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has chosen a completely new 198in cross-section and seven-abreast seat-ing. Boeing's decision is either bold or suspect, depending on the point of view (a Boeing or Airbus salesman's, that is). The seven-abreast layout is the least which allows the attractive twin-aisle cabin layout to be used and carries the advantage that passengers feel less cramped with only three seats in the centre row. On the other hand, it does reduce considerably cargo commonality with all the other wide-bodies. The 767 underfioor hold cannot take standard LD3 cargo con-tainers end-to-end because it is not wide enough, although its depth is the same as that of the other wide-bodies. Boeing has had to offer a modi-fied container, styled the LD67, which has the same height and width as the LD3 but is 181

2in shorter and some
25 per cent down on volume (120 cu ft compared with 158). It is interest-ing to note that when the 767 was launched, Boeing called its new con-tainer LD3A, but the marketing men obviously decided that this designa-tion carried with it the taint of com-promise and are now presenting the LD67 as something brand new.

Boeing claims that the LD67 makes more efficient use of the 767 constant cross-section than does the LD3 in the A310's tapering rear cargo hold. The 767 can carry up to 22 LD67s in its underfioor holds compared with 14 LD3s in the A310, a total container capacity of 2,640 cu ft, compared with 2,212 (or 2,370 if the bulk cargo A310 space, at the rear of the aft hold, is converted to take an extra LD3). However," the 767 cannot take double-width LD6 containers; the A310 can. The A310 also scores by being able to accept 88inX125in standard pallets (up to three in the forward hold) with-out modification, whereas the 767 needs an optional 134in forward cargo door and can then take only two pallets ranged fore and aft, or LD6s in the same position.

The question of underfioor cargo may seem rather marginal in a contest for a market in which passengers are the primary source of revenue, but the advent of wide-bodies ten years ago revolutionised airline attitudes to freight. Any airline which operates either 747s, DC-lOs, TriStars or A300s has substantial hold space to sell, and the amounts of underfioor cargo carried can be prodigious. Airbus has compiled figures for six A300 opera-tors (Air France, Lufthansa, Indian Airlines, Air Inter, Korean Airlines, South African Airways and Thai Inter-national) for the last quarter of 1977 which show that these carriers aver-aged nearly four tonnes (8,8001b) of freight, per flight and one (Thai) aver-aged 5*2 tonnes (12,0001b) during the period. Clearly, with such a heavy commitment to wide-body freight car-riage on existing types many airlines will have to think hard about adding 767s to their fleets, despite its theo-retically more efficient use of hold space, if it means a reduction in COD-

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tainer and pallet commonality. Luft-hansa and KLM, both recent A310 customers, have both stated that the Airbus type was chosen partly because of its wide-body freight commonality. Another notable contrast between the 767 and A310 is in wing design. Airbus has gone for a minimum-area wing, with maximum use of high-lift devices, following A300 design philo-sophy. Boeing has, on the other hand, gone for an enormous but simpler wing: with an area of 3,040 sq ft, the 767's wings are actually larger thqn the A300's 2,800 sq ft and nearly 30 per cent greater than the A310's 2,357 sq ft. Boeing's wing has double-slotted flaps only on the inboard sec-tions, whereas the A310 has these both inboard and outboard. The A310 has Krueger flaps to smooth wing-root airflow at high angles of attack, but Boeing has so far avoided this device for the sake of design simplicity. Even Airbus is attempting some simplifica-tion and will probably avoid the use of outboard low-speed ailerons, thus reducing complexity in a wing already dense, with actuators. Instead, a com-bination of spoilers and inboard ail-erons will be used for low-speed con-trol.

These differences—dramatic for two types which are designed for the same market—reflect the different starting points for Boeing and Airbus design teams. Boeing started from scratch and was heavily influenced by the re-quirements of US domestic trunk carriers LTnited, Delta and American, which wanted either one-stop trans-continental range or non-stop coast-to-coast capability. In addition, the development of a long-range trijet (the
777) had to be borne in mind: the same wing will be used when this air-craft is launched. Alternatively, the same wing can be used with a stretched 767 body to produce a com-petitor for the A300 (more of this later). The 767 is therefore at its best on stages of more than 1,000 n.m., when it can make use of its big wing at maximu m cruising altitude (39,000ft). On shorter stages, the A310 comes out tops on fuel burn per stage or per seat. Airbus claims a 10 per

cent fuel-burn advantage over a 500-mile stage, but Boeing figures reverse this position for a 1,000 n.m. flight. Airbus, when designing the A310, started with an existing design, the A300, and removed thirteen fuselage frames to produce a 200-seat cabin and then went for a minimum wing. The consortium's European A310 launch customers—Lufthansa, Swiss-air, Air France and KLM—operate shorter average stage lengths than the US trunks, and European air traffic control restrictions, as well as stage lengths, do not allow such high cruise altitudes. Airbus could thus optimise its contender for shorter stage lengths, with the knowledge that A300 ex-perience has shown that even a minimum wing can allow considerable range stretch. In fact, Airbus has al-ready done this with the A310-300. So airlines have a choice between two versatile competitors, each giving its best over a different set of stage lengths. Even when they are not being operated over their optimum range, both 767 and A310 will greatly reduce fuel burn per seat compared with the narrow-bodies which they re-place.
It is little wonder that airlines have
to resort to computers when evaluat-ing competing types over their route networks, when two aircraft are so evenly matched on fuel consumption, and when capitalising on underfioor cargo is important. Other factors have to be considered. Crew training costs, for instance, can help swing the bal-ance if the new type is derived from one that is already in the fleet. Airbus is pushing commonality with the A300 very hard, both in flying characteris-tics and cockpit layout. The consortium is offering identical two- or three-crew cockpits for both types, depending on customer requirements (or, put an-other way, depending on the strength of the local pilots' union). Boeing does not have the same opportunity to introduce commonality on the 767, although the company is trying hard. It is considering putting the 767 nose and flight deck on the 757, but aband-oning the 727 nose must surely in-crease overall development costs for