

Airbus Industrie:
An Analysis of the A3XX

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1 Executive Summary

The 23rd of June, 2000 marked an important day in the history of Airbus Industrie. On this day, Airbus Industrie's Supervisory Board approved an Authorization to Offer regarding a new aircraft, the A3XX, an airplane unlike anything previously seen in the market to date. The Very Large Aircraft (VLA) market had been dominated by Boeing's 747-400 model aircraft up to that point in time, and Airbus recognized the underlying need for an increase in passenger volume, improved technology, and increased passenger comfort by proposing and possibly launching this new model. Airbus' management felt the demand in the airline market was ready for a completely new revolutionary model to take these pushing factors into consideration. It felt the airline industry was at a pivotal point where a radical change was needed beyond glossing over the problem of growing demand with increased airport traffic, new routes and airports, or added flight frequency.

Looking at the history of the airline industry, such revolutionary advancements had been prevalent, with a major example highlighted by Boeing Company with their risqué launch of the 747 in the latter part of the 1960s. Such a breakthrough almost broke Boeing's back, but today this model of aircraft forms the backbone of the entire airline industry, providing outstanding performance the industry to date could not do without. In response to this, Boeing managed to swell a monopolistic stronghold in the VLA market.

Airbus Industrie, on the other hand, slowly began to surge forward only recently during the past decade. With their initial successful launches including the A300 and A310, they began to build a name for themselves in the aviation industry. As they gained popularity and market share, this revolutionary new launch came into consideration.

Is Airbus Industrie ready to launch this new innovation to the VLA market? Would this project place them as the lead runner in the aircraft market, eliminating the monopolistic grasp of Boeing? Or would the project break them as Boeing's launch of the 747 so many years ago almost forced them into bankruptcy? Based on current information, can the launch of the

A3XX be expected to be profitable? Or would the launch prove to be little more than a voluntary death sentence for Airbus Industrie?

This paper considers these questions and analyzes the aspects regarding the launch of Airbus' A3XX and the feasibility on whether the project should be undertaken based on costs, cash flows, and assumptions regarding these figures. After the completion of a thorough discussion of Airbus Industrie's revolutionary A3XX model aircraft as well as its place in the aircraft business, this paper will follow with in-depth financial calculations including NPV analysis and sensitivity analysis. Based on assumptions given in response to our figures, we will follow by explaining our decision we feel Airbus Industrie must implement.

2 Market Analysis: Airbus vs. Boeing

2.1 The New Launch: Details on the A3XX

The direct competition to the A3XX would be Boeing's 747 commercial aircraft. Beyond the basic size, passenger accommodating volume, and amenities offered with the new aircraft, the A3XX differs in many ways from the 747.

On the positive side, the A3XX would provide wider aisles and more space per seat, setting a new standard for airline comfort. To add to security, the plane would supply four engines as opposed to the 747's two engines, and the same "fly-by-wire" technology, deck design, and performance would encompass this line of Airbus aircraft as is prevalent in all previous models. In addition, costs would be significantly reduced with the A3XX model, providing for superior economics.

Major negative issues with the A3XX circulated around its large size and its subsequent effects regarding emissions, noise, evacuation, taxiway movements, and turnaround time. Although Airbus Industrie insists that these issues were solved, a question whether airports will be able to handle the greater passenger volume influx remains.

Given the strengths and weaknesses of the A3XX as outlined above, it is not easy to predict whether sales of the super jumbo can take off after its launch. Many analysts differ in opinion regarding the potential success of the project. Some say it is doomed to fail, while others claim that it may give Airbus a foothold in the VLA market.

2.2 The Question of Demand

Both Boeing and Airbus forecasted a growing demand for the use of air transportation services over the next 20 years after 1999, with overall passenger traffic expecting to double over this time period. Airbus set its figures at 4.9% annual growth per year, and Boeing's forecast was set minimally lower at 4.8%. However, this is where the similarity ends between Airbus' *Global Market Forecast* and Boeing's *Current Market Outlook*.

Based on their assumption that airlines would add capacity and increase aircraft size as increased flight frequency became infeasible in order to maintain market share, Airbus forecasted that 1,235 new passenger aircraft seating 500 passengers or more would be needed over the following 20-year period following 1999, a demand that aircraft of A3XX's caliber would fulfill. In contrast, Boeing's demand estimate supported a need for only 330 passenger aircraft seating 500 persons or more.

These previous figures highlight the stance that Boeing has made in regards to demand. They have steadily maintained that the market for aircraft of the A3XX's caliber is quite small, and they question how airline finance departments will handle the problem of first affording the new aircraft in the first place, followed by the difficult task of making profits with an aircraft that has so many seats to fill.

A large reason underlying this discrepancy in views between Airbus and Boeing lies with the fact that each company places a different importance on aircraft size, flight frequency, and new route development.

Mainly, Airbus Industrie believes that any increased efforts that new routes and upgraded frequencies would provide to the problem of growing demand would largely only be short-

term. There comes a point when short-term modifications no longer become efficient and drastic change is needed to upgrade the market. In addition, the response in the airline industry toward the launch of the A3XX is largely positive, with many airlines formally expressing an interest in buying the new model. The key factors facilitating this interest include capacity constraints at key airports and on important long range city connections, as well as the push for enhanced passenger comfort in the form of additional space and facilities, particularly for the crucial high yield first class passengers.

