GENERAL GUIDELINES FOR AIRCRAFT ACQUISITION

by

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A Capstone Project Submitted to Embry-Riddle Aeronautical University in Partial Fulfillment of the Requirements for the Aviation Management Certificate Program

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We have been living difficult times in all the world these years. In this challenging journey, this study brings to our lecturer the effort of the group members throughout this certification program.

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Abstract

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This Paper developed a basic guide for professionals in executive roles within airlines when facing the typical dilemma of which aircraft fleet type to choose and how to best finance it. The main investigation topic of this Paper was the elements to be taken into consideration for an airline executive when pondering the fleet of choice and respective financing structure (i.e., aircraft capabilities, asset liquidity, accounting treatment).

Moreover, this Paper briefly explored the upsides and downsides of each of the elements mentioned in the study. The research provided light on the respective practical consequences of such elements to the overall business. Furthermore, this Paper helped the reader to conclude that the fleet type to be acquired by the airline, as well as the associated asset financing alternative, was more or less adequate depending on the main characteristics of such airline. Capital structure, the business model and cash position are amongst the most significant characteristics of an airline. Therefore, it is fair to infer that no pre-existing recipe will necessarily work properly for every airline. The information and lessons contained in this Paper can be of great importance to aviation executives, as the impacts (i.e., financial, strategical, operational) of the fleet and financing structure are often extremely significant to the airline business. Making an adequate decision will most likely determine the success or demise of the airline.

Table of Contents

List of Tables

Table Page

List of Figures

Chapter I

Introduction

Project Definition

In light of the highly competitive and challenging environment within the aviation industry, airlines have no option but to be rigorous with their cost structure and be innovative with their revenue strategies. Furthermore, according to Lenoir (1998), there is an intimate statistical correlation between air transportation demand and economic growth, measured by Gross Domestic Product (GDP).

That being attested, it is not only important for airlines to develop flexible plans to face the upcoming volatility but also understand the timing of implementing actions contemplated in such plans. According to Airlines in a Post Pandemic World, "Although many airlines do develop scenarios, they do not necessarily engage in its use effectively to plan their business in the context of weaknesses and strengths of partners in the ecosystem. Although scenario planning is not a new concept, it is worthwhile to revisit the best practices in this area to deal with the increasing levels of uncertainty in the external environment in the near future, the internal capabilities of airlines, and the capabilities of partners in the ecosystem to deal with uncertainties." (Taneja, 2021).

An additional aspect that cannot be forgotten by airlines is the importance of the competitive advantages that should be the basis of its overall business plan and strategy. Given the framework of airlines as businesses and the large number of variables that can potentially impact their results. Airlines are deemed by specialized analysts to be the capital-intensive type of firms. That peculiarity usually leads airlines at some point in time to seek capital injections in the open capital markets. In that sense, their management must

be really knowledgeable and sharp when pitching the airline story. It is important to properly position key information about the business to assure that bankers and other types of investors are comfortable and bullish about making capital investments in that business.

Currently, after the covid-19 outbreak, the aforementioned assertion becomes even more true and radical. The relationship between airlines' Cost of Available Seat-Kilometer (CASK) and Revenue per Available Seat-Kilometer (RASK) appears to be declining. Thus requiring worldwide management teams to dive deeper into their options and alternatives before effectively making a business decision. Ultimately, the costs associated with the acquisition, financing, operation, and maintenance of its assets (more especially aircraft) are critical for the airline's success. Airlines have no more room for mistakes. (IATA Economic Performance of the Airline Industry, 2020).

This same aims to provides general guidelines to address the key factors in the aircraft acquisition field, including but not limited to financing costs, such as interest rates, lease rate factor, maintenance reserves, and redelivery costs.

Problem Statement

Demand for air transportation is highly impacted by the economic cycles of peaks and lows, being provoked by external causes such as the oil supply crisis and terrorism or internal causes, such as investment, supply & demand, and others (Lenoir, 1998). In contrast, the ability of airlines to acquire and/or dispose of an aircraft is historically limited by different factors.

Usually, macroeconomics factors are intimately correlated with higher demand for air transportation. As a result, and driven by optimism, airlines accelerate their expansion and fleet renewal plans. A key aspect of fleet management and planning is related to the

redelivery costs, which will also be analyzed in this capstone as these expenses can be very costly to airlines. According to Vasigh, Taleghani, and Jenkins (2012), "choosing the correct aircraft is crucial to ensuring reliable and profitable operations”.

Given the long-term length of a fleet decision, combined with the high level of impact in the balance sheet and cash flow, airlines have been developing a wide set of models. Such models allow them to understand and measure financial and operational impact using different equipment. In accordance with aircraft leasing specialists:

The redelivery process is the leasing contract's closure when the asset is transferred back to the lessor. All the agreed Redelivery Conditions when the contract was first signed have been met.

Attributes such as aircraft prices, operating costs, revenue estimates, the ability to generate ticket and non-ticket sales, and various specifications (payload, range, speed, and fuel efficiency) are key factors. (Vasigh & Taleghani & Jenkins, 2012). These factors play key roles in the aircraft fleet type and financing selection process. Additionally, exogenous factors such as macroeconomic environment (Gross Domestic Product (GDP), Inflation, Interest Rates, fuel price, etc.), population growth, air transport liberalization, privatizations, regulations, legal environment are important elements to be taken into account while measuring risks and the volatility of projected cash flows. (Vasigh & Taleghani & Jenkins, 2012).

While selecting an aircraft, airlines usually obtain data from the respective manufacturer. This information can contain different levels of aggressive assumptions, thus providing bias to the modeling exercise. The sensitivity matrix parameters have a consistent analytical policy to determine the best option to be selected.

The lack of consistency in aircraft selection criteria can cause several operational and financial risks for the airline. Usually, the aircraft selection is divided into two main segments: Operating and Financing metrics. These metrics bundled together are mainly responsible for the airline's management decision.

Aircraft compose a significant part of an airline's business cost. These costs include Operational Expenditures (OPEX), such as fuel consumption, maintenance, landing and navigation fees, and crew. Additional related costs can involve Capital Expenditures (CAPEX), such as significant components shop visits, overhauls, pre-delivery payments, and spare parts acquisitions.

Making the correct decision on the fleet financing structure is crucial for airlines. That can quickly become the "make or break" choice that can pivot an airline between success or demise.

Undoubtedly, it is widely held based on finance reviews among aviation industry leaders that aircraft and engines are the most expensive and complex assets to manage within any airline or leasing company portfolio. Therefore, it is imperative to understand the variety and nuances of the numerous sources of aviation asset financing available in the market. Also to be evaluated are the combined side effects within the airline capital structure. Critical to such analyses are the future cash flows of each aircraft decision and their respective acquisition structures.

Contributing to an airline's financially sound business plan in the future is having a robust and comprehensive fleet policy in place. Other macro decision factors and best practices involving the fleet selection process are:

- Deciding which markets the airline plans to focus on.

- Evaluating which aircraft type would be more adequate for the airline to deploy on the markets served.
- Estimating the planned overall growth of the firm for the next 5 and 10 years.
- Appraising asset financing figures, debt versus equity, and acquisition structures.
- Preparing aircraft sourcing requests for proposal.
- Developing an analytical model to evaluate responses to the aircraft sourcing request for proposal on an "apples-to-apples" basis.
- Evaluating and comparing the economic, technical, operational, and commercial terms and conditions of each response to the aircraft sourcing request for proposal by means of performing detailed structuring, negotiating, and analytical support.
- Arranging meetings with prospective financing parties to present the credit and financing program.
- Supporting your organization with responding to due diligence inquiries for a request for proposal respondents.
- Developing management reports and presentations, including but not limited to the business case support and recommendations with supporting analysis, as necessary.
- Negotiating the various transaction documentation and managing the documentation and closing process.

The base factors above are crucial for an adequate fleet planning kick-off in the macro environment of a company and all of its idiosyncrasies with the numerous

consequences in pretty much every single department of an airline. According to Vitaly S. Guzhva, Sunder Raghavan and Damon J. D' Agostino, "Where should fleet planning fit in a corporate environment? Fleet planning brings together multiple functions of an airline or lessor to decide on the best aircraft and quantities to acquire. Each function must work together in order to find the most appropriate option". (Vitaly S. Guzhva, Sunder Raghavan and Damon J. D' Agostino, 2019).

Purpose of Statement

This research intends to:

- Identify and explore the most common sources of aircraft financing structure available in the market for airlines.
- Provide a comprehensive guideline for aircraft financing structure evaluation along with modeling examples.

The research's focus will be to establish an overarching aircraft financing source selection for airlines' management usage. The reader will find in this capstone a multidisciplinary approach of the most significant factors to be considered while planning to address fleet financing within the airline perspective.

In order to reach the goal, hypothetical and public market data will be used to feed the empirical model developed by the authors by using the best of the knowledge acquired by more than fifteen years of combined inexperience in the field of fleet planning and management.

Project Goals and Scope

This capstone should allow the reader to develop a comprehensive analysis towards the financing evaluation of an aircraft to be operated by an airline by means of using correct

criteria and parameters. Consequently, the airline will benefit from having significant competitive advantages from a financial perspective. In other terms, this capstone will have the potential to serve as an effective tool for aeronautical operators to analyze aircraft financing to take strategic choices based on pre-determined parameters.

The core idea behind the capstone is to allow the reader to be more efficient towards the decision-making process of aircraft financing structure. The intend is to educate as to which are the real upsides and downsides are in the presented structures and provide sufficient leverages to perform activities in complete alignment with the organization's goals and needs in terms of cash flow and capital structure. This study will also elaborate on the topics involving aircraft selection and aircraft financing decisions and describing the main structures and also, operating and financing leases, and identifying advantages and disadvantages, and intricacies.

Research Questions

This research seeks to answer the following questions:

- What are the ground rules for aircraft financing structure criteria?
- What are the most critical factors that drive the decision towards a financing structure for an aircraft?
- How to evaluate the risk of exogenous factors within the decision matrix of a specific aircraft financing structure?

Definitions of Terms

CAPEX are funds used by a company to acquire, upgrade, and maintain physical assets such as property, plants,

	buildings, technology, or equipment. CapEx is often used to undertake new projects or investments by a company.
Financing costs	mean the costs usually incurred by a certain person and/or entity who is borrowing funds from a certain person and/or entity who is lending such funds and, in turn, receiving monies in return for the risk associated with lending such funds.
Lease rate factor	is the usual equivalent of a payment which one is required to make when an asset is taken under a lease agreement. Most of the time, it is expressed as a percentage of the total price of the equipment which has been leased.
Loan to value	represents a measure of risk used by lenders when deciding how large of a loan to approve.
Maintenance reserves	stand for the funds usually collected by the lessor during the term of the lease of an asset to cover the costs associated with such asset assumed maintenance events.
OPEX	which stands for operating expenses or expenditure refers to the costs incurred by your business via the production of goods and services.
Redelivery costs	stand for the costs associated with the process of return of a certain asset by the person and or entity who has leased such asset to the person and/or entity to whom such asset belongs at the end of the lease agreement agreed term.

