

Lie-flat seats require a high investment, but the benefits include better use of cabin space, increased demand & yields in business class & lower operating costs.

Exploiting the bonanza of lie-flat seats

Many airlines operating long-haul international services have reconfigured the premium aircraft cabins in their large widebodies with lie-flat seats. Some have chosen to replace their traditional first and business classes with a new style, premium business class with lie-flat seats, utilising the same cabin area. The main reason for this change is to improve an airline's branding and give it a marketing and revenue advantage over its competitors by offering more comfort and privacy to its high-yielding business-class passengers.

The transition to a new style, premium business class with lie-flat seats is not a simple one, however. Planning the change can take more than one year, the associated costs are high, extended aircraft downtime is required, and there are certification issues to be considered. Nevertheless, airlines must also consider the consequences of eroded revenue by not making this change while their competitors offer more attractive seating to business passengers.

Seating options

There are several permutations an airline can consider when installing lie-flat seats.

The first is to upgrade first and business classes by installing the new style of seats in both. This can generally mean accepting a smaller amount of seats.

The second is to swap the traditional first and business classes for a premium

business class with lie-flat seats. Another option is to add a premium economy class that offers seats with more pitch than standard economy seats. The airline can therefore end up with two, three or even four classes on its aircraft.

Jacques Pierrejean, president at Pierrejean Design Studio, explains that an airline has several types of lie-flat seat from which to choose.

The first option is a seat that is conventionally positioned facing directly to the front of the aircraft, and folding out straight and flat. This has a pitch and bed length of up to 80 inches, more than six feet, so that the tallest of passengers can lie completely flat. "This type of seat was selected by Air Mauritius for its A340s and also by Etihad. The seats have a width of 23-24 inches and can be configured six abreast in the A340," says Pierrejean.

"A second option is for the lie-flat seats to be installed at an angle in the cabin, in a herringbone fashion," explains Pierre-Jean. "This can still provide a completely flat bed for the passenger. Some seats like this have a stool in front of the seat which acts like a footrest when the seat is in the upright position, and is used as a support for the end of the bed when it is extended flat. The seats are 20 inches wide, so more can be fitted across the width of an A340. Etihad selected this type of seat. As the seats are narrower, more can be fitted in a certain space than when the seats are arranged in a straight-line basis."

Aviointeriors is a major lie-flat seat

manufacturer. "Singapore Airlines selected our lie-flat seats for its business class on its 747-400s," says Massimiliano Casini, area sales manager at Aviointeriors. "Our full flat seat has a pitch of 77 inches, which is the minimum required for a fully flat seat."

A third option for airlines to choose from is a seat that is aligned straight in the fuselage, and provides a completely flat seat, but is inclined at angle. "This kind of seat uses a tighter pitch, so a bed of about 76 inches can be used in a pitch of 55 to 70 inches," explains Trevor Skelley, vice president and general manager at B/E Aerospace. This seat has been selected by Qatar Airways and Lufthansa.

"This type of seat is not fully flat but inclines, and the passenger's feet go under the seat in front," says Casini. "However, more seats can fit in the cabin."

The most luxurious type of lie-flat seat is the hybrid seat. "We are developing a seat known as a privacy bench," says Pierrejean. "The seat unit is a J-shape. The seat section provides a seat pitch of 47 inches for the sitting position, but the longer part of the seat extends at an angle down the side of the seat in front and allows the passenger to lie completely flat. This seat is about 25 inches wide, but only four can be fitted across the fuselage width of an A330/340."

Skelley explains that B/E Aerospace offers a similar seat that it describes as a horizontal plus seat, which is used as a super-business-class type of product.





There are several grades of lie-flat seats airlines have to choose from. The most luxurious allow airlines to replace their first and business class cabins with a super-business class. While seat numbers in the aircraft may be reduced overall, there are several cost saving and revenue improvement benefits to be realised.