The question is about timing. Is the commercial airline market ready for this upgrade now? Will Airbus be launched into airline superstardom with the release of the A3XX? If the demand is not timed appropriately, the project could potentially flop and cost Airbus to lose ground.

However, Airbus felt that in the long-term the need for capacity increases would eventually overrule short-term modifications, and the corporation was convinced that the model A3XX aircraft would drastically change the way people fly in a similar fashion to how the 747 changed the industry decades ago.

2.3 Threats and Risks

Coming to the market as the most expensive airliner in the world, the revolutionary new features of the A3XX aircraft carried with it an exorbitant price tag that Airbus Industrie had to work with. Financial figures for the launch of the A3XX weighed in around \$13 billion, although those who doubted the figures cautioned it may reach upwards of \$15 billion.

The first planes were expected to be delivered in 2006, with full production capacity of just over four planes per month being reached in 2008. This uncovers a major concern with financial risk for Airbus Industrie. Financial success is clouded through the inability to secure enough orders by the time production begins. When a company invests billions of dollars knowing its break-even point is potentially several years off without having adequate information in the beginning, a great sense of insecurity develops within the company.

One of the biggest risks faced by plane manufacturers is the ability of their buyers to pay. If an airline goes bankrupt, the plane manufacturers will never see the money that is owed to them. With this and a trend of a slowdown in orders, a manufacturer has a tighter margin and may not sell as many planes as it would like to recoup costs. A slowdown or loss of market share means death for a company because it means that it will take longer to recoup development cost and prolong the time it takes to develop the next model. This can potentially pose as a very real threat to Airbus Industrie if it is not careful in the initial stages of the A3XX launch.

2.4 The Boeing Company's Reaction

The direct competitor of Airbus Industrie is the Boeing Company, and the potential launch of the A3XX poses a great threat to Boeing. Primarily, the introduction of a completely new model specialized to directly cater to a greater array of consumer and operating needs has the potential to anchor an entire market segment in the near future. Should Boeing stand by and let this happen without securing a piece of the newly expanded VLA pie? There are several responses that Boeing could take in reply to Airbus' launch of the A3XX.

First of all, it could develop a stretch version of the 747 to directly compete with the A3XX. In fact, Boeing had been planning to develop a 520-seat version of the 747 ever since it withdrew from the jumbo jet collaboration project with Airbus back in 1995. However, their dismal outlooks on future demand in airline usage caused it to reject the idea and cease developments in 1997. Although Boeing is an established company with an already popular model aircraft to use as a modification basis, the costs involved were high for having less demand forecasted. Furthermore, the technology and existing features of the 747 may not be able to compete with the A3XX's revolutionary offerings of space and comfort.

Secondly, Boeing could simply cut the price of the current 747 model. By doing so it could draw attention away from the A3XX and perhaps even divert sales. It is well known that initial sales and secured orders would be imperative to the success of the A3XX launch. By making the beginning of the road even bumpier, Boeing increase the chance that Airbus will fail in their launch.

Another option for Boeing is to develop a completely new jet as Airbus has done with the A3XX¹. This option houses a significant amount of risk for Boeing as it has already forecasted low demand for a jumbo jet at the caliber of the A3XX. A large investment needed would possibly extend beyond the costs of generating an expanded 747 model, and based on Boeing's current dismal outlook regarding future demand, this option may not appear to be a feasible one.

The final option, of course, is for Boeing to quietly sit back and do nothing. Reflecting on its own rocky launch of the 747 in the late 60s and how the launch almost bankrupted them, Boeing might feel that it is equally possible that the A3XX launch fails and eliminates Airbus from the aviation industry in the process, thus doing away with Boeing's competition. Although it would be a very convenient result, Boeing cannot ignore the upside of the launch either. Just as the 747 came to revolutionize the airline industry as we know it today, perhaps the A3XX will do the same in the future. This very real outcome cannot be ignored by Boeing.

The strategy adopted by Boeing could have adverse effects on the success of the A3XX launch. Without having full information on Boeing's response and counter strategy, estimating the profitability of the A3XX project becomes a much more challenging task.

3 Financial Analysis

3.1 Discussion of Assumptions

In our analysis of this case study, we have to make numerous assumptions on a whole myriad of variables. Figures on demand, research and development expenditures, and operating expenses provided by Airbus are only forecasts. These forecasts can only serve as "best estimates," given that Airbus would have access to more relevant information than other analysts. Other market variables such as inflation rate, market rate of return, and risk-free discount rate can be estimated from historical statistics. Again, these figures are only estimates, and analysts often have differing opinions on what these variables may be.

In the following discussion, we examine critically all the assumptions made in our calculation of the NPV for the Airbus A3XX project. A degree of skepticism must be applied, especially to figures provided by Airbus. These figures could be biased in order to induce a positive NPV analysis.