List of Acronyms

AFIC	Aircraft Finance Insurance Consortium
ASU	Aircraft Sector Understanding
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditures
CASK	Cost of Available Seat-Kilometer
DOL	Direct Operating Leases
ECA	Export Credit Agency
EETC	Enhanced Equipment Trust Certificate
GDP	Gross Domestic Product
IFRS16	International Financial Reporting Standards
LCC	Low-Cost Carriers
LTV	Loan to Value
LIBOR	London Interbank Offered Rate
MCS	Monte Carlo Simulation,
NPV	Net Present Value
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditures
PDP	Pre-Delivery Payments
PMA	Parts Manufacturer Approval
RASK	Revenue per Available Seat-Kilometer

SLB	Sale & Lease Back
WACC	Weighted Average Cost of Capital

Plan of Study

This study contemplates a general analytical approach for the main drivers and elements involved in the aircraft financing structure for airlines. While deciding the best structure, the airline's management has to be aware not only of the advantages and disadvantages but also the risk involved in any decision.

As a walk-through for the reader, Chapter One comprises the introduction of the study, from which, amongst other topics, encompasses the main purpose of the study, the project goals, and the intended approach and scope of the theme. In other words, the first chapter aims to offer the reader a simplified roadmap containing material elements to subsidize a proper analysis during a decision-making process.

In Chapter Two, the reader will find the Literature Review, where relevant literature in connection with the scope of this study will be presented and further detailed by the authors. Moreover, the idea of Chapter Two is to academically sustain the ideas, concepts, and tools available and considered in the study.

Chapter Three will present the Research Methodology used by authors while constructing the main guidelines hereby offered to the reader. In the Research Methodology section, the academic process and tools developed by the authors are described in detail. The research design is also presented along with all the relevant data required to perform the study, mathematical techniques, and sensitivity analysis.

Chapter Four, the effective results of the qualitative and quantitative approach considered in Chapter Three will be presented, as well as all the outcomes of the financial model developed by authors commented in detail, and also linked with all relevant literature reviews performed in Chapter Two.

Finally, in Chapter Five, the reader will identify the conclusions and recommendations derived from the discussions, implications, and modeling performed by the authors in the previous chapters. Such conclusions include but are not limited to theoretical and practice implications to the aviation industry of aircraft financing decisions, consequences, and obstacles of the study to be further explored. Most important, in Chapter Five, the reader will find the recommendations from the authors for the reader while developing their professional activities in aviation.

Chapter II

Review of Literature

Undoubtedly aircraft are the most expensive and complex assets to manage within an airline, thus becoming imperative to understand not only the many different sources of financing available in the market but also the side effects towards the airline capital structure (Flight Global, 2021). By addressing properly, the fleet decisions, it is less likely that the airline will jeopardize its business plan. Although by financing an aircraft, the tendency is to see the aircraft as a liability, there is a big piece of the transaction that also plays a key role within the business, the equity building (for the non-operating leasing fleet). That being said, it will discuss the macro decisions that should be addressed in order to optimize a portfolio of aircraft.

The literature review is essentially comprised of three evaluation processes that are fundamental for aircraft selection within the airline management subject-matter – at a minimum: macroeconomic factors, technical/operational factors, and financial/commercial factors. These three segments are imperative for aircraft selection criteria, although the goal of this study is focused on developing a comprehensive approach on the financial/commercial factors for aircraft selection.

It is a common practice that the most accurate technique to evaluate aircraft selection is cash-based, and the most used element to compare aircraft in terms of economic performance is still the direct operating cost (DOC). (Gibson & Morrell, 2004).

An early study administered by Christopher Colin New evaluated different types of airline fleet planning & management, including budget constraints, technology development, etc. (New, 1975). Other articles also include discussing the development of

a statistical model for auxiliary airlines to address fleet-related problems, such as lease versus buy. Hsu et al. (2011).

Commercial, Financial, and Contractual Aspects

Per Chen, Huang, and Ardiansyah (2018), aircraft acquisitions are responsible for enormous financial pressure on airlines, due not only to the large down payments and loan repayments but also non-cash costs, such as depreciation. In addition to that, there are several leasing structures available in the market. New types are also being developed. Therefore, it is important for airlines to consider all sources of aircraft financing available.

Whichever, among so many, the method of financing the aircraft, in a general approach, every structure will be considered either an operating lease or a capital lease. Endorsing the hypothesis about the crucial method for Fleet Selection.

The next diagram provides a general diagram, contemplating all variables involved for both operating and capital leases. Structuring Aircraft Financing Transactions (2019).

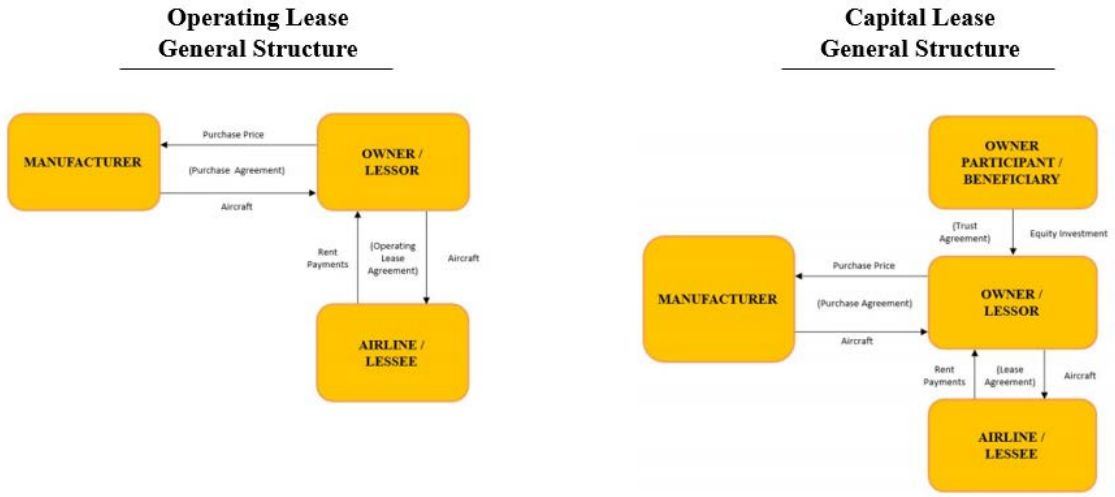

Figure 1. – Diagram for both operating and capital leases. Structuring Aircraft Financing Transactions (2019).

Innumerous intricacies are related to lease agreements, both involving commercial and financial aspects. Graham and Harvey (2001) found by means of surveys that financial managers are highly likely to analyze investments through Discounted Cash flows (DFC) techniques, for example, Internal Rate of Return (IRR) or Net Present Value (NPV).

In analyzing investments by the Net Present Value concept, companies have to take into consideration various criteria:

- Up-front investment.
- Operating cash flow (inflows and outflows).
- Financing cash flow (debt related to the aircraft).
- Residual value risk and investment to return aircraft to lessors. (Graham & Harvey, 2001).

Concurrently, Gibson and Morrell (2004) have attested that the Weighted Average Cost of Capital (WACC) is the most common rate used by managers for estimating the NPV of an aircraft's cash flow.

According to IATA (2017), the number of aircraft operating leases represented less than 5% of the total aircraft market in the 1980s. However, this number is growing

significantly. The percentage is expected to climb to more than 50% of the total market in the next years.

Airlines are willing to take advantage of various operating lease structures, such as:

-The transfer of residual value risk to another party.

-The up-front and acquisition cost, and.

-The ability to add aircraft into the fleet for a convenient period of time.

Still, according to IATA (2017), a complicated process is characteristically to generate a leasing contract that satisfies both the airline and the lessor.

Operational and Technical Aspects

According to FAA (2018) operating costs are generally divided into direct and indirect costs. Direct operating costs are related to the flight operation itself, such as oil, fuel, maintenance, and crew. The indirect operational costs are the other operating expenses, such as the depreciation, cost of ground equipment, and administrative costs.

Dupuy et al. (2011) stated that direct maintenance costs account for 11% of the total operating costs of an aircraft. In addition, according to IATA (2013), fuel and oil represent around 33% of the total airline costs. Also, FAA (2018) states that direct costs are around 48% of total costs for major passenger air carriers and 35% for cargo.

Per Tseco Mofokeng (2020), aircraft maintenance is required to keep its airworthiness, minimize its physical deterioration and related failure costs, and assure reliability in order to generate revenue. Maintenance tasks are performed for safety, operational, and economic reasons. They involve both preventive maintenance and failure-finding tasks. Brian McLoughin (2006) reinforces that scheduled maintenance programs

should be regularly analyzed for improvements to maintain safety and reliability and to achieve cost efficiency.

The most common aircraft maintenance services include A-checks, C-checks, D-checks, and routine checks**.** These checks are part of an approved aircraft maintenance program. Based on the assertions from Guzvha et al. (2018), all maintenance events are combined to form a program specific to each component and aircraft. This process is recorded using a maintenance planning document, which contains all MRBR minimum standards as well as any additional mandates for scheduled events.

The A-checks are biweekly to monthly. They consist of visual checks, operational tests, basic lubrication, and oil servicing. Such checks are normally done overnight. The C-Checks include operational and functional systems checks, cleaning and servicing of the aircraft systems, and some minor structural inspections. They are performed every 12 to 20 months, depending on the aircraft type. Finally, the D-check includes paint stripping and components check, repair or overhaul, removal of panels, detailed inspection of airframe, engines, and landing gears. The checks on mostly structurally significant items require service every 6 to 12 years. They also depend on aircraft type and its usage. In addition to that, also per Guzvha et al. (2018), for example, a program for the B737-800 might state a C-Check interval of 20 months. This means that operators must perform a C-Check every 20 months, regardless of whether it is operated or not. Likewise, other components have specially mandated maintenance intervals.

A cost breakdown from IATA (2018) shows that 42% of the aircraft maintenance costs involve engine overhauls and 23% with C and D-Checks.

The differences in intervals and requirements in a maintenance program impact the total operational cost of the aircraft. For example, Boeing (2006) states that the 787-8 airplane has 30% lower airframe maintenance costs than any actual comparable product due to some material and design solutions.

