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Research Report

Luxembourg as an aspiring platform for the aircraft engine industry

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EIKV-Schriftenreihe zum
Wissens- und Wertemanagement

Luxembourg as an aspiring platform
for the aircraft engine industry

Peter Koster

IMPRESSUM

EIKV-Schriftenreihe zum Wissens- und Wertemanagement

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Luxembourg as an aspiring platform for the aircraft engine industry

Peter Koster

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Preface

This document represents the results of the a study project carried out to conclude the ability of Luxembourg potential to diversify it's todays aviation industry and create or access synergies that may or may not yet be present. The document aims equally to assess and bring forward shortcomings but also strength that Luxembourg in its current economical environment holds. This study is an original intellectual product of the author; the document is ultimately based on the apparatus and data made available by industry experts and industry published articles.

The document has been subdivided into two main parts and the respective subtitles. It is attempting to translate a very specific industry segment, and its particularities, into a comprehensive document to an audience of non-expert and non-industry readers. The aim is to establish a comprehensive understanding of how a specific commodity within the aviation industry can form a particular asset and how this asset could be capitalized in a given environment, fully or partially, available in Luxembourg.

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Acronyms

| | | |
|------|---|------------------------------------|
| ABS | = | Asset Backed Security |
| A/C | = | Aircraft |
| AOC | = | Air Operator Certificate |
| Bn | = | Billion |
| B747 | = | Boeing 747 |
| CAA | = | Civil Aviation Authority |
| CAGR | = | Compound Annual Growth Rate |
| CIS | = | Commonwealth of Independent States |
| CTC | = | Cape Town Convention |
| EASA | = | European Aviation Safety Authority |
| ECB | = | European Central Bank |
| EEA | = | European Economic Area |

| | | |
|------|---|--|
| EECT | = | Enhanced Equipment Trust Certificates |
| EU | = | European Union |
| EUR | = | EURO |
| FAA | = | Federal Aviation Authority |
| FEP | = | Fixed Exchange Program |
| GAAP | = | General Accepted Accounting Principles |
| GDP | = | Gross Domestic Product |
| GE | = | General Electrics |
| IATA | = | International Air Transport Association |
| IRR | = | Internal Rate of Return |
| LCC | = | Low Cost Carrier |
| LLP | = | Limited Life Part |
| MRO | = | Maintenance Repair Overhaul |
| MTU | = | Motoren- und Turbinen-Union GmbH |
| NPV | = | Net Present Value |
| OECD | = | Organisation for Economic Co-operation and Development |
| OEM | = | Original Equipment Manufacturer |
| PWC | = | Pratt & Whitney Company |
| RH | = | Relative Humidity |
| RMB | = | Renminbi (official currency of P.R. China) |
| RR | = | Rolls Royce |
| SA | = | South Africa |
| SARS | = | Severe Acute Respiratory Syndrome |

| | | |
|------|---|---|
| SES | = | Société Européenne des Satellites |
| SPC | = | Special Purpose Company |
| SPV | = | Special Purpose Vehicle |
| SV | = | Securitisation Vehicle |
| TAPA | = | Technology Asset Protection Association |
| TV | = | Television |
| UAE | = | United Arab Emirates |
| UK | = | United Kingdom |
| UN | = | United Nations |
| US | = | United States |
| TAPA | = | Technology Asset Protection Association |
| VAT | = | Value Added Tax |

1. Luxembourg for Aviation

The airline industry in general requires huge amounts of investment and has over the years developed to one of the most assets driven industries in general. The increasing development of the aviation technologies have pulled up the investments needed to design, develop and manufacture aircrafts, avionics and engines. Economic problems have increasingly been impacting on the industry's profitability. As the manufacturing companies have either gone out of business or merged with peers, the industry today finds itself with a dominance of two major players; Boeing and Airbus.