3.1.1 Demand

Future demand for the super jumbo jet A3XX has been the subject of much dispute and discussion. As mentioned, Airbus predicts that there will be demand for 1,235 passenger aircraft with 500 or more seats over the next 20 years from 2000 onwards. They target to capture more than half of this market with the launch of A3XX, projecting sales of 718 A3XX over the 20-year period (Global Market Outlook 2001-2020). Interestingly, the VLA market leader, Boeing, is not half as confident as Airbus regarding the sustainability of long-term demand in the market. Boeing's forecast of the entire market for the corresponding aircraft type over the same period is only 330, 27% of Airbus' projection.

Although both companies' forecasts are based on theoretically and empirically sound models, they could be lacking in objectivity. A strong positive forecast of demand helps Airbus support their launch of the A3XX. On the other hand, Boeing can attempt to discourage Airbus from venturing into the VLA market (currently monopolized by Boeing's 747) by projecting weak market demand. While both companies have strong basis for their forecasts, a more objective demand forecast obtained from neutral analysts would probably be more reliable. A leading aviation industry journal, *The Airline Monitor*, forecasts that demand for the A3XX over the 20-year period of 2000-2019 would total 735. This implies that Airbus' target of 718 may not be too far off the mark.

Based on the assumption that total sales for the period 2000-2019 will approximately equal 718, we can assume steady-state sales of 50 aircraft per year, beginning in 2008 when full production capacity is reached, with a sales ramp up prior to that of 50% and 75% for years 2006 and 2007 respectively. This is of course assuming that manufacturing capabilities will grow at a rate to match the sales ramp, hitting full capacity of 50 planes per year in 2008. This will give a total of 713, as shown in Table 1 below.

Year	% full sales	# of A3XX
2006	50	25
2007	75	38
2008	100	50
2009	100	50
2010-20	100	50
Full sales per year		50

Table 1: Demand Forecast

3.1.2 Price and Payments

The price per plane is \$216 million in year 2006, increasing at the assumed inflation rate of 2% for years thereafter. Also, we assume that there will be no discount for early orders. That is to say, all purchasers will pay the full price for all A3XX aircraft purchased. We acknowledge that there will be initial cash flows coming in from customers purchasing the A3XX in the form of down payments or security deposits, but since we have no reasonable way to estimate the amounts or the times the payments will be made, we are choosing not to include them in our cash flow forecast. As a result of this, the actual NPV of the project will be arguably higher than that in which we compute in this analysis.

3.1.3 Project Life

Although demand projections for the A3XX are only for the next 20 years, the life of the project extends beyond the 20 years. Based on industry estimates, the A3XX is expected to remain economically viable for the next 50 years or so, before being replaced by a new model of aircraft. We will therefore assume the effective life of the project is 50 years, as opposed to 20 years.

In our model we present cash flows for the first 20 years, but we lack any sufficient information to generate cash flows for the remaining 30 years of the project's life. Therefore,

a terminal value is needed to be estimated at the end of year 2020 which represent the cash flows received over the next thirty years. In our NPV analysis we compute the terminal value of the project to be the present value at year 2020 of all cash flows received after 2020. We are assuming that cash flows after 2020 remain constant in real terms so that the nominal cash flows grow at the applied inflation rate annually after 2020.

3.1.4 Costs

Airbus has not revealed specifically details on both the required amount of investment or expected future operating expenses for the A3XX project. Instead, it has only stated a target operating margin of 15-20%, implying that the proportion of operating expenses to revenues will be held approximately constant. It may not be easy to maintain a targeted operating margin, so the assumption of an operating margin in this range may be overly simplistic. Learning effects are likely to push costs down in the later years of the project, as the production teams gain knowledge and increase efficiency. As a result, many analysts have estimated the operating margin to be between 20% and 30%. The wide estimate range demonstrates the difficulty of predicting an appropriate margin. In doing the NPV analysis, it might be only prudent to use a more conservative operating margin of 17.5%, the arithmetic average of Airbus' 15-20% target.

The way to spread out the required investment expenditure of \$13 billion over the life of the project is also only an assumption. The real manner in which the \$13 billion, which is only an estimate to begin with, will actually be disbursed remains uncertain. The manner we will utilize for expenditure disbursements is based on a report by Dresdner Kleinwort Benson, as quoted in the case (Table 2). Depreciation expenses are then derived from the capital expenditure schedule provided (Table 3).

	2001	2002	2003	2004	2005	2006	2007	2008	Total
R&D Exp (\$millions)	1,100	2,200	2,200	2,200	1,320	880	660	440	11,000
Capital Exp (\$millions)	0	250	350	350	50	0	0	0	1,000
Working Capital (\$millions)	0	150	300	300	200	50	0	0	1,000
Total	1,100	2,600	2,850	2,850	1,570	930	660	440	13,000

Table 2: Investment Schedule (in \$millions)

	2001	2002	2003	2004	2005	2006	2007
Depreciation (\$millions)	0	25	60	95	100	100	100
Depreciation (\$millions)	2008	2009	2010	2011	2012	2013	2014
	100	100	100	100	175	40	5

Table 3: Depreciation Schedule (in \$millions)

Finally, we exclude from our analysis the \$700 million already expended before 2000 since it is a sunk cost and therefore should have no bearing on our decision.