Moreover, per Eren Baharozu, Gurkan Soykan, and Baris Ozerden (2017), the importance of aircraft fuel efficiency has increased due to high fuel prices and pressures to address environmental concerns. Aircraft emissions have caused around 3% of all CO2 emissions worldwide. It is reported that 80% of the 3% of CO2 emissions come from civil aviation, in accordance with Eren Baharozu, Gurkan Soykan, and Baris Ozerden (2017). In addition, Hu Rong, Xiao Y-bin, Jiang, and Changmin (2018) state that air travel accounts for up to 9% of the total climate change impact. Air travel-related CO2 emissions have increased 83% over the past 15 years.

The aircraft type can contribute to a good deal of fuel efficiency. In line with an interesting article on fuel efficiency in the aviation industry Mrazova (2020), by gradually incorporating advanced technology, airlines have made impressive fuel efficiency improvements on their fleets. Each new aircraft generation brings a step-change in technology. New-generation aircraft planned by 2020 is expected to reduce fuel burn and carbon emissions by 25 – to 35 % compared to the aircraft they will replace just by using new technologies. On the other hand, we have to realize that operational performance is responsible for up to 10% of airborne fuel consumption. Also, planning for operational performance degradation incurs a fuel cost; however, this fuel cost is significantly less than the fuel consumed if the delay were not anticipated. Mentioned example in this chapter

may help to understand the relationship between schedule padding and airborne delay from a fuel consumption perspective.

In any case, the selected technologies must demonstrate environmental benefits under operational conditions. It is necessary that manufacturers and airliners work together on technologies to achieve this goal.

The volatile price of fuel is a key driver to reduce fuel burn, reduce emissions and reduce costs. While optimizing future efficiencies, safety must always be the first priority. Hence, all new technologies must be rigorously evaluated for their safety implications.

For example, Airbus (2020) stated that the new wingtips design for the A320 NEO, called sharklet, allowed increasing fuel efficiency by a factor of around 7% when compared to the A320 CEO, and the new engine brings another additional efficiency of 13%.

The FAA "Economic Values for Investment and Regulatory Decisions" has the table below for Group III 121 Air Carrier, with an average of direct and indirect costs:

Cost Group	Cost Type	Passenger			All-Cargo		
		Cost (millions)	Share of Cost	Cost per Block Hour	Cost (millions)	Share of Cost	Cost per Block Hour
Direct	Aircraft Operating Expense	$79,305.1	48%	$4,250	$15,802.1	35%	$10,155
	Subtotal Direct Expenses	**$79,305.1**	**48%**	**$4,250**	**$15,802.1**	**35%**	**$10,155**
Indirect	Advertising and Promotion Expenses	$1,454.5	1%	$78	$109.9	0%	$71
	Aircraft Servicing Expenses	$9,713.5	6%	$521	$1,797.8	4%	$1,155
	Amortization (non-flight equipment)	$486.2	0%	$26	$14.6	0%	$9
	Depreciation Expense - Maintenance Equipment	$53.2	0%	$3	$169.9	0%	$109
	General and Administrative Expense	$15,055.7	9%	$807	$3,121.5	7%	$2,006
	Maintenance and Depreciation (ground equipment)	$3,128.0	2%	$168	$625.0	1%	$402
	Passenger Service Expenses	$13,743.0	8%	$736	$60.5	0%	$39
	Reservations and Sales Expenses	$7,913.8	5%	$424	$336.0	1%	$216
	Traffic Servicing Expenses	$14,035.2	8%	$752	$2,833.7	6%	$1,821
	Subtotal Service, Sales, and General Operating Expenses	**$65,583.1**	**39%**	**$3,515**	**$9,068.9**	**20%**	**$5,828**
	Transport Related Expenses	$21,492.6	13%	$1,152	$19,855.3	44%	$12,760
	Subtotal Indirect Expenses	**$87,075.7**	**52%**	**$4,666**	**$28,924.2**	**65%**	**$18,588**
Total Operating Expenses		**$166,380.8**	**100%**	**$8,916**	**$44,726.3**	**100%**	**$28,744**

Table 1. General Operating Costs for an Airline According to IATA (2018)

Business Strategy and Macroeconomic Aspects

It is critical to consider a business strategy when the discussion is focused on fleet selection for the long term. Since 1970 the airline market has suffered from two great crises, one in the 80s and another in the 90s. The current global business recession and Covid-19 have not been included in the analysis.COVID-19. (Liehr & Größler & Klein, 2001).The chart below demonstrates the total profit overall for airlines from 1970–1997 (IATA World Air Transport, n.d.)

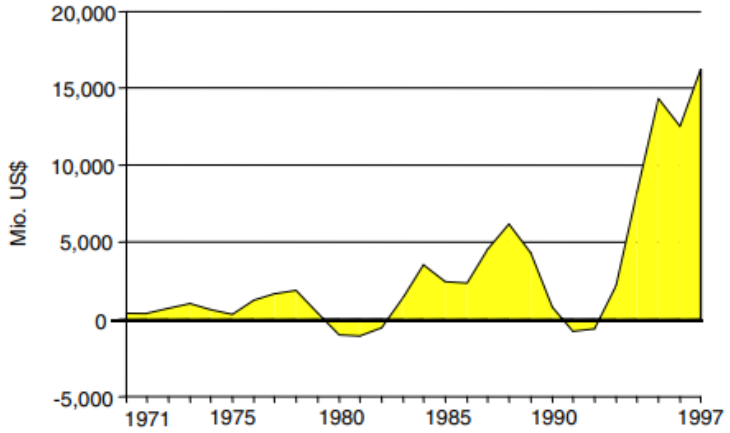

Figure 2. – Airlines profit worldwide from 1970 to 1997

It's is easier to understand these cycles when focusing the analysis on the factor that transform some strategies of the Arline Market into success. The service offered to the customers is the basic product of the airline market. There is a very significant variable that counts a lot for the negative impact on the airline market, the impossibility to produce on the stock. The graph below shows us the considerable gap that there is between some ordered aircraft and the shipped ones. (Liehr & Größler & Klein, 2001).

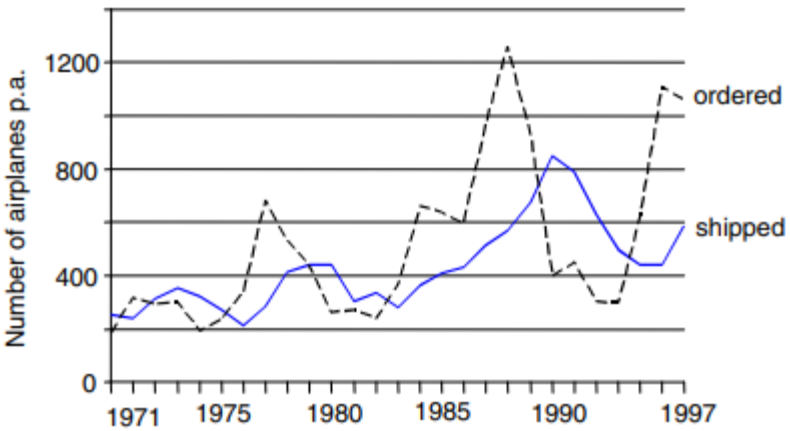

Figure 3. – Correlation between aircraft on order and aircraft delivered

The large number of macro and micro variables that can significantly impact the viability of an airline makes the process of selecting a certain fleet type invariably complex and utterly important.

All the above-referenced topics must be taken into consideration in order to allow for the possibility of optimization transactions. These topics could be guiding airlines to a potentially profitable and sustainable scenario as one of the consequences of making the most appropriate fleet acquisition decision. Furthermore and, in accordance with Taneja (2021), aircraft selection is incredibly risky because the wrong decisions can mean the downfall of a firm. The wrong fleet, in the best case, can greatly impede the profitability of an airline or lessor, and in the worst case, it can lead to bankruptcy.

On the other side of this decision-making and fast-paced fleet type selection game, there are strategies adopted by other significant players that can be very interesting for the purposes of this study, such as aircraft manufacturers. Amongst other variables, demand-

management strategies have largely assisted aircraft manufacturers in better managing short-term macroeconomic fluctuations and disruptions to their production process.

Manufacturers' production plans take into account the airlines' fleet-planning processes, which typically cover 15 to 20 years in time. This is the opposite of the short-term fluctuations in macroeconomic variables such as fuel price, interest rates, or exchange rates. Moreover, over time there has been a significant change in aircraft manufacturing business models.

That in many ways is adapted or learned from their customers. Airlines have long realized that their seats are a perishable product. The best way to fill them is to oversell, the so-called "over-book." The manufacturers have started following a similar type of production-management process. This is where they sell more than their planned production because they know that historically, based on many market fluctuation elements, some customers will most likely cancel or at least defer their respective orders. (Guzvha et al., 2018).

This production-management process has helped manufacturers create the needed flexibility to shift different customers and keep their production rates fairly consistent. In terms of productivity in aircraft manufacturing, the aircraft manufacturing industry is characterized by large capital requirements (Kronemer and Edwin Henneberger, 1993).

Second, airlines have started ordering aircraft on a much longer horizon. In general lines, airline backlogs are becoming longer and longer, and aircraft order backlogs were 2-3 years. Nowadays, it is not unusual to have 6 to 8 years of airline's aircraft backlogs. For

obvious reasons, this dynamic helps dampen the cyclicality of the aircraft production market, whether it is political or economic turmoil that causes volatility.

Finally, another important dynamic, which has helped smooth out the demand and the production for aircraft, has been the diversification in airline business models. As recently as 2001, the vast majority of the traffic was carried by "network carriers," such as Lufthansa, United Airlines, and Delta, with regional networks and global international connections.

The airline industry is a diverse sector, requiring the support of a varied range of ancillary businesses such as maintenance, catering, and travel agencies to carry out its activities.

Corporate diversification within the airline business has a long history. Many of the first airlines were initiated as related sub ventures by existing transport-focused organizations. (Redpath N, O'Connell J.F and Warnock-Smith, 2017).

The proliferation of the Low-Cost Carriers (LCC), such as Ryanair, Easyjet, and others, in the early 2000s, led to the diversification of the business model where both the "network carriers" and the LCCs have coexisted. This diversified business model has helped smooth the production process. This is because the economic life cycle causes varying peaks and troughs in demand for airlines with differing airline business models (Vitaly S. Guzhva, Sunder Raghavan and Damon J. D' Agostino 2019).

For example, in a weak economy causing network carriers to struggle, the LCCs are countercyclical, and their demand grows as passengers look for cheaper ways to travel.

As the economic environment heals, legacy carriers tend to have better overall performance as the customers will most likely be less price-sensitive, causing an opposite

move on the macro demand for aircraft ((Vitaly S. Guzhva, Sunder Raghavan and Damon J. D' Agostino 2019).

