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HONG KONG DRAGON AIRLINES LIMITED (B): LEASE VS. BUY DECISION

In January 2006, the management of Hong Kong Dragon Airlines ("Dragonair") recognised the need to find a replacement by early 2007 for one of its spare engines that was deemed beyond economic repair ("BER"). To address this requirement, a taskforce led by finance manager Bevis Ho and engineering manager John Walters was formed to evaluate the various options in detail and to report back to the board of directors with a formal recommendation in early February 2006.

Dragonair's A320-Family Aircraft

Dragonair was a regional airline founded by local businessmen in Hong Kong in 1985. Despite its humble beginning and conservative growth, by 2002, Dragonair's fleet consisted of eight Airbus A320s, four Airbus A321s, nine Airbus A330s and three Boeing 747-300 freighters, providing regional passenger services and long-haul freighter services. Its fleet of narrow-body A320s and A321s, which were both powered by V2500 engines manufactured by International Aero Engines AG ("IAE"), served secondary cities in greater China such as Ningbo, Changsha, Fuzhou, Hangzhou, Guilin, Haikou and Kaohsiung, and such other Asian cities as Phuket and Kota Kinabalu. Since Dragonair's first A320 entered into service in 1993, the fleet had been growing steadily. In 2002, the fleet was supported by three spare V2500 engines. Between 2003 and 2005, Dragonair took deliveries of two more A321s, three more A320s and one more V2500 spare engine. Nonetheless, because one of the earlier three spare engines had been determined BER in late 2002, the 17-aircraft A320-family fleet [see **Exhibit 1**] was only supported by three spare engines. The fleet operated an average of about 7.83 flight hours and four cycles per aircraft per day, giving an estimated annual utilisation of 2,860 hours and 1,460 cycles per aircraft.[1]

[1] Case writer's estimate, based on published flight schedule. One cycle was equal to one take-off and landing,

Andrew Lee prepared this case based on published sources and interviews with industry observers under the supervision of Professor Su-Han Chan and Professor Ko Wang for class discussion. This case is not intended to show effective or ineffective handling of decision or business processes. Timing, figures and values presented in the case are estimates only and are not intended to represent any actual timing, figures and values. Persons, names and titles used in the case are fictitious.

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Airbus Industrie and the A320 Family of Aircraft[2,3]

Airbus Industrie ("Airbus") was one of the world's two predominant commercial aircraft manufacturers. Headquartered in Toulouse, France, Airbus had a product line that comprised 14 aircraft models, ranging from the 100-seat single-aisle A318 to the 525-seat A380. In 2006, Airbus was troubled by significant delays in its delivery schedule for its A380, with the planned first delivery delayed from early 2006 to October 2007. Nevertheless, Airbus's single-aisle A320 family of aircraft remained successful, securing such orders as 150 aircraft for China Aviation Supplies Import and Export Group Corporation and another 212 aircraft for various low-cost carriers.[4]

The A320 family comprised four variants (ie, A318, A319, A320 and A321), which shared the same type of cockpit, flew with the same operating procedures, and had the same cabin cross-section and systems. Except for the A318, all members of the A320 family were powered by either IAE's V2500 engines or CFM International's CFM56-5. Because of the different payload/capacity of the different members of the family, each required two engines of a specific thrust rating.

A320 Family of Aircraft	Seat Capacity (2-class config.)	Range (nautical miles)	Engines	Engine Thrust Rating (lbs)
A318	107	3,250	2 x PW6000 or 2 x CFM56-5	21,600–23,800
A319	124	3,700	2 x V2500 or 2 x CFM56-5	22,000–24,000
A320	150	3,050	2 x V2500 or 2 x CFM56-5	25,000–27,000
A321	185	3,000	2 x V2500 or 2 x CFM56-5	31,500–33,000

Table 1: The A320 Family Aircraft

International Aero Engines AG and the V2500 Engine

IAE was formed by a consortium of companies in 1983. The five original partners included Pratt & Whitney (a US-based aircraft engine manufacturer with 32.5% shareholding), Rolls-Royce (a UK-based aircraft engine manufacturer with a 32.5% share), Japan Aero Engine Corporation (a consortium of the three largest heavy-industry companies in Japan, with a 23% share), MTU (a Germany-based engine repairer and parts manufacturer with a 12% share) and FiatAvio (which later withdrew as a shareholder).[5] Registered in Switzerland and headquartered in the US, IAE launched the V2500 engine-development programme in 1984.[6] The first batch of V2500-powered A320s began revenue service with Adria Airways, Cyprus Airways and Indian Airlines in 1989. Over the years, IAE continued to add new customers to its order book, and by 1998, it delivered the 1,000th V2500 engine to Lufthansa. The 2,000th engine was delivered only four years later in 2002. Then, in 2003, IAE's market share for the