3.1.5 Taxes

As stated in the case, Airbus Industrie is subjected to the standard French corporate tax rate of 38%. We will assume that taxes will be paid one year in arrears as this is a real-life happening. Furthermore, we are assuming Airbus had a clean slate in terms of tax credits beginning in 2000 and no losses existed to carry forward before this date. A corporate tax rate of 38% may be considered relatively high, so it is likely that Airbus may attempt to lower their tax rate through other means. A lower tax rate will have profound implications on the NPV of the project.

3.1.6 Inflation

We use an inflation rate of 2% for our analysis. This is because 2% is the targeted inflation rate for the EU, which includes France, Germany, and Spain, the host countries of Airbus' parent company, EADS. The United Kingdom, where the co-owner of Airbus, BAE Systems, is based, has an inflation target of 2.5%. Historically, inflation rates for the EU over the past ten years averaged 2.3% (Eurostat), so our assumption of 2% for the next 20 years is not unreasonable.

Inflation will lead to a rise in operating expenses, as the general price level in the economy increases under inflation, including wages. To maintain a profit margin of 17.5%, list price of the A3XX must rise. The net effect of inflation is therefore a growing cash flow as time passes, because nominal profits/losses are being inflated over time.

3.1.7 Financing

The project is estimated to cost Airbus a total of \$13 billion, of which \$3.5 billion would be provided by the "risk sharing partners" (RSPs), \$3.6 billion of "launch aid" from the various national governments, and \$5.9 billion from the Airbus partners themselves. Essentially, this is equivalent to all-equity financing. This is because the risk sharing capital from the RSPs and the government "launch aid" are more similar to cumulative preferred stock than debt. Since the arrangement of repayment to both RSPs and the prospective governments is on a per plane basis, Airbus need not make any repayment if they fail to sell any A3XX. This is to say, non-repayment does not imply default. This, combined with the fact that we do not know the full details of the payback arrangements, leads us to exclude any such repayments from our model. In any case, our main concern is the profitability of the A3XX project as a whole, because as long as the project has a positive NPV, it is worth going ahead with it since Airbus will not make repayments to the extent of making a loss.

3.1.8 Real Options

Due to lack of information, we have to assume that Airbus does not have the option to abandon the project once it begins, even if the project turns out less successful than forecasted. Similarly, we assume that Airbus will not be able to expand their capacity should they so desire. However, it is unlikely that Airbus will not hedge their risk through real options, so the assumption of no real options may be an over-simplification. The value of having a real option could increase the NPV of the project significantly, leading our computed NPV to be lower than its true value.

3.1.9 Discount Rate

The appropriate required rate of return to be used in our NPV analysis of the A3XX launch is derived from the cost of financing the project. We have concluded earlier that the project's financing can effectively be treated as all-equity financing. The cost of capital for the project is therefore roughly equivalent to Airbus' cost of equity. However, the required rate of return on the A3XX project should be higher than Airbus' return on equity because of the inherent high risks involved in the development of the super jumbo, given the uncertainties of market demand.

To calculate the cost of equity for Airbus, we can use the Capital Asset Pricing Model (CAPM), which states that:

$$R_e = R_f + \beta (R_m - R_f) \quad (1)$$

R_e : Cost of equity for Airbus

R_f : Risk-free rate

R_m : Market rate of return

The risk free rate can be approximated from yields on long-term US government bonds which were approximately 6% at December, 2000 (US Federal Reserve). The average return on stocks in the US market averaged 13% from 1926-2000 (Ross, Westerfield, Jordan), giving an equity risk premium of 7%. Airbus' beta can be estimated from the average of the betas of its

main competitors in the industry. Hence, it might be reasonable to assume Airbus' beta as 0.84, which is the average of Boeing and Bombardier's betas. If the assumptions for the aforementioned variables are valid, Airbus' cost of equity can hence be estimated to be:

$$6\% + 0.84 (13\% - 6\%) = 11.88\% \quad (2)$$

Since the A3XX project is arguably all-equity financed, 11.88% would be an appropriate discount rate to apply to future cash flows in our calculation of NPV. However, many assumptions have been made in deriving this discount rate of 11.88%. Any change in the environment affecting Airbus' return on equity will lead to a new appropriate discount rate. The assumption that the risk capital from RSPs and governmental launch aid can be treated as different forms of equity financing is also questionable.

Finally, using the average beta of Boeing and Bombardier, 0.84, as the beta of Airbus is another disputable assumption. More specifically, the A3XX project should have a higher beta than Airbus itself because the super jumbo jet is an unprecedented product in the industry, and the launch is exposed to a higher level of risk as a result. The problem is that the project's beta cannot be estimated quantitatively. Instead, it has to be an estimate based on qualitative analysis and hence vulnerable to subjectivity and bias.

In conclusion, the discount rate of 11.88% that we apply in our NPV analysis is a very simplified assumption due to the lack of complete information. Given the high risks inherent in the project, we will need to test the robustness of the project by varying our discount rate, and examining its impact on NPV.