Luxembourg as an economy has been able to develop itself into a sincere global actor of which the Steel Industry has indeed laid the foundation at the end of the 19th century. Nevertheless Luxembourg has always been eyeing the needs of its neighboring markets and very intelligently has anticipated well on these opportunities that were offered. Luxembourg exerts an immense media clout and has a long tradition of operating radio and TV services for pan-European audiences, including those in France, Germany and the UK. Generations of European listeners grew up with Radio Luxembourg, which beamed pop music programs into the homes of countless Europeans Teenagers. Luxembourg also became the home in 1985¹ to Europe's largest satellite operator, Société Européenne des Satellites (SES), which operates the Astra fleet, and thereby raising an extensive media empire.

Whilst Luxembourg's prosperity was formerly based on steel manufacturing, and with the decline of that industry Luxembourg needed –and succeeded through entrepreneurship pure sang - to diversify its economy. It is today best known for its status as Europe's most powerful Investment Management Centre, however the country's strict laws on banking secrecy produced a system that was open to exploitation for the purposes of tax evasion and fraud. Concern over Luxembourg's reputation as a tax haven - especially in the wake of the 2008 financial crisis - prompted the G20 group of countries to add it to a "grey list" of nations with questionable banking arrangements in April 2009.² Luxembourg responded by taking steps to improve the transparency of its financial arrangements. By July 2009 it had signed agreements on the exchange of tax information with a dozen countries, and was commended by the OECD for its prompt efforts to implement the internationally agreed standard. What may have been considered by the broad public to be “the

¹ SES History <http://www.ses.com/4337028/history>

² BBC News Country Profile Luxembourg http://news.bbc.co.uk/2/hi/europe/country_profiles/1061821.stm

threat” to Luxembourg’s economy was intelligently turned into an opportunity. Having diversified its financial centre Luxembourg offers today much more sophisticated products and services worldwide, and on top it succeeded to create great political, economic and social stability, openness to the world, its modern legal and regulatory environment and the availability of a skilled global workforce have attracted financial institutions and investors worldwide.³

From the aforesaid examples of how Luxembourg has managed to diversify its core pillars of their economy throughout a century and beyond, one should consider that Luxembourg has no issues with repeating the same over and over again. Yet Luxembourg does not have an ownership title on diversification and niche marketing, nor can it rely on a monolithic structure of its industry. For that reasons politicians are proclaiming since 2004 formally the establishment of an economic diversifications program that aims to maintain and further develop its platform of an international financial centre. This includes the approximately 150 highly competitive banking institutions, the high performance of investment funds sector, the dynamic insurance sector and the multitude of professionals and specialised companies offer a comprehensive range of diverse and innovative financial services.

The desire to further diversification of services led to the creation and development of activities in the field of insurance and reinsurance, logistic & transport, trade, tourism, telecommunications, e-commerce, broadcasting and business services.⁴

Aviation is missing! Broadly aviation maybe considered falling under the umbrella of Logistics or Transport, however that may simply mislead the potential of development for Luxembourg and diminish the aviation sector to a forwarding role only. The author is of the opinion that the grounds of aviation are much deeper and may not have been explored deep enough. Luxembourg does hold competence, skills and most important access to finance that could seriously create an environment which can compete with any other global platform on Air Finance.

³ Luxembourg an International Finance Centre <http://www.luxembourg.public.lu/en/investir/secteurs-cles/finance/index.html>

⁴ “Economic Diversification » <http://www.luxembourg.public.lu/en/investir/portrait-economie/diversification-economique/index.html>

2. Objective

The objective of the assignment is to provide a comprehensive understanding of today's aviation industry in general and more in particular on the aircraft engine industry. The document will work itself towards which parts of the aviation industry are already present in Luxembourg and what potential the Luxembourg platform offers today. More interesting will be to explore what potentials Luxembourg holds and which additional potentials it may be able to generate.

The purpose of this paper is to study theoretically the line between the market competitions and trade in equipment with a focus on the commercial aviation industry and test several empirical implications combining data on fleets of aircrafts and their respective engines.

The models brought forward will combine two key ingredients; the first is a dynamic model of an imperfectly competitive industry with a large number of atomistic output markets, where the actors within these segment have heterogeneous stochastic productivity and compete "à la Cournot" in an isolated segment that differs in size. The second element of the paper is an active market environment for inputs (aircraft engines), which can be leased, overhauled, stored and financed. Whether Luxembourg as a platform will be able to provide a frictionless environment for this industry segment will depend on numerous factors which will all together form the equivalent to a perfect rental market. Comparisons on transaction costs for leases, resale, operating costs and competence costs are meant to be included in the study.