[2] Wikipedia (2008) "Airbus 320", http://en.wikipedia.org/wiki/Airbus_A320 (accessed June 2008).
[3] Airbus (2009) "Aircraft Families—A320", http://www.airbus.com/en/aircraftfamilies/a320/index.html (accessed June 2008).
[4] The China Aviation Supplies Import and Export Group Corporation was the mainland Chinese government agency for aircraft acquisition.
[5] IAE (2008) "Shareholders", http://www.v2500.com/company/shareholders.shtml (accessed June 2008).
[6] IAE (2008) "History", http://www.v2500.com/company/history.shtml (accessed June 2008).

A320 family rose to 83%, and by then IAE had overtaken CFM International with a 56% market share since 1998 of the A320 family.[7]

IAE's V2500 engine was considered a reliable aero-engine; it could operate a long time before it was required to be removed from an aircraft for major maintenance. For an A320 operating with the V2527 (the 27,000-pound-thrust version of the V2500) at an average mission length of about two hours, the expected mean time between removal for maintenance was estimated to be around 18,000 flight hours.[8] However, for an A321 operating with the V2533 (the 33,000-pound-thrust version of the V2500) at the same average mission length, the expected mean time between removal would be reduced to around 13,000 flight hours. (Both should expect the maintenance event itself to take about 60–70 days to complete under normal circumstances.) In other words, the engine could stay on the aircraft for four to six years before being removed for heavy maintenance. Heavy maintenance of engines was a major cost item for airlines. In 2006, the estimated cost of performing major maintenance on a V2500 engine was between US$1.6 million and US$2 million. Because of inflation in labour and material costs, the cost per maintenance event was expected to rise about 3–5% annually.

For safety and certification reasons, certain parts of an engine were classified as life-limited parts, or parts with definitive life limits. From 2003 onwards, all life-limited parts on a newly delivered V2500 engine had the same life limit of 20,000 cycles (one cycle was equal to one take-off and landing). A life-limited part might need to be replaced or repaired before it reached its life limit because of other technical reasons, but it was not common and could not be planned for by airlines. Otherwise, airlines would plan for replacing life-limited parts during a major maintenance event shortly before the life limits were reached (note that it would be illegal to operate an aircraft with an expired life-limited part installed). As of 2006, a complete set of new life-limited parts on the V2500 was priced at about US$2 million, and the price was expected to escalate by about 4–6% annually.

When an engine was removed from an aircraft for maintenance (which would take about 60 to 70 days), a spare engine was needed to be installed in its place for the aircraft to remain operational. Hence, there was a need to provide spare engines to support the ongoing operation of a fleet of aircraft due to planned or unplanned engine maintenance events. The industry rule of thumb suggested that an airline would need about one spare engine for every eight operating engines. Since each variant of the A320 family aircraft (except the A318) was powered by two IAE V2500 engines of a specific thrust rating (see Table 1, above), an airline that operated a version of the V2500 engine with a particular thrust rating would require spare engines of the same thrust rating. An airline such as Dragonair, which operated more than one version of the V2500, could swap engines across its fleet with only a minor modification to the rating plug, subject to the commercial agreement between the airline and IAE. As of early 2006, the list price of a V2527 was about US$7.5 million, and that of a V2533 was about US$8.5 million.

Spare Engine Acquisition

A spare V2500 engine was purchased as part of the expansion plan for Dragonair's A320-family fleet between 2003 and 2005, and was delivered in late 2003. This additional spare engine would have increased Dragonair's number of spare V2500 engines to four—a number considered sufficient to support the fleet's operation. However, another engine on the fleet

[7] Wikipedia (2008) "International Aero Engines", http://en.wikipedia.org/wiki/International_Aero_Engines_V2500 (accessed June 2008).