In the next section we will test the impact of changing key variables in our model through sensitivity analysis. These variables include the discount rate, inflation rate, and tax rate, as well as sales and demand projections.

3.2 NPV and Sensitivity Analysis

3.2.1 Base Case

Based on the assumptions discussed above, we can form a “base case” model for our NPV analysis, with the results outlined in the income statement illustrated in Appendix A. In the base case, we have a positive NPV of \$594.19 million, which indicates that Airbus should go ahead with their plans to launch the A3XX.

In the following sections, we will test the viability of this result by manipulating the figures used in our NPV calculation. We will use sensitivity analysis on particular variables to examine the impact of change in these key variables.

3.2.2 Discount Rate vs. Inflation Rate

The first factors we considered modifying are the discount rate and the inflation rate. Our results are shown in Table 4.

	Discount rate %					
		10.00	11.88	14.00	16.00	18.00
Inflation rate %	2.0	\$1,656.12	\$594.19	-\$82.00	-\$444.86	-\$660.54
	2.5	\$2,074.42	\$877.85	\$120.01	-\$284.60	-\$524.07
	3.0	\$2,537.04	\$1,187.46	\$337.41	-\$114.10	-\$380.15
	3.5	\$3,049.71	\$1,526.01	\$571.77	\$67.54	-\$228.23
	4.0	\$3,619.01	\$1,897.24	\$824.89	\$261.36	-\$67.67
	4.5	\$4,252.48	\$2,304.87	\$1,098.80	\$468.48	\$102.19
	5.0	\$4,958.75	\$2,753.51	\$1,395.80	\$690.17	\$282.11
	5.5	\$5,747.75	\$3,248.32	\$1,718.46	\$927.87	\$472.94
	6.0	\$6,630.85	\$3,795.18	\$2,069.73	\$1,183.18	\$675.59

Table 4: Discount Rate vs. Inflation Rate NPVs

The assumed inflation rate of 2% is most likely too low in reality, so we need to calculate the NPV of the project under a higher inflation rate. From the table, we can see that a mere increase of 0.5% in the inflation rate can increase our NPV by almost \$300 million.

On the other hand, if the discount rate rises without a significant rise in the inflation rate, we could end up with a negative NPV. However, interest rates are usually positively correlated with inflation rates, implying that our NPV is most likely to still stay in the positive region.

3.2.3 Beta

As discussed earlier, we feel that the beta assumed in the base case may be too low because there are high risks involved in launching a new product. By modifying beta to a larger value, we implicitly change our discount rate to a higher rate as well via the CAPM model. Keeping all other variables constant to the base case scenario, changes in beta, and consequently the discount rate, yield the following NPV values shown in Table 5.

Beta	Disc Rate	NPV
1.00	13.00	\$187.67
1.20	14.40	-\$170.85
1.40	15.80	-\$416.58
1.60	17.20	-\$587.10
1.80	18.60	-\$706.78

Table 5: Beta and NPV

From the table, we can see that once our beta increases to 1.2, we encounter a negative NPV. This is disturbing for Airbus because the assumption of a 0.84 beta for the A3XX project is probably an underestimation. However, we must not forget that the table shown assumes the base case inflation rate of 2%, when it should be higher in reality.

3.2.4 Tax Rate and Discount Rate

We have questioned earlier the reality of a 38% tax rate. To investigate the impact of tax rates on our model, we examine changes in the tax rate along with the discount rate, as demonstrated in the following Table 6.

	Tax Rate %					
		25.0	30.0	35.0	38.0	40.0
Discount rate %	10.00	\$2,135.48	\$1,951.11	\$1,766.74	\$1,656.12	\$1,582.37
	11.88	\$857.85	\$756.44	\$655.04	\$594.19	\$553.63
	14.00	\$44.30	-\$4.28	-\$52.86	-\$82.00	-\$101.44
	16.00	-\$392.26	-\$412.49	-\$432.72	-\$444.86	-\$452.95
	18.00	-\$651.75	-\$655.13	-\$658.51	-\$660.54	-\$661.89

Table 6: Tax Rate vs. Discount Rate NPVs

It is likely that the tax rate will be lower than 38% as opposed to higher. If this is the case, it is likely that we have a greater positive NPV, assuming the discount rate stays the same or even falls. If the discount rate rises as we hold all other variables constant, even a fall in the tax rate may fail to return a positive NPV.

3.2.5 Demand

Another uncertainty that could be vital to the success of the project is the demand in the market for the A3XX. Table 13 and Table 14 in Appendix B show that varying the total demand under different ramp up sales assumptions can change our NPV rather drastically. Based on our base case assumptions, however, the project will be likely to have a positive NPV as long as the total demand over the next 20 years stay above 660 planes. If Boeing's estimates of demand for the A3XX market are accurate, the launch would be a disaster indeed, as it would then have a negative NPV of approximately \$3 billion!