Summary

Chapter Two contemplates a literature review produced for the purposes of this study. Such a literature review contemplates the most significant aspects to be taken into consideration for a proper aircraft type selection process. The above-mentioned aspects are commercial, financial, contractual, operational, and technical. This impacts the business strategy and macroeconomic factors.

The reader will identify in this Chapter several ground rules and significant examples demonstrating the importance of such factors. Also, this chapter highlights and describes the intrinsic relation of all the above-referenced aspects. That will already allow the reader to reach certain conclusions as to how the dynamic of the combination of said aspects can impact – positively or negatively – an airline. Finally, it is important to mention that this chapter reveals the extreme importance of taking a multi-disciplinary approach to any aircraft type selection evaluation.

Chapter III

Methodology

In this chapter, it will be exposed a comparison between a typical operating lease (DOL) and a financing lease via ECA for a given asset, in order to demonstrate the real importance behind the variables that assemble the cash flow of each structure and how sensitive the decision may be based on a few key factors. As the decisions will be based on NPV, it is vital that both options considered in the model provides the same period of duration, otherwise NPV will not work properly.

In Figure 4 it is possible to see the general formula of Net Present Value

NPV Calculated at year end points

$$NPV = \sum_{t=0}^{n} C_t / (1 + D)^n$$

NPV Calculated at mid-year points

$$NPV = \sum_{t=0}^{n} C_t / (1 + D)^{n - 0.5}$$

where,

C_t = Net cash flow over a period of one year,

t = the period of time over which that cash flow occurs,

D = Discount rate (% per annum) and

n = Timespan (number of years) from time now.

Figure 4. – General Net Present Value Formula and Methodology

To set up a cohesive model, the first and most important step is to deeply understand each component of the cash flows being analyzed and its relevance to the NPV result. Per Ramesh (2016), if the project's NPV calculated is positive (or the less negative in case it is only considering cash out flows), the "project" is justified. Then, any mistakes made during the model development phase will be easily identified and rectified. In addition, another key factor that has to be cautiously pondered is the discount rate. Different discount rates may guide the decision towards different solutions, not to mention that the discount rate (Cost of Equity or WACC) will likely vary throughout the years in "real life". Some airlines use the Weighted Average Cost of Capital (WACC) to discount cash flows. Here

a different approach was used, as the equity can be provided by a bond for example and consequently the premium paid by the airline to the bondholders would be the cost of equity in this case, therefore each case has to be analyzed. Gibson and Morrell (2004), states that when using WACC the result tends to be more favorable to leasing due to the large up-front investment in purchasing.

In Figure 5 it is shown the assumptions considered to develop an Operating vs. Capital Lease model. All the pricing assumptions were taken out with the exclusive intention of generating a scenario where the application of the concepts may be seen in a more didactic way.

Base Assumptions	Financing Lease (ECA)	Operating Lease (DOL)
• Study Discount Rate: 10,00% p.a.	• Loan-To-Value: 85,00%	• Contract Term: 144 Months
• Aircraft: Boeing 737-MAX 8	• Contract Term: 144 Months	• Purchase Price: US$ 50M[1]
• Estimated Delivery Date: Jan-18	• Amortization: Straight-Line	• Basic Rent: US$ 380.000,00 p.m.
• Aircraft Market Price: US$ 51M	• Payment Periodicity: Monthly	• Assumed SWAP 9Y: 2,10%
• Aircraft Net Cost: US$ 49M	• Balloon: No	• SWAP 9Y @ Delivery: 2,25%
• Residual Value @ Year 12: 40%	• Margin: 3,50% p.a.	• N Adjustment: 1.400,00
• Utilization p.a.: 300FH/177FC	• LIBOR: 01M	• (E) Final Rent: 401.000,00 p.m.
	• Interest Calculation: 30/360	• Security Deposit: 2x Final Rent
	• Up-front Fee: 0,00%	• Maintenance Reserves: No
	• Commitment Fee: 0,00%	• End of Lease Adjustment: Yes/New
	• Agency Fee: US$ 5.000,00 p.a.	• EOL Rates: Eng PR: US$ 148,84 per FH Eng LLP: US$ 179,00 per FC LDG: US$ 3969,00 per Month AF 9Y: US$ 11.364,00 per Month AF 12Y: US$ 6993,00 per Month AF 15Y: US$ 7426,00 per Month
	• ASU Premium: 6,00%	
	• Cost of Equity: 5,00% p.a.	

Figure 5. – Main assumptions responsible for drive the economic model

In order to clarify to the reader, below it is observed the concept of each line that were considered in the modeling:

Discount Rate: The interest rate used to discount future cash-flows. In this case, express the time-value of money.

Aircraft Market Price: Price determined by market conditions, in other others, the actual price manufacturers, lenders and airlines are negotiating the aircraft.

Aircraft Net Cost: Price determined by the Purchase Agreement between the Airline and the Manufacturer.

Residual Value: The estimated value of a fixed asset at the end of its lease term or useful life. In this study, it was considered a depreciation curve of the “Blue Book”.

Utilization: The ration between the hours flew by the aircraft and the cycles performed by the aircraft, where the cycle is comprised by a take-off and a landing.

Loan-to-Value: The ratio of the loan compared to the aircraft value.

Balloon: A balloon loan is a type of loan that does not fully amortize over its term. Since it is not fully amortized, a balloon payment is required at the end of the term to repay the remaining principal balance of the loan.

Up-front Fee: A fee that the lender charges in advance based in a percentage of the total loan value.

Agency Fee: Fees required to pay legal and minor transaction costs over the period of the loan

Security Deposit: A deposit required by lessors as a condition precedent for the lease that can be offset in the end of the lease towards remaining payments due by the lessee to the lessor.

End of Lease (EOL) Rates: Rates to be considered in the redelivery of the aircraft in order to bring the aircraft back to contractual level of maintenance and conditions.

It is important to do a couple of “stress-tests” before going further, to assure that all the logics behind the numbers are working properly. With that, the second step would be generating a Present Value Curve Comparison between both structures analyzed, then it is easier to observe not only where the shift(s) between the proposals is/are located (if

applicable) but also the upsides and downsides of each structure and the amplitudes (Figure 6). By knowing where the downsides are, becomes easier to negotiate an agreement aiming the maximization of the deal.

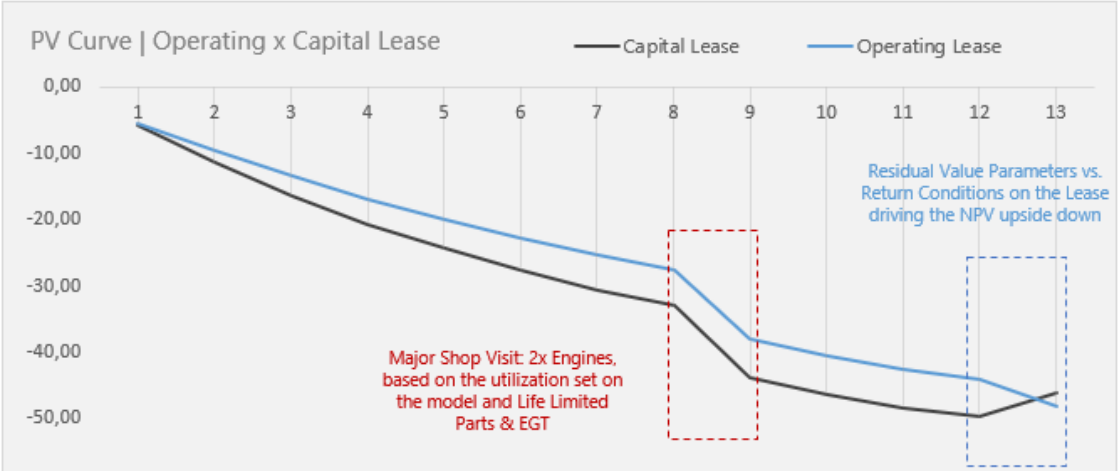

Figure 6. – Present Value Curve for the two leasing structures presented by authors

The third step in the analysis is to set up the first sensitive matrix to support the decision. This is the first time we will see and measure different scenarios that may happen with the deal along the contract term.

By analyzing different scenarios, it is known that the most sensitive components of the cash flows are: Discount Rate and Aircraft Utilization for the General Assumptions; LTV, Interest Rate and Residual Value for the Financing Lease and Adjusted Rent and Maintenance Reserves for the Operating Lease. Acknowledging that fact, it will be illustrated below three possible matrices that gives the manager a good view of the deal.

In the elaboration process towards accurate fleet planning for an airline, certain key decisions must be consistently taken in accordance with the business model in place. This will trigger or limit a bunch of other actions, including expectations for growth, inventory level requirement, crew headcount, etc. How to finance the fleet expansion and, eventually,

its renewal will be an essential piece of the discussions also. Among the main macro decision that must be addressed by the Fleet Department, it is worth it to highlight the following ones:

- The appropriate equipment(s) for the intended market(s);
- Number of aircraft, Fleet Compound Annual Growth Rate (CAGR), and leverages to manage capacity management;
- The fleet financing structure, which will support its expansion and eventually its renewal

In this research study, the focus will be kept in a shred of the third point raised above. That is where it will first be reviewed through the particularities usually observed on capital and operating lease agreements. Then, discourse about the pros and cons of each structure in the airline standing point will follow. Last but not least, this study will demonstrate in a didactic way the Present Net Value (NPV) approach together with a sensitivity analysis, including but not limited to Monte Carlo Simulation.

Background

The growth observed in commercial aviation in the last 50 years has been characterized by a notorious cycle of asynchronism between offer and demand for seats. This can be explained by, among other things, the lead time mismatch between the changes in the macroeconomic environment and the ability of the industry to react to it. (Vasigh et al., 2008).

Usually, periods of macroeconomic tailwinds are intimately correlated with high demand for seats and, driven by optimism, and airlines put their expansion and fleet

renewal plans in motion. That can be easily detected through new and/or incremental purchase agreements with OEMs and/or additional lease agreements with lessors.

Airlines typically enter into purchase agreements with OEMs to guarantee a certain number of aircraft deliveries per year and, thus, assuring their fleet renewal and/or expansion. The punctual lease agreements, on the other hand, are often used as a manner to respond to high demand in the short term without obligations that drain off the airline's cash flow. Usually, new aircraft models are responsible for the airline's desire to renew its fleet, mainly driven by the fact that new technologies are designed to burn less fuel, produce less noise to the customer and also have an environment appeal by issuing less CO2. The problem lays in the fact that airlines and manufacturers have long delivery streams. Eventually, some of the aircraft in the order book will be delivered when the airline is experiencing demand contraction or when financials are not favorable.