3. Assignment Analysis

3.1. Background

The author has a strong relation to aviation; not so much the flight operational part but in particular the transport of cargoes by air has been forming the root of his professional career. Having accumulated almost 30 years of "Hands On Experience" in the air transport industry, a profession tends easily to turn into a passion. The main milestones of the professional experience were generated in major cargo air lifters such as Cargolux, China Airlines Cargo and Martinair Cargo - all major wide-body cargo operators- as to finally set up an independent cargo airline in Luxembourg; West Air Luxembourg S.A. The later operated at peak a fleet of 19 narrow body cargo aircrafts exclusively operating for an express and postal portfolio; (i.e. DHL, TNT, Fedex, UPS, Royal Mail, La Poste etc.). In addition the author has assumed presidency and vice

presidency in industry association such as Findel ASBL, AROC (Airline Representatives and Operators Committee) and was a member of the Luxembourg Airport User Committee.

Having observed over the years how the industry shifted and how several of the authors personal business interfaces one by one were moved to Ireland, to follow the overall trend of the leasing industry establish their head offices in either Dublin or Shannon. Eventually an article that appeared in the industry press in 2012 under the title: *"positive resound on the engine leasing market"*⁵, indicating substantial growth expectations for aero-engine leasing, led to the simple question by the author: *"Why Ireland? Can't we turn Luxembourg into an Ireland for the engine leasing?"*

There was not a doubt that leasing, and increasingly engine leasing, has grown into a lively topic amongst the industry, topped by the ever-increasing competition, regulatory compliances and demands for absolute quality, the aforesaid resulting in each market actor putting its focus on his or her respective scope. Yet, aero-engine leasing industry is different to aircraft leasing, different parameters of life expectation are involved and different values are involved. As the aero-engine values are increasing over time in relation to its host: the airframe. This market will be expected to absorb a more important factor in the airline's asset management strategy. Does Luxembourg hold sufficient tools to position itself into a real platform for the aero-engine industry, and has its present actors already paved this road, knowingly or unknowingly, and what are the shortcomings that will need to be achieved? Several studies have been conducted to enforce the aviation and logistic platform in Luxembourg, yet an active liaison to the industry assets and its financial platform appears to be lacking so far.

3.2. Approach Strategy

The approach applied in this thesis is clearly a qualitative approach. The core problem setting in this thesis can be defined as: **Assessment of Needs**. The first part of the work will attempt to elaborate on the technicalities that the industry as a whole is composed of and what the key actors will expect of the commodity "the Aero-Engine". An attempt to provide reassurance of viability of this commodity by the macro-environment will be demonstrated by forming a correlation of GDP growth forecasts and historic interaction of the same with the economical footprint provided by the air transport industry.

⁵ « Positive resounds in engine leasing market » Airline Fleet Management June 2013

With limited stakeholder and competent resources to provide an eligible input and contribution to the analysis to be made, the approach technique best suitable to achieve the expected results will be the Delphi process. Applying the aforesaid technique to foster consensus building amongst the limited amount of interfaces available is expected to best achieve a convergence of opinions on this specific issue. This approach can be used in various fields of studies, such as program planning, policy determination and resource utilization. The assessment on whether Luxembourg can develop into a platform of aero-engine leasing will depend severely on an opinion making of industry experts, bringing forward their personal experiences either made in Luxembourg itself or having been confronted to industry obstacles. There again the Delphi technique seems well suited as a means and method for consensus building by using a series of questionnaires and interviews to collect data from a panel of selected subjects. As a matter of fact the chosen feedback process allows, and moreover encourages, the selected Delphi participants to reassess their initial judgments about the information provided in previous iterations based on their ability to review and assess the comments and feedback provided by the other Delphi participants⁶.