3.2.6 Other Variables

There are an infinite number of combinations to be obtained from manipulating the variables. As we have emphasized throughout, the NPV of the project is highly volatile and minor changes in our assumptions can have very strong reverberations. The results of our analysis on the impact of changing certain assumptions including capital expenditure, R&D, learning curve, operating margins can be found in Appendix B.

Furthermore, we are uncertain of Boeing's likely response to the launch of the A3XX. If Boeing is able to formulate an effective counter-strategy to thwart Airbus' ambitions, many of our assumptions could be seriously challenged. A fierce response from Boeing could result in lower demand for the A3XX, which may force Airbus to cut the price of the A3XX in order to remain competitive and/or push operating margins down. The impact of all these are also examined in Appendix B.

4 Conclusion

Our analysis concludes that the expected NPV of the project (based on assumptions in the base case) is positive. While this is an indication that the project is likely to be profitable, we must bear in mind that there are significant downside risks as well. However, in calculating the base case NPV, we have exercised restraint and attempted to err on the safe side in our estimates. There is significant upside potential to the project as we have not figured in the value of real options, nor have we considered that customers will need to make down payments on their purchases, resulting in a healthier cash flow for Airbus.

In conclusion, our advice to Airbus would be to go ahead with the A3XX project, but they should limit their downside risk exposure through real options, ensuring that they will be able to abandon the project prematurely if the market proves to be unreceptive to the new product. We must not forget that the benefits of a successful launch will go beyond the cash flows resulting from the project alone. The A3XX not only gives Airbus the chance of breaking Boeing's monopoly in the VLA market, but also the opportunity to boost their reputation and positioning in the industry.

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Appendix A - NPV and Cash Flow Analysis – Base Case

General Data

Expenditures (in \$ millions)	
R&D Expenditures	\$11,000.00
Capital Expenditures	\$1,000.00
Net Working Capital	\$1,000.00
Total	\$13,000.00

Funding (in \$ millions)	
Risk Sharing partner	\$3,500.00
National Governments	\$3,600.00
Airbus Partners	\$5,900.00
Total	\$13,000.00

Assumptions for Discount Rate	
Risk-free Rate %	6
Market Return %	13
Market Premium %	7
Asset Beta	0.84
Discount Rate %	11.88

General Assumption in Year 2000

Variable	Value
Inflation Rate %	2
Tax Rate %	38
Total Demand of A3XX	718.0
Price/plane (million) 2008	\$225.00
On-going capital expend.	\$0.00

Demand forecast - Case 1

Year	% full sales	# of A3XX
2006	50	25
2007	75	38
2008	100	50
2009	100	50
2010	100	50
-2020	100	50
Full sales per year		50

Learning Curve Effects

Year	Op. margin
2006	17.5
2007	17.5
2008	17.5
2009	17.5
2010	17.5
2011	17.5
-2020	17.5

Further assumptions

Taxes paid in arrears

No pre-payment from ordering airlines

No optionality for airbus

Zero tax credits prior to 1999

No discount for early orders

Production capacity in 2008: 4 planes per month - 48 planes per year

Airbus Development Expenditure by Year (\$ millions)

Required Investment	2001	2002	2003	2004	2005	2006	2007	2008	Total
R&D Expenditures %	10	20	20	20	12	8	6	4	100
R&D Expenditures	\$1,100.00	\$2,200.00	\$2,200.00	\$2,200.00	\$1,320.00	\$880.00	\$660.00	\$440.00	\$11,000.00
Capital Expenditures %	0	25	35	35	5	0	0	0	100
Capital Expenditures	\$0.00	\$250.00	\$350.00	\$350.00	\$50.00	\$0.00	\$0.00	\$0.00	\$1,000.00
Working Capital %	0	15	30	30	20	5	0	0	100
Working Capital	\$0.00	\$150.00	\$300.00	\$300.00	\$200.00	\$50.00	\$0.00	\$0.00	\$1,000.00
Total	\$1,100.00	\$2,600.00	\$2,850.00	\$2,850.00	\$1,570.00	\$930.00	\$660.00	\$440.00	\$13,000.00

Table 7: Airbus Development Expenditures by Year (\$ millions)

Assumption:

After 2005 on-going Capital Expenditures: **\$0.00**

Cum. Investment	2001	2002	2003	2004	2005	2006	2007	2008
R&D Expenditures %	10	30	50	70	82	90	96	100
R&D Expenditures	\$1,100.00	\$3,300.00	\$5,500.00	\$7,700.00	\$9,020.00	\$9,900.00	\$10,560.00	\$11,000.00
Capital Expenditures %	0	25	60	95	100	100	100	100
Capital Expenditures	\$0.00	\$250.00	\$600.00	\$950.00	\$1,000.00	\$1,000.00	\$1,000.00	\$1,000.00
Working Capital %	0	15	45	75	95	100	100	100
Working Capital	\$0.00	\$150.00	\$450.00	\$750.00	\$950.00	\$1,000.00	\$1,000.00	\$1,000.00