The economic cycles not only affect the industry in terms of demand for seats (revenue side) but also plays a very important role in the financials of an airline (cost side). It is not rare to see an airline struggling to address the finance of an aircraft during liquidity shortage periods. The airline business itself presents a higher leveraged beta when compared to many other industries. It is worth it to mention also that the volatility of oil price, which is another exogenous variable for the airline. It plays a very strategic role in the decision of whether or not to renew the fleet and also in the pricing of a transaction as it changes the value of an asset. These are a couple of examples that demonstrate how volatile the scenario can be, consequently, how important it is to understand all the risks the airline is assuming by deciding the "when" move towards new technology and "how" to finance the fleet renewal (Vasigh et al., 2008).

While operating lease agreements usually have their rent payments fixed on the delivery date of the aircraft, capital leases have their interest rates usually reset monthly or quarterly based on London Interbank Offered Rate (LIBOR). Both add a component of uncertainty and exposure to embedded derivatives. In addition to that, to analyze new investments, the airline usually uses its cost of equity or its weighted average cost of capital (WACC) to discount future cash flows, and both rates are usually very volatile. These facts can easily explain why a robust fleet department has to be developed and followed. The greatest challenge in the industry is to deal with unexpected shocks and a high level of unforeseeability.

Although it is not the scope here, it is important to mention that commercial airplane manufacturers are creating a very interesting paradox. They are competing inexhaustible to increase their production ratios, fighting for each ten basis points of market share. On the other hand, they are creating a huge side effect by putting their current assets' market value in jeopardy since the high volume of new deliveries is flooding the market. It is becoming clear that the airlines are struggling to absorb it for many reasons, from the lack of space to grow at such a large pace to the lack of cash to return airplanes and replace them with new ones. To drive this interesting discussion, we will be considered the microeconomic law of diminishing marginal utility.

Given that we are living in a very competitive world, there is an intangible value in responding to the market seasonality and particularities rapidly. In this context, leasing companies are becoming more essential to airlines as it represents opportunities to increase capacity in the short term with less capital expenditure – No obligations related to Pre-Delivery Payments, for example.

Although both players (lessors and airlines) are dealing with the same asset, there is a gigantic difference in how each of the values it. In the airline standing point, an aircraft value is measured by its ability to generate profit throughout its useful life or leasing agreement period. On the revenue side, exogenous factors represent a risk for the modeling as the macroeconomic environment plays an important role in key quantitative variables such as load factors, RPK, and yield. On the cost side, it is often seen a more predictable cash flow for airlines in the maintenance field as the major components are controlled by calendar, hours, or cycles. However, the oil price is also affected by exogenous factors and thus adding a considerable level of uncertainty/risk to model the total cost of operating the aircraft. In addition to that, other elements are responsible for drive the aircraft value, such as the flexibility of the equipment assumes different missions, commonality with the current fleet of the airline, dispatch reliability, average speed, and historical levels of liquidity.

On the other hand, leasing companies and aircraft investors have a more straightforward view of the same asset. According to Ackert (2012), the value of an aircraft is measured by the expected cash flows from lease income and eventual capital gains resulting from the sale of the aircraft at a certain point in time. The risk factors for investors are also different when compared with airlines as it lies basically on the residual value of the aircraft and the chance of facing a default from an airline. Thus, as an investor, portfolio diversification is one of the more important strategies to be adopted, mix risky assets with consolidated ones, such as the Boeing 737 and Airbus A320 to address the residual value matter and geographic/business model asset allocation to address the chances of facing insolvency of a customer. (Guzhva et al.,2018).

In summary, it is vital for investors to develop credit risk and residual value risk policy in order to guide the process of allocation and management of their portfolios throughout the years. Also, it is vital for airlines to come up with a comprehensive fleet policy that is closely related to the long term strategy of the company, addressing important issues such as an acceptable level of flexibility to add or cut capacity during unstable periods and also build equity in order to help the airline overcome harsh periods where aircraft sale may be leverage.

It is well known that investors have historically been more successful in dealing with portfolio management than airlines. It might be explained by the simple fact that this is their core business, and they have almost no distractions to deal with while the airline's core business is to transport passengers and cargo, not to mention the usual fire drills that come up on a daily basis.

Introduction to the main sources of aircraft finance

There are plenty of sources, structures, and players available in the market to finance aircraft. However, we can separate all of them into two main general structures: Operating Lease and Capital/Finance Lease. There is no thumb rule to weigh the mix of structures within the company balance sheet as the maximization of capital structure is not static (it depends on the cost of equity of each company and many other factors).

However, it is clear that strong airlines have more aircraft owned or on capital lease structures than operating leases, while airlines operating in harsh macroeconomic environments and/or with weak balance sheets have the vast majority of their fleet under operating leases. (Guzhva et al.,2018).

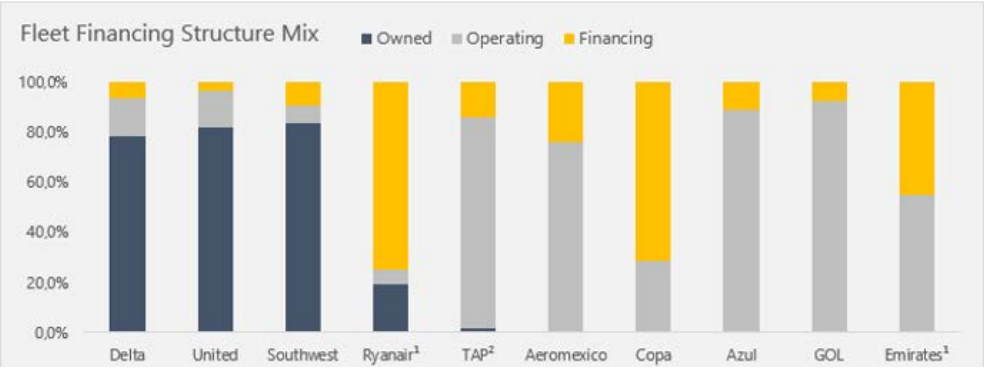

Figure 7. – Owned x Operating x Financing Leases per airline data – 1Q-2019¡ and 3Q2019[2]

Moreover, airlines that present a high fleet average age tend to present a higher exposure to owned/financed assets, while low-cost carriers and airlines that have a lower fleet average age usually have higher exposure to operating leases. That can be explained among other factors, by two issues:

- Airlines with strong balance sheets can raise funds at very competitive rates and have enough volume to manage/dilute aircraft residual value risk. It becomes more competitive than pay for return conditions and the premium embedded on the rent by the lessors;
- Usually, the operating leases, mainly the sale & leaseback transactions, provide the airline with short-term liquidity. It is crucial to companies with weaker balance sheets and depreciated credit grades, thus becoming very attractive regardless of the premium embedded in the rent.

In addition to that, there is an important piece in the aircraft finance business called Pre-Delivery Payments (PDP). The PDPs are not exclusively seen in the capital leases, and they can be due also on operating leases when the aircraft is originally coming from a purchase agreement between the airline and the OEM. The PDPs are used as a risk

mitigation tool by manufacturers against eventual default/insolvency of its customers during the aircraft production process and usually represent the payment in advance of 30% of the aircraft list price (without any discount the customer might have according to the purchase agreement). In addition to that, PDP finance is seen as a junior loan by investors even though it is financed with an asset as collateral. Thus as a junior loan, the interest rates are higher to compensate the lender for its risk. PDP Financing in Aviation (2020).

Below is brought a brief introduction to the two general structures and their particularities.

Operating Leases

One of the most popular structures around the globe; It has been exponentially growing, mainly driven by the increasing number of Low-Cost Carriers (LCCs) and demand for seats. It is basically a contract where the airline and the lessor agree to, among other commercial terms, a monthly rent payment, the duration of the contract, and the return conditions of the aircraft at the end of the lease. Sometimes the airline has to pay maintenance reserves to the lessor in order to mitigate their risk of having to repossess the asset with very depreciated components.

The pros and cons of the operating lease can be tricky. While theoretically, the airline is getting rid of residual value risks and preserving working capital by avoiding upfront cash payments, the return over capital expenditure (ROIC) of the lessor is embedded on the rent payment, not mentioning the usually expensive "bill" related to the return conditions. This trade-off has to be cautiously analyzed. The establishment has a very strong narrative towards the enormous value in avoiding the risk of assuming the

residual value of an asset but was tended to disagree when it was analyzed the long-term and historically liquid and value retainer assets.

The three sub-structures under Operating Leases to be highlight are:

Sale & Lease Back (SLB). Under an SLB transaction, the airline sells the aircraft from its order book to the future lessee or lessor, who then immediately leases the aircraft back to the airline without any disruption of the aircraft operation. Many reasons might make the airline move towards an SLB agreement. The main ones are:

- It can free a piece of the equity tied up in the aircraft in the short term, usually a very sensitive issue for airlines;
- It is a manner to transfer the ownership risk to another entity, thus avoiding impairments in the future;
- Usually, lessors are able to provide slightly better finance conditions for PDPs when they have an SLB agreement attached;

Prior to IFRS16's implementation on January 1st, 2019, SLB could remove the debt from the airline's balance sheet, which is not valid anymore since the recent implementation of International Financial Reporting Standards.

In contrast, the side effects below can be seen and might drive the airline's decision away from the SLB transaction:

- Limitations to operate the asset – Usually, lease agreements forbid the operator to fly the aircraft under certain territories;
- Less flexibility to manage capacity during harsh environments as it is required previous approval of the lessor to sublease the aircraft to another airline;

- Exposure to non-projected cash flows as the rent is usually adjusted by a or LIBOR in the aircraft delivery date (or a couple of days before).

The risk above is often seen in sale & leaseback transactions where the lessor/investor is financing the PDP of the aircraft as well. The Pre-Delivery Payments are usually due to the OEM 24 months before the scheduled delivery date. PDP Financing in Aviation. (2020).

Although lessors are very strict with rent adjustments, there are a couple of leverages that the airline can fight to include in the agreement to cap their risk of having an adjusted rent completely different from the expectations when the deal was closed. Among these leverages, establish a cap on the delta between the assumed LIBOR rate at closing and share the risk above the cap (when applicable) between lessor and airline usually works. In addition to that, it is important to set the mirror condition wherein case the index rate is below the assumed, the rent will be decreased. This second option might be useful in periods where interest rates are close to zero.

Direct Operating Leases (DOL). There are no structural differences in the lease agreement of a DOL and an SLB transaction. The difference lays in the fact that DOL transactions do not present an additional agreement of purchase & sale agreement as a condition precedent of the lease and a PDP involved.