Economic considerations

There are many issues an operator must consider when making such a fundamental change to the cabin interior. The first of these, and the primary reason for making the change, is the effect on the overall revenue that the airline can generate across its long-haul network. The main issues that affect this consideration are: how the number of premium-class seats will change; whether the change will result in higher demand and yields for the airline from its premium-class traffic; and whether the airline's operating costs associated with the change from two premium classes to one class will be affected.

Several issues relate to the impact of revenue following the installation of lie-flat seats. The first of these is the change in the airline's booking policy. With the traditional layout of three classes, airlines typically overbooked their economy and business classes by a few percentage points on the basis that a small number of 'no-show' passengers would bring the actual load factor in each cabin close to 100%. On occasions when all business- and economy-class passengers checked in for a flight, surplus economy passengers could be upgraded to business class, and surplus business-class passengers to first class. With first class being eliminated and replaced with a premium business class, airlines have to be more cautious and disciplined with respect to their overbooking policy, in order to avoid the damaging scenario of denying boarding

to business-class passengers.

Some airlines have encountered another development, following the installation of lie flat seats: the level of passenger no-shows has diminished, as regular business-class passengers become more disciplined in confirming bookings in advance and check in for these flights, rather than not turning up. This is because they have become aware of the possibility that they may be denied boarding following the removal of first class. A lower rate of no-shows means that airlines no longer have to overbook, and can plan for higher load factors.

Some airlines that have installed lie-flat seats use the same cabin area, and therefore have fewer seats because the lie-flat seats are larger. The demand in terms of the actual number of business passengers remains the same, so a higher load factor is experienced, as high as in excess of 90%.

The number of seats often increases where a premium business class replaces first- and business-class sections. The first airlines to introduce lie-flat seats on a route have seen an increase in demand for business class, since more passengers see a point in paying higher fares if they are able to get proper sleep as a result of the lie-flat seat. "The actual demand for lie-flat seats is affected by the direction of travel," explains Skelley. "Passengers on overnight flights generate higher demand for lie-flat seats than passengers travelling during the day. The installation of lie-flat seats, and the type selected, often has to be considered separately for each city-

pair in an airline's network."

There is also a stronger demand for premium business than there is for first class, since the demand curve is bell shaped. The demand for first class is on the right side of the curve, while demand for business class is in the middle of the curve. Overall, higher demand has resulted in airlines that offer a premium business class with lie-flat seats being able to charge up to 20% more than their competitors. This changes as more airlines on a route start to offer lie-flat seats, but a premium can still be charged when some airlines do not offer them. These carriers also suffer from weakening demand and load factors at the expense of those which have lie-flat seats. Fares then come back down to the level offered before the first airline offered premium business class, when all airlines on a route eventually offer lie-flat seats. The last airlines to install lie-flat seats will benefit the least, since they will have incurred the cost of modifying their aircraft, but will have lost the opportunity to benefit from high yields, and lost market share to their competitors.

Only a few airlines have installed lie-flat seats in some of their long-haul fleets, so premium yields are still currently enjoyed by most carriers that have installed them. The general trend is for both passenger yields and load factors to improve, thereby increasing unit revenues for business class. In some cases the number of seats also increases, delivering a further benefit.



Lower grade lie-flat seats are positioned at an incline, with the end of the bed passing underneath the seat in front. This type of seat, however, allows overall seat numbers to be maintained or increased.

Finally, revenue management is also simplified when an airline changes from a three- to a two-class configuration. It is relatively easy for an airline to accurately forecast demand for economy class, where the cabin accommodates 200-300 passengers. Forecasting demand can still be relatively accurate for a cabin of 55-80 passengers, but it becomes harder to estimate for a cabin size of fewer than 20 passengers, which is the size of first-class cabins. Inaccurate forecasting of demand in first class can lead to denied boarding in the case of higher-than-expected demand, and distressed inventory where demand is overestimated. The problem of inaccurate forecasting is removed when first-class services are deleted.

Airlines can also benefit from cost savings. "Most airlines can expect their operating costs to decrease, since operating one premium class instead of two is cheaper," explains Pierrejean.

