircraft is becoming limited," says Convey. "Those aircraft that are available will have higher cycles and require more maintenance to prepare them for service. This could trigger a short-term resurgence in 737-300 and MD-80 conversions."

AEI has 19 737-400s, five 737-300s and three MD-80s on backlog for conversion. Convey estimates a demand for another 48 737-400, 27 737-300 and 15 MD-80 modifications.

Precision Aircraft Solutions says it will convert 12 757-200s this year. It believes that 135 more 757s could be converted by 2023. "Some of this demand could come from airlines replacing ageing 767-200s and A300B4s, while the market waits for affordable 767-300ERs," says Brian McCarthy, vice president marketing & sales at Precision Aircraft Solutions. "We believe there will be a gap to fill between the end of 737-400 feedstock availability, and the arrival of new certified conversion programmes, like the 737-800 and A320/321."

Precision says it will also consider converting 757-300s. "If we see any availability of that aircraft over the next few years, we may include it as a natural extension to our 757-200 programme," says McCarthy. The 757-300 would probably be an 18-position freighter.

Precision believes that 757 feedstock

levels will not subside before 2021.

In the longer term the narrowbody conversion market is likely to shift towards younger generation aircraft, as 737 Classic and 757 feedstock availability declines, and the acquisition cost of younger aircraft declines to the economic zone of convertibility.

"The future narrowbody conversion market will likely be dominated by younger 737NGs and A320/321s," says Dr YIP Yuen Cheong, executive vice president, aerospace engineering & manufacturing at ST Aerospace.

AEI, IAI Bedek and Pemco have all launched conversion programmes for the 737NG family.

AEI is focusing on the 737-800. Convey does not believe the 737-700 would make a good freighter, owing to its shorter fuselage and inferior payload.

AEI expects to receive an STC for its 737-800 conversion in the third quarter of 2017. "We are close to announcing two launch customers and estimate that there is a potential market for about 300 737-800 conversions," says Convey.

A 737-800 converted by AEI would be able to hold 11 standard AAA/AAY containers or 88-inch X 125-inch pallets, plus one additional smaller container. It would have a structural payload of 23t.

IAI Bedek is offering conversions for 737-700s and 737-800s. It already has a launch order for the 737-700 conversion.

Pemco also plans to offer conversions for 737-700s and 737-800s. It hopes to receive an STC for its 737-700 conversion in 2016. The availability of

the 737-800 conversion will be dictated by customer demand and aircraft market values. Pemco is prioritising the 737-700 over the -800, due to the -700's lower acquisition costs. Pemco expects airlines to keep 737-800s in passenger service for longer than the smaller -700. It believes the -800's acquisition costs will be too high to consider it for conversion over the next few years.

"High fuel prices and low borrowing costs have driven new aircraft orders over the past few years," says Pastor Lopez, chief executive officer at Pemco. "As the macroeconomic environment improves, analysts are expecting interest rates to rise. Combined with low fuel prices, this will make older aircraft more attractive."

A320s and A321s represent the main challenge to 737NGs in the future narrowbody conversion market.

PACAVI Group, in association with Aeroturbine and GAMECO, is the only firm developing a conversion programme for A320s and A321s.

PACAVI plans to make A320 and A321 conversions available almost simultaneously in 2017. It has received orders, and will soon announce a list of conversion customers.

"Depending on demand and the overall economic situation, we expect 400 A320s/321s to be converted in the US, plus a similar number in Europe over

the next 10 years," says Patrick Schultheis, director corporate communications at PACAVI Group. "Our goal is to serve 40% of the potential A320/321 conversion market directly."

PACAVI's A320 Freighter Lite will accommodate up to 10 88-inch X 125-inch ULDs or pallets, plus an additional half-size ULD on its main deck. It will have a structural payload of about 21t.

An A321 Freighter Lite will hold up to 13 88-inch X 125-inch ULDs, plus a smaller ULD on its main deck. It will have a structural payload of 25t.

It is likely that most demand for narrowbody freighters will come from a need to replace older, obsolete aircraft, although some may be used for growth or expansion.

Converted 737-700s, 737-800s and A320s will offer similar volumes and payloads to 737 Classic freighters. The A321 will offer greater capacity, and will be the closest replacement option for ageing 757 freighters.

### Medium Widebody

There are two new-build freighters in the medium widebody market: the 767-300ERF and the A330-200F.

There are also active conversion programmes for 767s and A300-600s, and a P-to-F modification for A330-200s

and -300s has been launched.

Airbus estimates a demand for up to 1,145 medium-widebody freighters from 2014 to 2033. It forecasts that 730 of these aircraft will be converted, and the remainder will be new-build freighters.

There are 42 767-300ERFs (destined for FedEx) and eight A330-200Fs on order backlog.

The most likely future conversion candidates in the medium-widebody market are the 767-300ER, and the A330-200 and -300.

EFW does not see a large market for further A300-600 conversions. It has seven aircraft on conversion backlog. "EFW has already converted most of the available feedstock, so it is unlikely that more than five additional conversions will follow the current backlog," explains Thomas Centner, director sales aircraft conversion at EFW.