Table 8: Cumulative Investment

Depreciation for capital expenditures: Assumption - Straight-line over 10 years

	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Depreciation	\$0.00	\$25.00	\$35.00	\$35.00	\$5.00	\$0.00	\$0.00	\$0.00	\$0.00
Depreciation	\$0.00	\$25.00	\$60.00	\$95.00	\$100.00	\$100.00	\$100.00	\$100.00	\$100.00
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Depreciation	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Cum. Depreciation	\$100.00	\$100.00	\$75.00	\$40.00	\$5.00	\$0.00	\$0.00	\$0.00	\$0.00
	2019	2020	2021						
Depreciation	\$0.00	\$0.00	\$0.00						
Cum. Depreciation	\$0.00	\$0.00	\$0.00						

Table 9: Depreciation for capital expenditures

Income Statement 2001 – 2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Revenues						\$5,448.31	\$8,335.91	\$11,336.84	\$11,563.58
% of steady state						50	75	100	100
Number of planes						25	38	50	50
Price per plane						\$216.26	\$220.59	\$225.00	\$229.50
Operating margin %						17.5	17.5	17.5	17.5
Operating profit						\$953.45	\$1,458.78	\$1,983.95	\$2,023.63
Development Costs									
R&D Expenditures	-\$1,100.00	-\$2,200.00	-\$2,200.00	-\$2,200.00	-\$1,320.00	-\$880.00	-\$660.00	-\$440.00	\$0.00
Depreciation	\$0.00	-\$25.00	-\$60.00	-\$95.00	-\$100.00	-\$100.00	-\$100.00	-\$100.00	-\$100.00
EBIT	-\$1,100.00	-\$2,225.00	-\$2,260.00	-\$2,295.00	-\$1,420.00	-\$26.55	\$698.78	\$1,443.95	\$1,923.63
Taxes		\$418.00	\$845.50	\$858.80	\$872.10	\$539.60	\$10.09	-\$265.54	-\$548.70
EBIAT	-\$1,100.00	-\$1,807.00	-\$1,414.50	-\$1,436.20	-\$547.90	\$513.05	\$708.87	\$1,178.41	\$1,374.93
Depreciation	\$0.00	\$25.00	\$60.00	\$95.00	\$100.00	\$100.00	\$100.00	\$100.00	\$100.00
Capital Expenditures	\$0.00	-\$250.00	-\$350.00	-\$350.00	-\$50.00	\$0.00	\$0.00	\$0.00	\$0.00
On-going Expenditures	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Net Working Capital	\$0.00	-\$150.00	-\$300.00	-\$300.00	-\$200.00	-\$50.00	\$0.00	\$0.00	\$0.00
Cash Flow	-\$1,100.00	-\$2,182.00	-\$2,004.50	-\$1,991.20	-\$697.90	\$563.05	\$808.87	\$1,278.41	\$1,474.93
Discount Rate %	11.88								
Discount Factor	0.8938	0.7989	0.7141	0.6382	0.5705	0.5099	0.4558	0.4074	0.3641

Table 10: Income Statement 2001 – 2009

Income Statement 2010 – 2018

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Revenues	\$11,794.85	\$12,030.75	\$12,271.36	\$12,516.79	\$12,767.13	\$13,022.47	\$13,282.92	\$13,548.58	\$13,819.55
% of steady state	100	100	100	100	100	100	100	100	100
Number of planes	50	50	50	50	50	50	50	50	50
Price per plane	\$234.09	\$238.77	\$243.55	\$248.42	\$253.39	\$258.45	\$263.62	\$268.90	\$274.27
Operating margin %	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Operating profit	\$2,064.10	\$2,105.38	\$2,147.49	\$2,190.44	\$2,234.25	\$2,278.93	\$2,324.51	\$2,371.00	\$2,418.42
Development Costs									
R&D Expenditures	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Depreciation	-\$100.00	-\$100.00	-\$75.00	-\$40.00	-\$5.00	\$0.00	\$0.00	\$0.00	\$0.00
EBIT	\$1,964.10	\$2,005.38	\$2,072.49	\$2,150.44	\$2,229.25	\$2,278.93	\$2,324.51	\$2,371.00	\$2,418.42
Taxes	-\$730.98	-\$746.36	-\$762.04	-\$787.55	-\$817.17	-\$847.11	-\$865.99	-\$883.31	-\$900.98
EBIAT	\$1,233.12	\$1,259.02	\$1,310.44	\$1,362.89	\$1,412.08	\$1,431.82	\$1,458.52	\$1,487.69	\$1,517.44
Depreciation	\$100.00	\$100.00	\$75.00	\$40.00	\$5.00	\$0.00	\$0.00	\$0.00	\$0.00
Capital Expenditures	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
On-going Expenditures	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Net Working Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Cash Flow	\$1,333.12	\$1,359.02	\$1,385.44	\$1,402.89	\$1,417.08	\$1,431.82	\$1,458.52	\$1,487.69	\$1,517.44
Discount Rate %	11.88								
Discount Factor	0.3254	0.2909	0.2600	0.2324	0.2077	0.1857	0.1659	0.1483	0.1326