Although it is not a rule, usually, when the airline goes to the market to look for an aircraft, the commercial terms are more favorable in DOLs than in an SLB transaction. It is mainly driven by the fact that in DOLs, the pressure to find a place to the asset lays with the lessor/investor, not to mention that if the airline looks for a best seller equipment, the competition will help to bring the terms down. That being said, the main advantages of a

DOL differ a bit from SLB transactions, while the side effects might be very much the same.

The discussion between SLB and DOL is intimately related to the value of having a purchase agreement with an OEM.

Whereas having a big order book with an OEM put pressure on the airline to address the PDPs and absorb new aircraft even in periods which this is not recommended, having any aircraft on order with an OEM take away the airline's ability to seize the relationship to leverage other subjects, such as a more tailored customer service, that brings intangible value for operations in a daily basis.

Wet Leases. A wet lease is where the lessor keeps operational control of the aircraft, operates flights for the airline, provides crew for the flights, maintains and ensures the aircraft throughout the entire period of contract. The costs provided by these items are paid by the lessee under the conditions previously set in the agreement. Some regulatory agencies do not allow the airline to provide or engage in wet leases.

In addition to the exposed above, it is worth highlighting that there are a couple of other clauses that might be carefully negotiated by the airline on operating lease transactions, such as the non-payment of maintenance reserves, fair maintenance rates to calculate return conditions along with fair escalation, and the return of the security deposit adjusted by the money value on time during the 10 or 15 years of the contract. All these variables, mainly the payment of maintenance reserves, play a tremendous role in the economics to address aircraft finance.

Capital Leases

The main source of aircraft financing for big airlines with robust balance sheets, capital leases present a bunch of sub-structures available on the market, but in general, the concept is quite straightforward. The cash flow includes an upfront capital expenditure when the loan to value (LTV) of the deal does not cover 100% of the acquisition price, then usually monthly or quarterly amortization and interest payments. It is usual to see other fees included as agency fees, upfront fees, commitment fees, and ASU in case the finance is secured by an Export Credit Agency (ECA).

Financing via Export Credit Agency. It is a very common source of aircraft financing, and its main attractiveness relies on the fact that by having an ECA acting as its guarantor, the foreign airline is able to obtain lower interest rates from banks that are willing to finance the aircraft (i.e., EX-IM in the USA for Boeing, EDC for Bombardier in Canada).

ECAs, like any other government agency, it is subject to fiscal and monetary politics and might not be available every time the airline needs, not to mention that it is not an endless source of guarantee to airlines when negotiating with investors. All the ECAs are obliged to operate under the laws of (Organization for Economic Cooperation and Development) OECD. Thus many commercial conditions and pricing, including the Aircraft Sector Understanding Fee (ASU Fee), do not have too much space to be negotiated.

Enhanced Equipment Trust Certificate (EETC). It is a debt instrument that allows the airline to take possession of and enjoy the use of an aircraft while paying for it over time, like many other financing structures. The debt issued has the aircraft acting as

collateral, and before the end of the debt repayment, the title of the equipment is held in trust for the holders of the issue.

In general, investors supply capital by buying certificates, allowing trust to be set up to purchase assets that are then leased to companies. EETCs are medium to long term debt instruments, and as it is usual to see in financing leases, there is a tax benefit for lessees arising from the fact that while they don't own the title of the asset, they are not required to pay any property taxes (that may change once the title is transferred from the trust to the lessee).

Aircraft Finance Insurance Consortium (AFIC). The AFIC arose when the ECAs were shut down by political decisions, thus affecting Boeing and Airbus's ability to sell aircraft. As a new product to fill this void, AFIC created a non-payment insurance product to provide financing opportunities to airlines and investors interested in Boeing aircraft. Although the structure is quite similar to the ECAs, the guarantee against payment defaults by an airline on the AFIC transaction lays in an insurance policy. The insurance policy is issued by a consortium of insurers. In 2018, Airbus launched a similar product to finance its aircraft named Balthazar.

Although the insurers are highly rated, they are not sovereign entities, which means that some particularities that the ECAs has to comply with, it is not mandatory for AFIC transactions, such as being subject to the ASU Fee and have the cash being used strictly to financing aircraft that will be exported.

The variety of capital lease structures and the opportunity to mix them with each other are very important and should be carefully studied by the airline regardless of its credit grade. Although the airline might face a situation where it is indifferent go towards

a capital or operating lease, some strategies leverages should be taken into account, such as the importance of build equity throughout the years.

Operating vs. Capital Lease – Pros and Cons

As briefly demonstrated above, each structure has its particularities and shall be carefully weighed by the airline before moving forward into one or another. In the bottom line, the most assertive decision is the one that addresses all the concerns of the airline in terms of creating flexibility, build equity and maximize the capital structure, and that might be achieved through an operating or capital lease. In order to clarify some of the key issues of each structure, will be pinpoint below three of the most critical items for an airline and how each structure affects it.

Liquidity

The importance of liquidity in an industry like aviation is redundant and, at the same time, would require deep research only to address it. It will be pointed out some of the most important effects on each structure without going deep into the matter.

Operating leases provide the airline with less up-front cash expenditure as the lessor/investor will be responsible for the acquisition of the asset. In addition, DOL transactions are even more attractive when the airline is trying to avoid upfront cash out since there are no PDP obligations with the manufacturer. In contrast with that, airlines might be carrying very heavy burdens by avoiding the up-front cash. The rent and return conditions will implicitly "hold" a premium for the lessor that overpays their initial disbursement, not to mention that eventually, airlines are required to pay maintenance reserves over the entire period of the lease.

On the maintenance cost side, there's a big advantage for the capital leases as the airline will not be required to pay for maintenance reserves, do not need to spend tons of cash to comply with return conditions, and it is usually allowed to use Parts Manufacturer Approval (PMA) on the aircraft. In the long term, it represents a great amount of cash savings.

On the operations side, both structures usually forbid the airline to sublease the aircraft to another airline without previous approval, which indirectly affects the airline's ability to rapidly manage capacity when adjustments are indispensable, which is usually seen where demand has a high level of seasonality. The impact on liquidity is perceived when the airline has to deal with the surplus of aircraft and consequently with its fixed costs.

Clearly, the short-term liquidity provided by operating leases has an implicit cost in the long term for an airline, which is not always measured and especially weighted properly. When the airline starts to measure and weigh this implicit cost along with its other options to address an aircraft financially is when the advantage is created.

Sensitivity Analysis

Residual Value x Rent

An interesting and simple approach to understanding the residual value risk can be seen by setting up a sensitivity matrix comparing a range of operating lease rent (column) with an expected residual value at the end of the lease (line), considering all the other assumptions ceteris-paribus.

Intuitively the matrix also tells us if the model is running properly or not by its results. In Figure 1, the results make sense as whereas the residual value is higher, the

capital lease becomes more attractive (or less inadvisable).

Sensitivity Matrices | Financing Lease Advantage When Greater Than Zero (NPV in US$ '000)

Residual Value vs. Adjusted Rent @ Delivery																
Matrix	15,00%	18,75%	22,50%	26,25%	30,00%	33,75%	37,50%	41,25%	45,00%	48,75%	52,50%	56,25%	60,00%	63,75%	67,50%	71,25%
210.000	-17,92	-17,34	-16,76	-16,18	-15,60	-15,02	-14,45	-13,87	-13,29	-12,71	-12,13	-11,55	-10,97	-10,39	-9,81	-9,24
220.000	-17,08	-16,50	-15,92	-15,34	-14,77	-14,19	-13,61	-13,03	-12,45	-11,87	-11,29	-10,71	-10,13	-9,55	-8,98	-8,40
230.000	-16,24	-15,66	-15,08	-14,51	-13,93	-13,35	-12,77	-12,19	-11,61	-11,03	-10,45	-9,87	-9,30	-8,72	-8,14	-7,56
240.000	-15,40	-14,83	-14,25	-13,67	-13,09	-12,51	-11,93	-11,35	-10,77	-10,19	-9,62	-9,04	-8,46	-7,88	-7,30	-6,72
250.000	-14,57	-13,99	-13,41	-12,83	-12,25	-11,67	-11,09	-10,51	-9,94	-9,36	-8,78	-8,20	-7,62	-7,04	-6,46	-5,88
260.000	-13,73	-13,15	-12,57	-11,99	-11,41	-10,83	-10,26	-9,68	-9,10	-8,52	-7,94	-7,36	-6,78	-6,20	-5,62	-5,05
270.000	-12,89	-12,31	-11,73	-11,15	-10,58	-10,00	-9,42	-8,84	-8,26	-7,68	-7,10	-6,52	-5,94	-5,36	-4,79	-4,21
280.000	-12,05	-11,47	-10,89	-10,32	-9,74	-9,16	-8,58	-8,00	-7,42	-6,84	-6,26	-5,68	-5,11	-4,53	-3,95	-3,37
290.000	-11,21	-10,64	-10,06	-9,48	-8,90	-8,32	-7,74	-7,16	-6,58	-6,00	-5,43	-4,85	-4,27	-3,69	-3,11	-2,53
300.000	-10,38	-9,80	-9,22	-8,64	-8,06	-7,48	-6,90	-6,32	-5,75	-5,17	-4,59	-4,01	-3,43	-2,85	-2,27	-1,69
310.000	-9,54	-8,96	-8,38	-7,80	-7,22	-6,64	-6,07	-5,49	-4,91	-4,33	-3,75	-3,17	-2,59	-2,01	-1,43	-0,85
320.000	-8,70	-8,12	-7,54	-6,96	-6,38	-5,81	-5,23	-4,65	-4,07	-3,49	-2,91	-2,33	-1,75	-1,17	-0,60	-0,02
330.000	-7,86	-7,28	-6,70	-6,13	-5,55	-4,97	-4,39	-3,81	-3,23	-2,65	-2,07	-1,49	-0,92	-0,34	0,24	0,82
340.000	-7,02	-6,45	-5,87	-5,29	-4,71	-4,13	-3,55	-2,97	-2,39	-1,81	-1,24	-0,66	-0,08	0,50	1,08	1,66
350.000	-6,19	-5,61	-5,03	-4,45	-3,87	-3,29	-2,71	-2,13	-1,56	-0,98	-0,40	0,18	0,76	1,34	1,92	2,50
360.000	-5,35	-4,77	-4,19	-3,61	-3,03	-2,45	-1,88	-1,30	-0,72	-0,14	0,44	1,02	1,60	2,18	2,76	3,34
370.000	-4,51	-3,93	-3,35	-2,77	-2,19	-1,62	-1,04	-0,46	0,12	0,70	1,28	1,86	2,44	3,02	3,59	4,17
380.000	-3,67	-3,09	-2,51	-1,94	-1,36	-0,78	-0,20	0,38	0,96	1,54	2,12	2,70	3,27	3,85	4,43	5,01
390.000	-2,83	-2,26	-1,68	-1,10	-0,52	0,06	0,64	1,22	1,80	2,38	2,95	3,53	4,11	4,69	5,27	5,85
400.000	-2,00	-1,42	-0,84	-0,26	0,32	0,90	1,48	2,06	2,63	3,21	3,79	4,37	4,95	5,53	6,11	6,69
410.000	-1,16	-0,58	0,00	0,58	1,16	1,74	2,32	2,89	3,47	4,05	4,63	5,21	5,79	6,37	6,95	7,53
420.000	-0,32	0,26	0,84	1,42	2,00	2,57	3,15	3,73	4,31	4,89	5,47	6,05	6,63	7,21	7,78	8,36
430.000	0,52	1,10	1,68	2,25	2,83	3,41	3,99	4,57	5,15	5,73	6,31	6,89	7,46	8,04	8,62	9,20
440.000	1,36	1,93	2,51	3,09	3,67	4,25	4,83	5,41	5,99	6,57	7,14	7,72	8,30	8,88	9,46	10,04
450.000	2,19	2,77	3,35	3,93	4,51	5,09	5,67	6,25	6,82	7,40	7,98	8,56	9,14	9,72	10,30	10,88
460.000	3,03	3,61	4,19	4,77	5,35	5,93	6,51	7,08	7,66	8,24	8,82	9,40	9,98	10,56	11,14	11,72