4. Aircraft Leasing & Engine Leasing.

During the years the airline industry has experienced years of good profitability, particularly during the long economic upswings from the 90's until 2008/2009. This followed its emergence from four to five years of large financial losses, following the economic recession. In parallel the increasing global nature of the airlines, together with a growth in airline privatization, alliances and cross shareholding, is focusing attention on the wide variety of accounting principles used. Airlines have consequently become more vigilant with regards to asset management and re-evaluated all the risks and benefits of ownership. To transfer the risk of ownership from Lessee to Lessor has increasingly been taken into consideration of the airlines. A known saying in the Transport Business goes: *If it rolls, flies or floats, you should rent it!* We are not assessing other transport industries in depth, however a quick glance over to the Trucking Business or Maritime Business indicates that the same philosophy is being applied. Like these two actors mentioned, Airlines had traditionally bought their aircrafts, albeit many purchases were arranged as 'Financial Leases' whereby the monthly rent instalment were eligible for tax reduction, the industry is now heading increasingly to all forms of Leases.

⁶ Practical Assessment, Research & Evaluation, Vol 12, No 10 2007; <http://pareonline.net/pdf/v12n10.pdf>

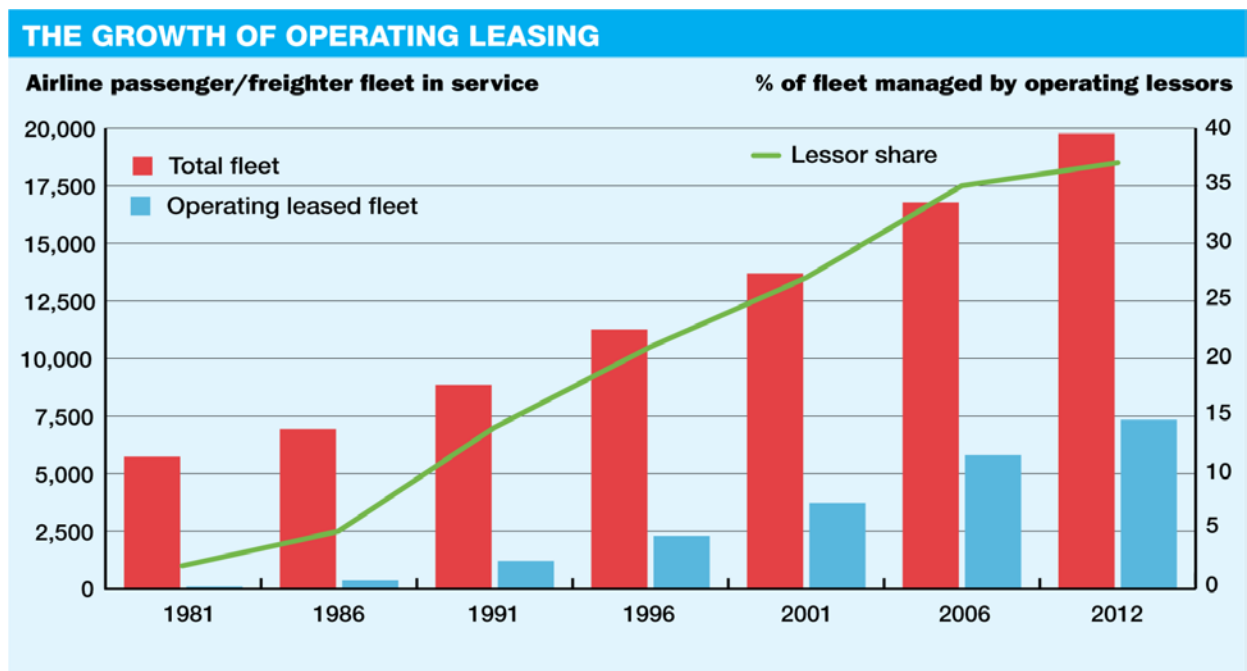


Figure 1: Owned vs Lease trend⁷

Given the aforesaid trend setting, it is no understatement to say that the aviation leasing industry is a healthy state, and in particular the aero-engine leasing wing. According to industry statements by 2020 half of the airline's fleet will be leased and there will be a demand for 68,000 engines plus 5000 spare engines. Of these some 1,700 will be with leasing companies and asset managers. Predictions are that between by 2031, there will be a demand of 40,000 single-aisle aircrafts worth \$ 500bn in engines. It is also forecasted that the market will require 3,200 spare engines for single-aisles worth \$32bn and 1500 spares for twin-aisles worth \$40bn.⁸

The preferential appetite for operational leases by the financial market over financing the operators has been increasing over the recent years and 40% of the commercial bank debt in 2014 went to lessors; not operators. More detailed description on the financing motivations will be addressed at a later stage.