[8] Mean time between removal for maintenance of an engine was typically represented by the number of flight hours the engine operated before requiring removal from the aircraft for major maintenance at an engine repair and overhaul facility.

was deemed BER during a heavy maintenance event in late 2002. In order to protect the operation of its expanded A320-family fleet against frequent engine maintenance events from the beginning of 2007, Dragonair's board of directors had accepted in principle the recommendation from the engineering team to acquire one additional spare V2500 engine by early 2007, subject to detailed analysis by a taskforce of the various options to source a spare engine.

Having already explored and determined the discount rates at an earlier meeting on 22 January 2006, Walters and Ho held a follow-up meeting on 24 January 2006 to review the three different options to source the spare engine. The discussions went as follows.

Ho: John, would you explain in detail what those three options are?

Walters: Alright. Let me start with the simplest one. We can purchase a spare engine outright by placing an order with IAE. The order lead time is normally about 12 months, but the delivery can be expedited to January 2007. Our initial discussion with IAE's sales team has indicated that the purchase price of a V2533 in 2006 is US$8.15 million. The actual purchase price at the time of delivery will be subject to escalation, and IAE would require an upfront deposit of 15% on the estimated escalated price, assuming an annual escalation of 3%. The remaining portion would be payable immediately prior to delivery of the engine.

Ho: So, in other words, we don't really know exactly how much the engine is going to cost us until we take delivery of it?

Walters: That's correct. The rate of 3% is an average based on historical escalation. I'd say from experience that's a pretty good number to use, though it can vary from 1% to 5%,[9] which might mean that we would need external financing if we went with this option.

Ho: For our purpose, let's use 3%, and we'll note that this is only an estimate. About the need for external financing, I already discussed it with our CFO yesterday. He said that would not be necessary because of our strong cash position.

Walters: That's good to know. Now, the second option is a sale-and-leaseback arrangement. After placing an order for the spare engine with IAE, we can do a sale-and-leaseback with an engine leasing company. This means that upon taking delivery of the engine from the manufacturer, we would sell the engine to a leasing company, which in turn would lease the engine back to us. I have received a few proposals and here is the most favourable one for your reference [see **Exhibit 2**].

Ho: Can you highlight the key points to me? I'm new to this engine leasing business.

Walters: Of course. The first item in the offer is the purchase price, which is what we'll pay to IAE. The monthly lease rental is shown as a factor, which is 0.8% of the purchase price of the engine at delivery. The next item in the offer is the maintenance reserve rates. Engine leasing companies require lessees to pay maintenance reserves for each flight hour and cycle operated on the engine to make them accountable for the cost of repairing the wear and tear incurred on the engine. The rate per hour is derived by dividing the estimated maintenance cost by the

[9] The escalation rate was usually calculated based on an escalation formula, which was a function of labour, material and energy, referencing indices published by the bureau of census of the manufacturer's country of domicile.

mean time between removals. If the engine is operated at 27K (or 27,000 pounds of thrust) on an A320, the rate per flight hour is US$100. If it is operated at 33K (33,000 pounds of thrust) on an A321, the rate per flight hour is US$130. Now, about the rate per flight cycle…

Ho: Hold it. Is this what you guys call an operating lease, and how is that different from a financial lease?

Walters: Yes, that's correct. An operating lease is simply a rental arrangement that is not much different from renting an apartment from a landlord. The agreement is usually five to 10 years long and non-cancellable.[10] On the other hand, a financial or capital lease is more like a mortgage arrangement with a bank. Its term can be equally long or longer than an operating lease, but may involve a transfer of ownership of the asset to the lessee at the end of the lease.

Ho: Now, about the maintenance reserve rates, why is it that the rate per engine flight hour is more expensive for a 33K engine than for a 27K engine?

Walters: In short, it is because an engine operating at 33K incurs wear and tear faster than at 27K, and therefore the engine won't last as long on the aircraft before it needs to be removed for major maintenance. The rate per flight hour is really simple mathematics. All you do is divide the major maintenance cost by the number of flight hours operated by the engine. Although the major maintenance cost of a 33K engine is more or less the same as that of a 27K engine, the number of flight hours operated on a 33K engine is less, and hence the higher rate per flight hour.

Ho: Okay. I think I understand. What about this rate per flight cycle. How does it work?

Walters: It works in a very similar way to the rate per flight hour. On the engine, there are a bunch of parts that are classified as life limited parts. This means that these parts have a definitive life span in terms of the number of cycles they can operate from the time they come out of the manufacturing plant. Do you know what a cycle is?