"There are several reasons for this. One is because the ratio of seats to flight attendants is lower in first class than in business class, so the change is more economic in terms of flight attendant numbers," continues Pierrejean. The logistics of providing services for two different classes are changed when a single class is introduced. Two classes require their own catering, menus, linen, crockery, cutlery and other equipment. Skelley points out that two classes may also require two sets of crew training.

One small disadvantage of changing the cabin configuration to lie-flat seats is that there may be a small net increase in the aircraft's empty weight. This will marginally increase fuel burn. Lufthansa's A340-300s, for example, experienced a 1,000kg (2,200lbs) increase in empty

weight following installation of lie-flat seats.

Seat numbers

"Some space is wasted when first and business classes are divided, so taking out this division releases some space and creates room for seats," explains Casini. "In addition most airlines also have galleys and toilets in this dividing area, so when the cabin is reconfigured the overall area available for seating is increased."

How lie-flat seats affect seat numbers is not straightforward. Upgrading a business class with traditional seats at a 55-inch pitch with lie-flat seats will reduce seat numbers. Merging first and business classes will remove some galley duplication and the divider between the two classes, and so can generate extra space, but the outcome is also influenced by the type of lie-flat seat selected.

"We decided to exchange our old first- and business-class cabins on our 747-400s for a new business-class cabin with lie-flat seats set in a herringbone fashion," says Baden Smith, programme manager design engineering at Air New Zealand Engineering Services. "These extend straight out and provide a length of 80 inches, but only have a pitch of 38 inches. We also installed a premium economy class, whose seats have more pitch than regular economy class. The cabin area used for the new business class is the same as the previous first and business classes, but the total number of seats in the aircraft is lower because of the premium economy class."

Air New Zealand now has 36 lie-flat seats with foot stools in the area previously occupied by the first and

business classes on the maindeck. These are arranged in a herringbone style, and are four abreast in the full width of the main cabin. It has another 10 lie-flat seats in a two-abreast configuration in the front section of the upper passenger deck.

Lufthansa changed the first- and business-class sections in some of its A340-300s from a tri-class layout of 247 seats to a two-class configuration of 264 seats. The economy class was increased from 197 seats to 220 seats, while the area of the cabin used for first and business class was reduced to allow for three more rows of economy seats, and changed to a business class that has 44 lie-flat seats supplied by Recaro. Overall, the number of premium seats only declined by six, but the total number on the aircraft increased by 17 due to the larger economy class. "The inclined seats use the space underneath the seat in front when fully extended," explains Heinrich Peter, manager system engineering of cabin & payload systems at Lufthansa Technik. "The old first-class seats had a pitch of 84 inches and the old business-class seats had a pitch of 48 inches. The new business-class seats have a pitch of 60 inches, but have a fully extended length of 76 inches, which allows the passenger to lie flat. Each lie-flat seat has a hard shell back section, and a space underneath the seat section where the fully extended seat from behind can pass underneath, thereby allowing the passenger to lie completely flat."

"There are also some unexpected benefits," explains Smith. "If the new business-class cabin has an upgraded in-flight entertainment (IFE) system installed that features audiovisual on demand (AVOD), it can actually mean that fewer toilets are required. This is because passengers watch movies whenever they want and so do not all get up to go to the toilet at the same time when a movie finishes."

Besides changes to the style of seating, B/E Aerospace can provide several ways for airlines to improve the overall utilisation of aircraft space. "We reconfigure aircraft, as well as providing lie-flat seats," says Skelley. "One example is the overhead crew rest that we have installed for several airlines. This can release an area of up to six business-class seats where a crew rest was previously in the cabin, or can avoid the use of a crew rest area in the underfloor compartment,



which takes up the space of freight containers.”