Despite of its general positive resounds the aircraft and engine leasing is however in a fiercely competitive market. Differentiation of services and effective portfolio management is key and with aero-engine lessors an increasingly important part of the maintenance transaction. Strategies are revised to take into account the rise of leasing companies as aero-engine owners.

⁷ The economist / Aircraft Leasing 21.01.2012 www.economist.com/node/21543195

⁸ « Positive resounds in engine leasing market » Airline Fleet Management June 2013

Today's leasing market is already to some extent mature and it has nowadays more dynamic than at the very early days. Nevertheless in its relatively short history of approximate 25 years, engine leasing has established a proven record. Additionally sale-and-leasebacks continue to see significant volumes booked by bigger and more traditional participants, whereas the lessor base active in smaller transactions continuous to expand.

Remains to be stated that the overall goal-setting of the key manufacturers for the future remain very ambitious, in particular Airbus is reporting new market captures in areas such as Iran but also growing expectations in Africa and a recovery of Japan and Korea. Fresh orders fill up the order books of Airbus for the next three years on their flagship the A380 with operator's plans to expand with both new and used A380s. Airbus sees a market developing over the next few years for second hand A380s, like any other aircraft types, and Airbus actively to facilitate this. Consequently one can expect Aircraft (and aero-engines) lease opportunities to see increasingly high demand as air travel continues to rise exponentially.⁹

4.1. Outlooks of Asset Exploitation

Whatever the scope of the aviation leasing business may be anticipating, the exploitation of the asset will remain the key factor to the success; a good moment to look into the aircraft (and aero-engine) operators: The Airlines.

The past decade has been a tough one for the airlines and consequently for the airline industry in general. There may be some expectations, and these could be found in the Low Cost Operators eventually, but globally airlines have incurred significant losses. Part of these reasons could be blamed on macro events like 911, SARS, Swine flue or volcanic eruptions, all factors which have led to capacity excesses and intense competition resulting into poor results. Additionally financial performances of classic airlines, but to some extend also low cost carriers have also been adversely impacted by the overall economic downturn at the end of the former decade. In particular safety and security obligations, as to mitigate the associated risks, had been imposed upon the airlines by the regulator. For the operator (the airline) the above resulted in loss of equity and are now facing weakened balance sheets, subsequently the airlines achieving the lowest margins in their value chain. In contrast to the early days of commercial aviation, airlines have mutated in many cases to operating shells dependant on third parties' assets, i.e. financiers / leasing companies.

⁹ Airfinance Journal « John Leahy (Airbus) : Our goals for 2016 are ambitious 10.3.2016.

Today the industry looks more confident than ever into their future, the successful implementation of the Cape Town Convention (CTC), followed by an overall upturn and in some perspectives an unprecedented volumes of orders for aircrafts has been built. The leading OEMs of airframes, Airbus & Boeing both report in their current Market Outlook 2015-2035 a global increase of passenger traffic between 4.7% and 4.9% and around 4.7% in air cargo growth over the next 20 years. Forecasting a need of 38.050 airplanes (resp. 33.070 Airbus) valued at more than \$5.6 trillion, (resp. \$5.6 trillion by Airbus).¹⁰