Table 11: Income Statement 2010 - 2018

Income Statement 2019 – 2020

	2019	2020
Revenues	\$14,095.94	\$14,377.86
% of steady state	100	100
Number of planes	50	50
Price per plane	\$279.76	\$285.35
Operating margin %	17.5	17.5
Operating profit	\$2,466.79	\$2,516.12
Development Costs		
R&D Expenditures	\$0.00	\$0.00
Depreciation	\$0.00	\$0.00
EBIT	\$2,466.79	\$2,516.12
Taxes	-\$919.00	-\$937.38
EBIAT	\$1,547.79	\$1,578.75
Depreciation	\$0.00	\$0.00
Capital Expenditures	\$0.00	\$0.00
On-going Expenditures	\$0.00	\$0.00
Net Working Capital	\$0.00	\$0.00
Cash Flow	\$1,547.79	\$1,578.75
Discount Rate %	11.88	
Discount Factor	0.1185	0.1059

Assumption for Cash flow after year 2020

Cash Flow 2020	\$1,578.75	
	2020	2000
Perpetuity; g = inflation	\$16,298.79	\$1,726.26
CF for 10 more years	\$9,832.83	\$1,041.43
CF for 20 more years	\$13,723.07	\$1,453.46
CF for 30 more years	\$15,270.58	\$1,617.36

Results	NPV
NPV Perpetuity	\$703.09
NPV - CF 10 more years	\$18.26
NPV - CF 20 more years	\$430.29
NPV - CF 30 more years	\$594.19

Table 12: Income Statement 2019/2020

Appendix B - Sensitivity Analysis

Different Sales ramps

Sales ramp	Case 2 %	Case 3 %	Case 4 %	Case 5 %
2006	25	35	50	100
2007	40	45	65	100
2008	65	65	75	100
2009	85	85	85	100
2010				
-2021	100	100	100	100

Note: Case 1 is the base assumption!

Table 13: Different Sales Ramps

Different total sales

Total Sales	Case 1	Case 2	Case 3	Case 4	Case 5
330	-\$3,023.48	-\$3,077.47	-\$3,065.53	-\$3,037.39	-\$2,973.25
620	-\$319.55	-\$420.99	-\$398.56	-\$346.44	-\$225.28
640	-\$133.07	-\$237.78	-\$214.63	-\$160.83	-\$35.66
660	\$53.41	-\$54.41	-\$30.70	\$24.78	\$153.87
680	\$239.88	\$128.63	\$153.23	\$210.39	\$343.39
700	\$426.36	\$311.84	\$337.16	\$396.00	\$532.91
718	\$594.19	476.72	\$502.70	\$563.05	\$703.48

Table 14: Different Total Sales – Changing Sales Ramp

Learning curve effects

Case 2		Case 3		Case 4	
Year	Op. Margin	Year	Op. Margin	Year	Op. Margin
2006	13	2006	11.5	2006	13
2007	14	2007	13	2007	15
	15	2008	15	2008	17
2009	16	2009	16.5	2009	18
2010	17	2010	18	2010	19
2011	18	2011	18	2011	19.5
-2020		-2020		-2020	
NPV	\$420.95	NPV	407.59	NPV	996.53

Table 15: Learning Curve Effects

Different Beta

Price	NPV	Beta	NPV
\$210.00	\$147.89	1.00	\$187.67
\$215.00	\$296.66	1.10	-\$8.74
\$220.00	\$445.42	1.15	-\$93.64
\$230.00	\$742.96	1.20	-\$170.84
\$235.00	\$891.73	1.30	\$305.08
\$240.00	\$1,040.50	1.40	-\$416.58

Table 16: Different Beta

Expenditures

Case 2

Initial Expenditures (in \$ million)

R&D Expenditures	\$12,692.32
Capital Expenditures	\$1,153.84
Net Working Capital	\$1,153.84
Total	\$15,000.00

Results

NPV Perpetuity	-\$235.42
NPV - CF 10 more years	-\$920.25
NPV - CF 20 more years	-\$508.23
NPV - CF 30 more years	-\$344.32

Case 3

Initial Expenditures (in \$ million)

R&D Expenditures	\$10,153.86
Capital Expenditures	\$923.07
Net Working Capital	\$923.07
Total	\$12,000.00

Results

NPV Perpetuity	\$1,172.35
NPV - CF 10 more years	\$487.52
NPV - CF 20 more years	\$899.55
NPV - CF 30 more years	\$1,063.45

Case 4

Initial Expenditures (in \$ million)

R&D Expenditures	\$11,846.15
Capital Expenditures	\$1,076.92
Net Working Capital	\$1,076.92
Total	\$14,000.00

Results

NPV Perpetuity	\$233.84
NPV - CF 10 more years	-\$450.99
NPV - CF 20 more years	-\$38.97
NPV - CF 30 more years	\$124.94

Case 5

Initial Expenditures (in \$ million)

R&D Expenditures	\$11,423.08
Capital Expenditures	\$1,038.46
Net Working Capital	\$1,038.46
Total	\$13,500.00

Results

NPV Perpetuity	\$468.46
NPV - CF 10 more years	-\$216.37
NPV - CF 20 more years	\$195.66
NPV - CF 30 more years	\$359.56

Note: Case 1 is the base assumption

Table 17: Different Expenditures