Installation considerations

The effect on seat numbers and revenue following the installation of the seats must be considered against the initial cost. This starts with planning and preparing for the installation, which in most cases will be up to 24 months before the installation starts for a completely new redesign. “We used 15,000-20,000 man-hours (MH) of engineering time for our fleet of eight 747-400s,” says Smith. “This large number of MH is required because there are a lot of changes to the aircraft. These include reconfiguration of overhead bins and passenger service units (PSUs), changes to the wiring that supplies the IFE system and seats, installation of emergency cabin floor lighting, cabin signs and other lighting, positioning of floor seat racks, and repositioning of galleys and toilets. All of this has to be considered and performed in parallel with certification issues.”

Skellely adds that 10,000-50,000MH can be used in the engineering and design process for a fleet type. Completion of this phase takes up to 18 months.

Preparation also requires several months, or even up to one year. Pierrejean explains that this depends on the programme selected and the degree of change, but also on the availability of the seats, galleys and lavatories selected. “Some seats have already been certified, which shortens the preparation and ordering time, but many airlines want to offer a completely new type of seat which is designed from scratch. The testing and certification process will therefore extend

the preparation and design time,” explains Pierrejean. “Some airlines want to provide new design overhead bins and stowage closets for coats, which will also add to design and certification time.”

The installation of lie-flat seats does not just affect the aircraft. “There are several marketing issues, including changes to business-class lounges,” says Peter. “For the particular aircraft that have been modified, changes must be made to the airline’s schedule, to seat numbers, to first- and business-class inventory on the reservation computers, and to advertising to the public.”

“The whole process begins with a layout study,” explains Pierrejean. “This starts with deciding which space in the aircraft should be allocated to the new business class. This is often dictated by the positioning of doors, since this is a useful division between cabin classes. Business class is often up to the second door on a widebody.

“First and business classes have different ratios of lavatories and galleys, and the merging of the two will mean that their number and positioning will have to change,” continues Pierrejean. “These have to be considered together with the style and number of lie-flat seats. It is best to keep most of the lavatories and galleys in the same position, as this will keep the cost down. I think it is preferable to have a larger galley at the front of the business-class area, adjacent to door 1. This means redesigning the galley to accommodate more ovens, cooling trolleys, coffee machines and additional trolley stowages, and also removing the business-class galley near door 2, which provides some space for seats. This means that the toilets at the front of the old first class and at the rear

Air New Zealand installed large lie-flat seat units in its eight 747-400s. Arranged in a herringbone style, they provide four abreast seating in the main cabin. Planning for such an installation can take up to two years, with ten of thousands of man-hours required alone for the design process for a small fleet of large widebodies.

of the business class can stay in the same place.”

Pierrejean estimates that if toilets are placed at the front and aft section of the new business-class cabin, and the galley in the old business class and the cabin divider are removed, then the number of seats will be about 10% lower than the combined number of the old first and business classes.

This configuration redesign requires a lot of physical changes to the aircraft. A significant change involves the aircraft’s plumbing for the galleys, which require hot and cold water supply, as well as disposal pipes for waste and dirty water.

The next main issue is the overhead bins, passenger service units (PSUs) and emergency oxygen systems. Overhead bins will have to be changed so that they are uniform throughout the new business-class cabin. At the very least this means that the bins in the old first-class will have to be removed, and new bins installed in the division between the two classes and in the old first-class area.

Airlines are more likely to install a complete new set of overhead bins. “I think it is best not to have overhead bins in the central area of the cabin ceiling, and just have larger bins on the lateral areas instead, on either side for the whole length of the cabin. This more open ceiling design provides an opportunity for a ‘moodlighting’ concept,” says Pierrejean. “This configuration opens up space in the cabin roof area while maintaining the total amount of bin volume, but if this is selected then other changes are required. These include a new ceiling in the centre section and changes to the air conditioning vents, and re-design and re-engineering of oxygen mask boxes, cabin signage, and public



address system loudspeakers.”

Airlines installing lie-flat seats must also consider their effect on electrics and electrical supply. Lie-flat seats use a lot of electricity to all the motors, but also require a lot of wiring in relation to IFE systems and ports for laptop computers and in-seat phones. “We had to adapt the PSU channel to cope with the different number of seats,” says Peter. PSUs are controlled by a computer, which has to be reprogrammed with any change in seating configuration. “Changing seat numbers and their positioning also requires changes to the oxygen generators. Longer lanyards for oxygen masks have to be installed, since the height of the oxygen mask box above the seat has been increased.”