In the future EFW's focus will be on A330 conversions. Airbus, ST Aerospace and EFW are working in partnership to offer P-to-F conversions for A330-200s and A330-300s.

A converted A330-200 will have a maximum structural payload of up to 58t. There are low gross weight and HGW versions of the A330-300. A converted HGW A330-300 will have a structural payload of up to 60t.

Egyptair was announced as the



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launch customer for the A330 P-to-F programme, after ordering two A330-200 conversions. EFW expects the prototype A330-200P2F to enter service in 2018. The first A330-300P2F is expected to enter service in 2017, with a launch customer still to be announced.

The 767-300ER is the most likely medium widebody candidate for future P-to-F conversion among the 767 family (see *Cherry picking 767s for conversion to freighter, Aircraft Commerce August/September 2014, page 54*), until the A330P2F programme starts modifying airframes.

It is difficult to predict if new-build deliveries will continue to outpace conversions in the medium widebody freighter market. “Conversion orders are usually placed at short notice with almost immediate demand,” explains Centner.

### Large widebody

Two new-build large widebody freighters are available: the 777-200F and the 747-8F. The 747-700 is the only large widebody that can be converted.

Airbus estimates a demand for 600 freighters in this size category from 2014 to 2033. It estimates that 65% of these will be new-builds. There are 42 777-200Fs and 10 747-8Fs on order backlog.

Fortune believes there will be no more demand for 747-400 conversions. “There are a number of parked 747-400 production freighters. If the global economy and air cargo market continue to improve these aircraft may be reactivated, but it is unlikely any more will be converted,” says Fortune.

In the near future, the large widebody market will be dominated by new-build freighters, in particular the 777-200F.

### Weak widebody conversions

New-build freighter deliveries have exceeded conversions in the widebody market in recent years. No large widebody aircraft have undergone P-to-F conversion since 2012.

Cliff Duke, chief executive officer at the Eolia Group, believes that the widebody conversion market could continue to struggle in the near future.

“Integrators such as Fedex and UPS represent more than half of the potential widebody freighter market,” explains Duke. “They have the resources and willingness to finance the acquisition of new-build freighters, as do the Middle Eastern carriers that have been growing their air cargo networks in recent years.

“There is also little interest in financing widebody conversions, owing to risks associated with investing in end-of-life programmes with uncertain obsolescence, where influencing factors include age limitations, noise restrictions and alternative lift options,” adds Duke.

“Parting out a third-generation widebody like the A330 can be a more attractive investment than converting it for use as a freighter,” says Duke.

Duke highlights the threat posed to the widebody conversion market by a growth in the ratio of air cargo shipped in the belly holds on passenger flights.

New generation widebodies, such as the 777, 787, A300, A340 and A350, offer more belly capacity than older widebodies. Belly cargo can be attractive to airlines, since it can incur lower unit costs than a dedicated freighter.

Airbus recently reduced its 20-year forecast for large widebody freighters due to expected growth in belly freight on long-haul sectors of more than 5,000nm.

There are no new-build freighters available in the narrowbody market. Converted 737 Classics have been one of the main narrowbody freighters options in recent years. IAI Bedek offers P-to-F conversions for 737-300s and -400s. AEI and Pemco also provide conversions for the same aircraft.

### LCF

Duke believes that the annual need for widebody conversions could drop to less than 10 if the large integrators focus on new-build freighters. “If that happens, the economics of investing in standard widebody conversion programmes will fade,” claims Duke.

Low Cost Freighter (LCF) Conversions Ltd is part of the Eolia Group. It has developed an alternative to standard widebody conversions. Duke believes the LCF approach of targeting a low-cost niche can succeed in the changing widebody freighter market, which he claims could become dominated by expensive OEM P-to-F conversion and new-build programmes.

The LCF concept avoids the high research and development costs associated with installing large cargo doors. Freight is loaded through the aircraft’s standard belly cargo doors, and is raised or lowered between the main and lower decks using two internal lift platforms.

The LCF conversion will be available for all third-generation widebodies, including the A330, A340 and 777 families. Typical gross structural payloads for LCF conversions would be 62t for a HGW A330-300, 66t for an A340-300 and 77t for a 777-200ER.

The total volume offered by an LCF aircraft would be lower than that for a standard main deck P-to-F conversion, because the size of containers that can be loaded on an LCF aircraft would be limited by the dimensions of the standard lower deck cargo door. “The operational impact of this will depend upon the average packing density,” claims Duke. “At standard industry packing densities of 7-8 lbs per cubic foot there is no significant loss of payload between most LCF variants and standard freighters. Today 60% of air freight is transported in the belly. All belly cargo containers can be accommodated on the main deck of an LCF modified aircraft.”

Duke believes that the low cost of an LCF conversion could make it attractive for certain niche operators. LCF says it could have a converted aircraft in the air by the fourth quarter of 2016. **AC**

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