Figure 8. – Sensitivity Matrix (Residual Value x Rent)

Given our main assumptions described above in Figure 1, the expected adjusted rent is in the neighborhood of US$ 400K. Therefore, by assuming a ceteris-paribus condition for all the remaining terms, we can guide ourselves by the columns of expected residual values to find the break-even point, for example (around 30% in this case). The exact break-even point can be found by using the tool Goal-Seek of Excel.

If we consider, for example, that a Boeing 737 has its market price annually depreciated by 4,00%, at year 12, the aircraft will have a value of approximately U$ 31.85M (given the assumed market price of U$ 51M), which is roughly 62% of residual value, then the odds are the favorites to the capital lease – NPV in this scenario equal to roughly U$5.5M. However, the airline might face extra costs to bring the aircraft to half-life condition where the 4% depreciation rate is standardized. This has to be considered in the cash flows as well.

Interest Rate x Rent

Another approach to sensitize both proposals goes by the matrix of the interest rate on the capital lease versus the adjusted rent on the operating lease. Below, in Figure 2, it

becomes clear that the higher the adjusted rent (expected net rent at delivery after adjustments) and the lower the interest rates, the capital lease proposal becomes more advantageous, which also shows that the model is working properly.

Sensitivity Matrices | Financing Lease Advantage When Greater Than Zero (NPV in US$ '000)

Margin vs. Adjusted Rent @ Delivery

Matrix	2,00%	2,35%	2,70%	3,05%	3,40%	3,75%	4,10%	4,45%	4,80%	5,15%	5,50%	5,85%	6,20%	6,55%	6,90%	7,25%
210.000	-9,07	-9,71	-10,36	-11,01	-11,66	-12,30	-12,95	-13,60	-14,24	-14,89	-15,54	-16,19	-16,83	-17,48	-18,13	-18,78
220.000	-8,23	-8,88	-9,52	-10,17	-10,82	-11,46	-12,11	-12,76	-13,41	-14,05	-14,70	-15,35	-16,00	-16,64	-17,29	-17,94
230.000	-7,39	-8,04	-8,68	-9,33	-9,98	-10,63	-11,27	-11,92	-12,57	-13,22	-13,86	-14,51	-15,16	-15,80	-16,45	-17,10
240.000	-6,55	-7,20	-7,85	-8,49	-9,14	-9,79	-10,44	-11,08	-11,73	-12,38	-13,02	-13,67	-14,32	-14,97	-15,61	-16,26
250.000	-5,71	-6,36	-7,01	-7,66	-8,30	-8,95	-9,60	-10,24	-10,89	-11,54	-12,19	-12,83	-13,48	-14,13	-14,78	-15,42
260.000	-4,88	-5,52	-6,17	-6,82	-7,47	-8,11	-8,76	-9,41	-10,05	-10,70	-11,35	-12,00	-12,64	-13,29	-13,94	-14,59
270.000	-4,04	-4,69	-5,33	-5,98	-6,63	-7,27	-7,92	-8,57	-9,22	-9,86	-10,51	-11,16	-11,81	-12,45	-13,10	-13,75
280.000	-3,20	-3,85	-4,49	-5,14	-5,79	-6,44	-7,08	-7,73	-8,38	-9,03	-9,67	-10,32	-10,97	-11,61	-12,26	-12,91
290.000	-2,36	-3,01	-3,66	-4,30	-4,95	-5,60	-6,25	-6,89	-7,54	-8,19	-8,83	-9,48	-10,13	-10,78	-11,42	-12,07
300.000	-1,52	-2,17	-2,82	-3,47	-4,11	-4,76	-5,41	-6,05	-6,70	-7,35	-8,00	-8,64	-9,29	-9,94	-10,59	-11,23
310.000	-0,69	-1,33	-1,98	-2,63	-3,27	-3,92	-4,57	-5,22	-5,86	-6,51	-7,16	-7,81	-8,45	-9,10	-9,75	-10,40
320.000	0,15	-0,49	-1,14	-1,79	-2,44	-3,08	-3,73	-4,38	-5,03	-5,67	-6,32	-6,97	-7,62	-8,26	-8,91	-9,56
330.000	0,99	0,34	-0,30	-0,95	-1,60	-2,25	-2,89	-3,54	-4,19	-4,84	-5,48	-6,13	-6,78	-7,42	-8,07	-8,72
340.000	1,83	1,18	0,53	-0,11	-0,76	-1,41	-2,06	-2,70	-3,35	-4,00	-4,64	-5,29	-5,94	-6,59	-7,23	-7,88
350.000	2,67	2,02	1,37	0,72	0,08	-0,57	-1,22	-1,86	-2,51	-3,16	-3,81	-4,45	-5,10	-5,75	-6,40	-7,04
360.000	3,50	2,86	2,21	1,56	0,92	0,27	-0,38	-1,03	-1,67	-2,32	-2,97	-3,62	-4,26	-4,91	-5,56	-6,21
370.000	4,34	3,70	3,05	2,40	1,75	1,11	0,46	-0,19	-0,84	-1,48	-2,13	-2,78	-3,43	-4,07	-4,72	-5,37
380.000	5,18	4,53	3,89	3,24	2,59	1,94	1,30	0,65	0,00	-0,65	-1,29	-1,94	-2,59	-3,23	-3,88	-4,53
390.000	6,02	5,37	4,72	4,08	3,43	2,78	2,13	1,49	0,84	0,19	-0,45	-1,10	-1,75	-2,40	-3,04	-3,69
400.000	6,86	6,21	5,56	4,91	4,27	3,62	2,97	2,33	1,68	1,03	0,38	-0,26	-0,91	-1,56	-2,21	-2,85
410.000	7,69	7,05	6,40	5,75	5,11	4,46	3,81	3,16	2,52	1,87	1,22	0,57	-0,07	-0,72	-1,37	-2,02
420.000	8,53	7,89	7,24	6,59	5,94	5,30	4,65	4,00	3,35	2,71	2,06	1,41	0,76	0,12	-0,53	-1,18
430.000	9,37	8,72	8,08	7,43	6,78	6,13	5,49	4,84	4,19	3,54	2,90	2,25	1,60	0,96	0,31	-0,34
440.000	10,21	9,56	8,91	8,27	7,62	6,97	6,32	5,68	5,03	4,38	3,74	3,09	2,44	1,79	1,15	0,50
450.000	11,05	10,40	9,75	9,10	8,46	7,81	7,16	6,52	5,87	5,22	4,57	3,93	3,28	2,63	1,98	1,34
460.000	11,88	11,24	10,59	9,94	9,30	8,65	8,00	7,35	6,71	6,06	5,41	4,76	4,12	3,47	2,82	2,18

Figure 9. – Sensitivity Matrix (Interest Rate x Rent)

As it is well known, many capital leases have floating interest rates as the majority are indexed into a macroeconomic index, such as the LIBOR. In this case, as well as where operating lease rents are floating, we would recommend use Monte Carlo simulation (with > 10.000 samples) to provide a better certainty around the NPV resulting from the comparison. Please consider that as much data is available to provide a standard deviation and variance, the better.

Cost of Equity x Rent

When the capital lease does not offer a 100% loan to value, another key factor becomes comes to play, the cost of capital (or cost of equity) of an airline. And along with the fact that aircraft financing usually is a long-term investment, a matrix where we sensitize the fluctuation of an airline's cost of capital/equity provides another perspective towards the final decision.

According to Gibson and Morrell (2004), using the Capital Asset Pricing Model (CAPM), it is possible to find the cost of equity of a company, although it is very often to see the Weighted Average Cost of Capital (WACC) being used to discount future cash flows whilst comparing aircraft financing alternatives.

$$\underbrace{K_e}_{\text{Cost of Equity}} = \underbrace{R_F}_{\text{Risk Free Rate}} + \underbrace{(R_m - R_F)}_{\text{Market Risk Premium}} \times \underbrace{\beta}_{\text{Beta}}$$

Figure 10. – General Cost of Equity Formula

Either way, regardless of the approach on the discount rate, sensitize a rate is an important tool that has to be inserted in the business case and converge towards the decision.

Flexibility

One of the main subjects within the Fleet Planning process, flexibility, is vital for the survival of an airline and for its competitiveness within the industry. Many leverages can be used to enhance this feature, although depending on how the airline has addressed the finance of its fleet, some obstacles may arise.

The main difference between operating and capital leases on the flexibility perspective is that on the operating lease, the airline usually faces more difficulty in disposing of the asset before the agreed date and creates no equity on it. Yet, on capital leases, the airline not only creates equity throughout the contract term but also is able to

sell the aircraft (eventually subject to pre-payment fees) if it suddenly decides to decrease its capacity to face macroeconomic headwinds.

Among the main leverages to create flexibility, it is worth highlighting the following ones shown by Figure 3.