Most electrical cabling and wiring relating to seats and IFE systems is passed through underfloor channels, and this has to be redesigned and changed, as well as the floor covering over the wiring channels.

“Seats have the selected IFE equipment fitted when they are delivered to the airline for installation on the aircraft,” explains Casini. “The airline therefore just has to plug the seats into the position on the cabin floor, and so the relevant wiring has to be present. There is a server on the aircraft that controls the IFE in each seat, which of course has to be re-programmed. The seats are basically a stand-alone unit.”

The process of co-ordinating IFE systems with lie-flat seats has to be managed by the seat manufacturers. “There can be some additional engineering time involved if the IFE system has not previously been installed in the seat,” says Skelley. “The IFE

system has to comply with all regulatory requirements, such as how the heat generated by the IFE system is to be tested and analysed. B/E Aerospace acts as an integrator for aircraft retrofits when installing new IFE systems and seats, and we have to get the supplemental type certificate. The IFE system also has to be interfaced with the aircraft, and flight tests are also required.”

Many airlines are installing controlled lighting systems where the intensity of light in the cabin is controlled to give sunrise and sunset effects, rather than coming on and off instantly. Such lighting systems are installed in the ceiling area, and are computer controlled.

“We have developed a moodlighting system that was used by Emirates in its first-class cabin on its A340-500s,” says Pierrejean. “The system will dim lights on an evening flight to coincide with sunset, then project a night sky of stars on the ceiling and walls at night, and then produce the effect of a sunrise in the morning. All these effects can be programmed to coincide with the actual time of day outside the aircraft, as well as the cabin service being offered. A sunrise can be programmed to occur an hour before breakfast, for example.”

A third major issue is the remaining decor in the aircraft, which includes the carpeting, sidewall panels and cabin partitions.

Installation process

Most airlines find it simplest and cheaper to combine a major cabin reconfiguration with a heavy check. Estimates are that the downtime to complete such a major reconfiguration on

Airlines that have installed lie-flat seats gain from savings in operating costs, increased demand for business class and up to a 20% increase in business class yields.

a 747 or other large widebody is about one month. Although this provides an ideal time from a maintenance and engineering point of view, as well as minimising aircraft downtime, airline marketing departments need to introduce new cabin concepts over a concentrated period. Even if two or three aircraft are required to service a more prominent route in an airline’s long-haul network, these all have to be modified within the same period so that all flights on that route have the new cabin and lie-flat seats. Having one aircraft with the new lie-flat seats, and the other aircraft with the old-style business-class seats operating together on a prime route is unacceptable, from the point of view of marketing and customer satisfaction.

Several aircraft will therefore have to be taken out of service to go through heavy checks over a short period so that the new business class with lie-flat seats can be introduced on at least one or two routes at the same time. This can simply be done by bringing heavy checks forward of their due date. It is less of a logistical problem to organise with large fleets, but may require the airline bringing in widebodies from outside for a temporary period.

“Even though we combined our reconfiguration with a heavy check, it still extended the usual downtime of the heavy check,” says Smith.

Lufthansa completed the modification on its A340-300s in about three weeks, and combined it with a heavy check. “We used 12,000-15,000MH per aircraft to complete the process on the A340-300s,” says Peter. “This is not so surprising when you consider that the modification involves re-engineering the galleys and lavatories, changing the panels, carpets, overhead bins and PSUs, plumbing and wiring, IFE systems, and installing the seats themselves.”

In addition to the cost of MH and materials used in the installation process, the cost of design, certification and testing, cost of seats and new IFE systems, and associated costs relating to marketing has to be considered. The seats themselves have a unit cost of about \$30,000 each, but this is without IFE being installed, which incurs an additional cost. [AC](#)

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