Ho: One cycle is just one take-off and landing, right?

Walters: Spot on! On a V2500, all life limited parts have a life of 20,000 cycles. Basically, the rate per cycle is calculated by dividing the total cost of all the life limited parts by 20,000. However, because life limited parts can only be changed during a major maintenance event, and because the timing of life-limited part expiries almost never coincides with the timing of major maintenance events, a 10% wastage (or 10% stub life) is assumed. Thus, the denominator in calculating the rate per cycle is 18,000 cycles, not 20,000 cycles.

Ho: I see. So what happens to the maintenance reserves that we would have paid?

Walters: During the lease term, the lessee is allowed to draw down on the flight hour reserve for the actual cost of a major maintenance event. Such drawdown, however, would be limited to the amount remaining in the reserve. Similarly, the lessee would also be allowed to draw down on the flight cycle reserve for the actual replacement cost

[10] A short-term engine lease was likely to be as short as a few days and up to a few months long, and was used to address a sudden and unforeseen spare engine requirement. A lease anticipated in this case would be a longer-term deal with a minimum of 3–5 years and up to 7–10 years and would be non-cancellable.

of any life limited parts. Any amount of reserves left with the leasing company at the end of the lease will be kept by the leasing company.

Ho: Wow, that sounds like a good business to be in!

Walters: It sure does.

Ho: The last two items of the proposal have to do with return conditions. Should we be concerned with them? What happens if we cannot meet the return conditions?

Walters: We absolutely need to be. If we cannot meet the return conditions at the end of the lease term, the lessor could refuse to take the engine back, force us to spend maintenance dollars on the engine and make us pay additional rent until the engine is good for lease return. I've already asked one of the engineers to assess if we'll have any problem meeting the return conditions. I'll let you know as soon as that assessment is in.

Ho: Alright.

Walters: The third option is to lease a new or used spare engine from an engine leasing company. However, due to the high demand for spare engines forecasted for 2007 and 2008 to cover for V2500 engine removals worldwide, I have not been able to source any V2500 engines for lease from the market to meet Dragonair's requirement. The same leasing companies that submitted sale-and-leaseback proposals have also offered to put in an order with IAE, provided that Dragonair would agree to lease the engine from them on the same lease terms as the sale-and-leaseback proposal.

Ho: So, in short, we have only two options to evaluate. There are still a few more bits and pieces of information that we need for our analysis. First, we need to decide how long we're going to use this engine, and hence the timeframe of cash flows that we need to consider.

Walters: I suggest we use 10 years. Not only do we have a 10-year lease term from the lease proposals, but airline planning has also indicated that we intend to fly the A320 for at least another 10 years.

Ho: Okay, 10 years it is, then. Next, we need an estimate of what the engine will be worth after 10 years. Is there any industry source that we can rely on for this information?

Walters: There are a few trade publications that contain information like that. Let me have a look and get back to you.

Ho: Great, I'll check with financial accounting to confirm our depreciation policy. We need to use the profit tax rate for our analysis, which in Hong Kong is 17.5%. But since there is no capital gains tax in Hong Kong, there is no tax implications associated with the disposal of an owned engine.

Now, due to all these requirements for maintenance reserve rates per flight hour and cycle and for reserve drawdown, I need your help to work out how many hours and cycles we will operate this spare engine over the 10-year period, when it will need

to be removed for major maintenance, and if any life limited parts will need replacing and when.

Walters: Consider it done!

Ho: Terrific! Shall we target having all the additional information available in two days?

Walters: That should be fine. Let's touch base again in two days, then.

Additional Information

Subsequent to meeting, Walters and Ho had collected the following additional information:

- According to *Aircraft Commerce*, an airline industry trade publication, the estimated market value of a used V2500 in 2003 was US$4.02 million. By 2008, the figure was expected to go up to around US$4.4 million.[11] Due to the high popularity of this engine type and normal price escalation, the taskforce believed that a residual market value of about US$2.5 million to US$3 million for a 10-year-old engine in about 10 years' time would be very reasonable.
- Dragonair's depreciation policy of fixed assets such as passenger aircraft and spare engines was a 10-year straight-line depreciation down to a 20% residual value.[12] Assuming the airline's operating parameters remained unchanged, the subject spare engine would need to be installed on an A321 in early July 2007 and could stay on the aircraft for 4.5 years before requiring removal from the aircraft at the end of December 2011 for heavy maintenance starting in January 2012. Then, in the second quarter of 2015, the engine would need to be installed on another A321 for about one year. The rest of the time, the engine would be stored at Hong Kong Aircraft Engineering Company's engine storage facility as a spare engine to protect the operation from any unexpected engine problems [see **Exhibit 3** for the estimated utilisation of the engine over a 10-year period].
- The cost of the heavy maintenance event expected in early 2012 was estimated to be around US$1.9 million in 2012 dollars.
- Given Dragonair's aircraft utilisation and the planned usage of the subject spare engine, there would not be any need to replace any of the life limited parts on the engine due to life expiry. Although there was always the possibility of replacing life limited parts due to damage, it was considered a rare occurrence and difficult to model. By the same token, Dragonair would have no issue in complying with the return conditions in the lease proposal.

Making the Comparison

Time was running short. With an order lead time of 12 months plus a one-month buffer for further questions from the board of directors, the taskforce would have to complete its evaluation of the alternatives and put forward its recommendation to the board for approval by February 2006 in order to get a March 2007 delivery slot.

[11] Aircraft Commerce (June–July 2003) "The Profit Potential of Engine Sale & Leaseback Transactions".
[12] Estimated based on industry common practice.

EXHIBIT 1: DRAGONAIR'S FLEET OF A320-FAMILY AIRCRAFT

Aircraft Type	Manufacturer's Serial Number	Aircraft Registration	Delivery Date
A320	756	B-HSD	16 February 1998
A320	784	B-HSE	6 March 1998
A320	816	B-HSF	26 May 1998
A320	812	B-HSG	22 June 1998
A320	877	B-HSH	16 October 1998
A320	930	B-HSI	29 January 1999
A320	1253	B-HSJ	29 June 2000
A320	1721	B-HSK	7 March 2002
A320	2229	B-HSL	9 July 2004
A320	2238	B-HSM	13 July 2004
A320	2428	B-HSN	29 April 2005
A321	993	B-HTD	1 April 1999
A321	1024	B-HTE	4 June 1999
A321	633	B-HTF	2 May 2000
A321	1695	B-HTG	15 March 2002
A321	1984	B-HTH	24 September 2003
A321	2021	B-HTI	22 October 2003

Source: Planespotters.net (2008) "Dragonair", http://www.planespotters.net/Airline/Dragonair?show=all#Fleet_Details (accessed June 2008).

EXHIBIT 2: SALE-AND-LEASEBACK PROPOSAL

Purchase Price:	Actual purchase price of the engine at the time of engine delivery with full title transfer to the leasing company
Lease Term	10 years from the date of delivery
Monthly Lease Rental:	0.8% × the purchase price, payable monthly
Deposit:	3 months' rental, payable upon acceptance of the lease proposal, and refundable upon lease expiry
Maintenance Reserve Rates:	Payable monthly
Per Engine Flight Hour:	US$100 per engine flight hour at 27K US$130 per engine flight hour at 33K
Per Engine Flight Cycle:	US$111 per engine flight cycle (assumed 10% stub life)
Validity of Maintenance Reserve Rates:	The Maintenance Reserves Rates per Flight Hour and Flight Cycle are fixed for the entire lease term and are not subject to any escalation.
Return Condition 1	Certified serviceable and have at least 9,000 hours (at 27K) or 6,500 hours (at 33K) remaining until its next heavy maintenance
Return Condition 2	Each life-limited part shall have at least 6,000 cycles remaining

Source: Case writer's estimates.

EXHIBIT 3: ESTIMATED UTILISATION AND CORRESPONDING MAINTENANCE RESERVES REQUIRED (IN CASE OF A LEASE ARRANGEMENT) FOR THE SPARE ENGINE

Year	Flight Hours	Total Flight Hour Reserves	Flight Cycles	Total Flight Cycle Reserves
2007	1,429.6	US$185,848	730	US$81,030
2008	2,859.2	US$371,696	1,460	US$162,060
2009	2,859.2	US$371,696	1,460	US$162,060
2010	2,859.2	US$371,696	1,460	US$162,060
2011	2,859.2	US$371,696	1,460	US$162,060
2012	-		-	
2013	-		-	
2014	-		-	
2015	2,144.4	US$278,772	1,095	US$121,545
2016	714.8	US$92,924	365	US$40,515
2017	-		-	

Source: Case writer's estimates.