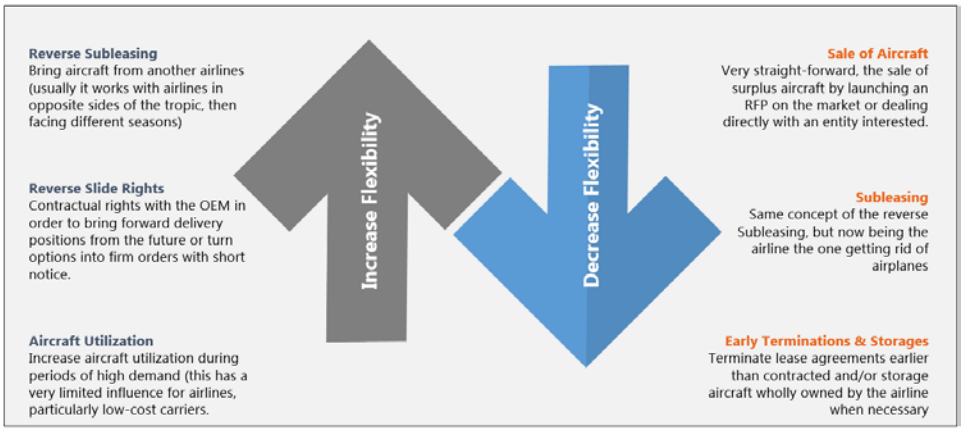

Figure 11. – Leverages to address flexibility concerns on the fleet planning

In order to apply the tools shown above, it is important to develop the original plan that can be expressed by a Compound Annual Growth Rate (CAGR) and then create derivate curves containing the maximum and minimum flexibility throughout each quarter (or month, or year).

Figure 12. – Hypothetical Airline CAGR and alternative curves due to flexibility

There are many approaches to develop derivation curves around the fleet's expected CAGR, such as by using the GDP as a proxy to the growth/decline of expected demand and consequently the need for aircraft. It is important to understand and apply the standard

deviation concept in order to understand the risk in any approach. This is an example where it is interesting to apply the Monte Carlo Simulation. Although the sample does not necessarily follow a normal distribution, the MCS will provide a very interesting view of the risks.

Ownership Risk

The big debate around the operating and capital leases lays, among others, on the risk of keeping the ownership of a certain asset. What really needs to be understood is that Milton Friedman was right when he said: "There is no free lunch." In other words, investors/lessors implicitly add a calculated risk premium related to ownership on the lease rent in case an airline decides to go towards an operating lease. Thus the real question is: is the premium paid during the whole operating lease agreement fair?

To answer that question and deal with uncertainty, it is gonna be used Monte Carlo Simulation (MCS). Using this tool, it is possible to compare thousands of NPV results (usually, it is considered at least 10.000 simulations to generate a comfortable confidence interval) based on discrete random variables for many factors that assemble the cash flow. On the MCS, it is important to not only run the simulations but also weigh each component of the cash flow on the final NPV.

In addition, it is important to understand that the aircraft value is subject to exogenous factors, such as offer x demand, oil price, new technologies, etc. Then, it is possible that the aircraft value curve throughout the years not only goes down but also creates "opportunity windows" during the years where the airline can make money, as shown in Figure 5. A very important factor to highlight is that airlines who register their assets in a different currency may be dealing with currency volatility. In some cases, it can

save the airline from recognizing impairment in its book even if the aircraft is sold by a Dollar amount lower than it should be (if there are no currency effects) and vice-versa.

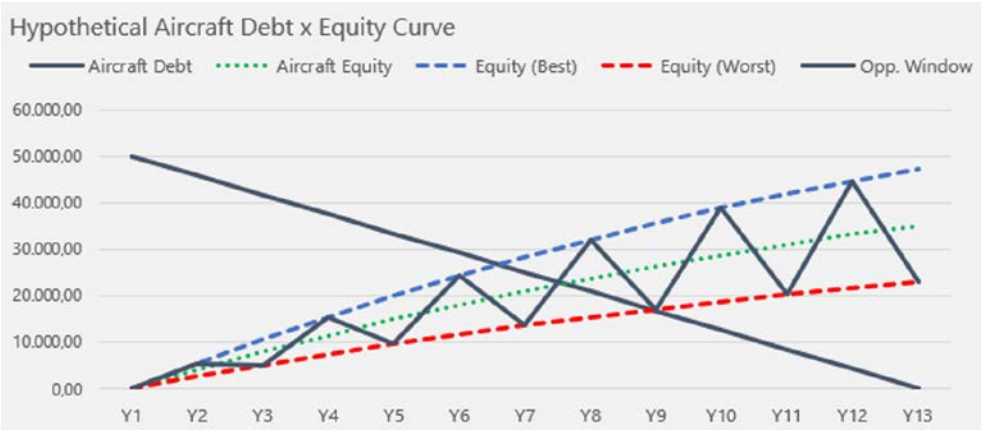

Figure 13. – Hypothetical Aircraft Debt, Equity and Opportunity Window Curves

The ownership risk is not only a risk exposure strategy but also an equity creation strategy as the asset may be important in the long term to finance the fleet renewal through its sale, for example. Indeed, more liquid assets such as the Boeing 737NG and the Airbus A320 bring a higher level of confidence to the investor/airline.

Chapter IV

Conclusions

While evaluating the results, it is worth mentioning that the results are focused on the pros and cons of each structure (operating and capital lease) and its general impact on the airline's cash flow and business model. The two main conclusions of this study are related to the two mentioned leasing structures as described below:

Conclusion One

- Data Gathering: Companies responsible for appraisals of aircraft and engines worldwide such as Avitas, Aircraft BlueBook, and Ch-Aviation.
- Results: Operating leases are the most common source of aircraft financing among airlines worldwide, given its non-requirement for advance capital expenditure and the transference to the lessor/owner of the own risk of the asset. The most important factors while negotiating the leasing agreement (in the airline perspective and according to our results) are the lease rent, provision for maintenance reserve payments, and the rates for major components – along with the escalation rates – to calculate the end of lease adjustments.
- Conclusions: Usually, operating leases are comprised of a lower payment (i.e., Monthly or Quarterly). However, the requirement for maintenance reserves or maintenance deposit payments (if applicable), security deposit, and the redelivery cost are negative in terms of cash flow and Net Present Value analysis while compared with a Financing Lease. In addition to that, usually, operating leases do not allow the operator to sublease the aircraft to

a third party without the prior consent of the owner, which is also a negative contribution in terms of flexibility and costs.

Conclusion Two

- Data Gathering: Companies responsible for appraisals of aircraft and engines worldwide such as Avitas, Aircraft BlueBook, and Ch-Aviation and ODCE for Aircraft Sector Understanding for Aircraft Financing with Export/Import Credit Agencies.
- Results: Financing leases are used by airlines with relatively competitive costs of capital as a strategy to build equity and diversify its fleet financing source. The most important points for an airline while negotiating the financing lease – according to the model developed in the study – are the interest rates, the portion of equity required to purchase the aircraft - once the creditors usually finance up to 85% of the cost, ability to have a balloon payment, tenor and the upfront fees required by agencies such as the ASU fee required by the Ex-Im Bank of the United States.
- Conclusions: By having financing leases, the airline is able to take advantage of the residual value of the asset (equity generated throughout the years of amortization) to finance new deliveries or even the maintenance of its current fleet.

In order to provide the reader with a comparison among the main topics mentioned in this Chapter IV, we present – based on the assumption determined by the authors in Chapter III – sensitivity analysis encompassing some of the key factors mentioned on the capital lease perspective, compared to the leasing rent of an operating lease.

Chapter V

Recommendations

Recommendation One: Airlines seeking to add capacity in the short term, without necessarily having to deploy significant capital for doing so, must seriously look at the most popular aircraft financing structure available, Operating Leases.

- **Airline executives should never ignore the possibility of financing aircraft by means of entering into operating lease transactions vis-à-vis the multiple upsides of such financing solution.**
- **Notwithstanding that, it is strongly advised to also factor in, on top of the cash benefits, the important downsides of the operating lease structure, such as the limited fleet flexibility and the potentially high asset return cost.**

Recommendation Two: The Finance Lease, a judicious and inexpensive asset financing alternative for well-capitalized airlines. Airlines that are able to access the capital and banking markets must entertain the alternative of financing a portion of their assets through finance leases, given the lower financial costs and higher fleet flexibility associated with it.

- **Airlines that are generally well-capitalized and in good stand in terms of corporate governance should seriously consider financing some of their assets through finance leases.**
- **Typically, the financial costs of the transaction are lower when compared to an operating lease.**

- **The airline retains the ability to dispose of the asset in case of having excessive capacity. Taking into consideration the characteristics of the asset is also key, as the liquidity and residual value are significant elements of it.**

Background

Recommendation One

Operating leases are very popular and largely used by airlines. Operating leases tend to be beneficial to the airline from a cash-flow perspective, especially in the short term. The transaction Net Present Value analysis makes the operating lease type of aircraft financing very attractive to financial executives. The structure does not necessarily require capital injections by the airline. The highest costs are concentrated closer to the lease expiration date in connection with the asset return process.

Recommendation Two

Finance leases are also quite popular among airlines worldwide when it comes to aircraft and engines financing. In most cases, when the airline is in better financial shape, it is thus, not completely focused on avoiding capital expenditures. The finance lease pops up as a good financing structure. That is mainly due to the lower financing cost, corporate-driven credit analysis by the financier, and the ability to dispose of the capacity, assuming the pre-payment of the debt. The market perception and overall liquidity of the assets to be financed should also be taken into consideration as the airline retains the asset and respective residual value after the complete amortization of the associated debt.

Further to the recommendations above, it rests absolutely clear that deciding which type of financing to choose is complex and requires extensive analysis of the upsides and

downsides of each structure. Moreover, such a decision shall also be consistent with the main characteristics of the airline.

Under regular market conditions and, excluding extraordinary micro or macro events (i.e., covid-19 pandemic, 9/11 terrorist attacks), a diversified portfolio of asset financing structures would most likely be the optimal response, as the airline would not be exposed to a single set of risks, having a balance between fleet flexibility and lower financial costs.

Future Research

- New technologies. As studies advance in the technology research field, more and more airlines will have to turn their attention to the use of new technologies in their operations, such as clean energy-powered aircraft and autonomous flying aircraft.
- Social and corporate governance driven investments that is also becoming a key element for companies to retain access to specific niches of the capital markets vis-à-vis all environmental,
- Accounting, choosing the adequate asset financing structure will invariably communicate with the respective accounting treatment of such financial transaction. In that sense, investigating the optimal accounting solution for each financing structure available is a must. Especially for publicly traded airlines, as market analysts will always keep an eye for the airline's debt.

Lessons Learned

- Multi-disciplinary considerations: managing an airline's fleet of aircraft is a challenging task as it requires vast knowledge and a diversified skillset,

given the significant impact of each fleet decision on the overall business. The starting point of the job is, most of the time, the choice of the asset financing structure.

- Be careful with the single right answer for an airline while planning the financing of its assets. Often, the correct approach will be a hybrid response, by means of which the risk against reward evaluation is diversified and balanced.

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