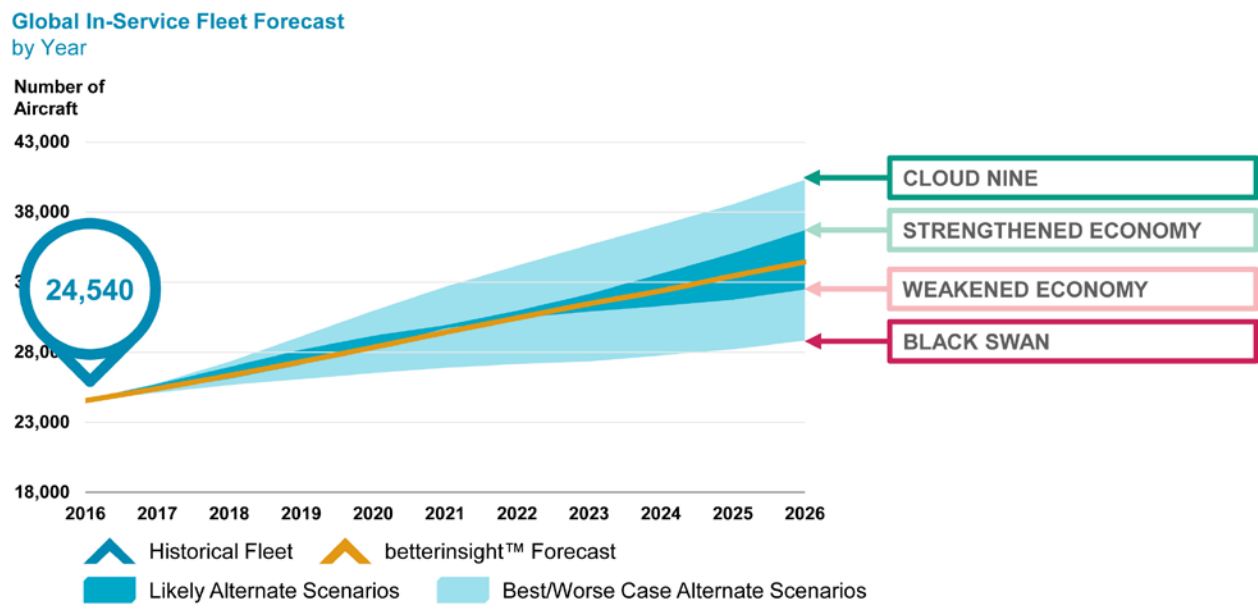


Figure 2: Global Fleet in Service

Contrary to public believe the current low jet fuel prices and economic indicators have not had a direct effect on the delivery of new aircraft. It is generally perceived in the industry that fuel prices can rise at any moment whereas the ordering of (new) aircrafts will be long-term fleet decisions. These decisions are made by the major actors in the industry many years in advance and are made independently of macro level factors.¹¹

Despite the aforesaid extremely positive outlooks for OEM's, the airlines themselves are facing a much more delicate situation. Finding sources for financing has become increasingly difficult: *"Aircraft Financing is extremely difficult.... Banks are being very selective in their lending"* states

¹⁰ Airbus "Global Market Forecast" 14 July 2016
<http://www.airbus.com/company/market/global-market-forecast-2016-2035/>

¹¹ CAVOK April 2016 "Winds of Change" http://www.cavokgroup.com/content/dam/oliver-wyman/cavok/files/20160405_OW_CVK_MRO_Americas_Presentation.pdf

Ulf Gedamke Lease and Asset Manager Air Berlin¹². Taking into account the recent turbulent decade for airlines, and taking furthermore into account the increasing number of labour conflicts, airlines, and in particular legacy carriers, have been exposed to during the past 2-3 years, these airlines find themselves in a very vulnerable position towards the lenders. Today airlines are, and will continue, to work a lot harder to arrange funding. With the overall supply of financing reduced, airlines nowadays need to continually review their fleet management policy and actively manage their future financing. Today a much larger scope of competition is acting on the market, consequently airlines will need to find more innovative funding to match this magnitude over the next few years as to balance against the backdrop of liquidity drying up (or already has been drying up).

The mitigations for the airlines in respect to this situation have been driving the asset management more and more into the field of the Lease Companies. Sale-and-leaseback has formed a valuable alternative for airlines to allow short term bridging of financial thirstiness. On short terms this tool provides the possibility to free up capital.

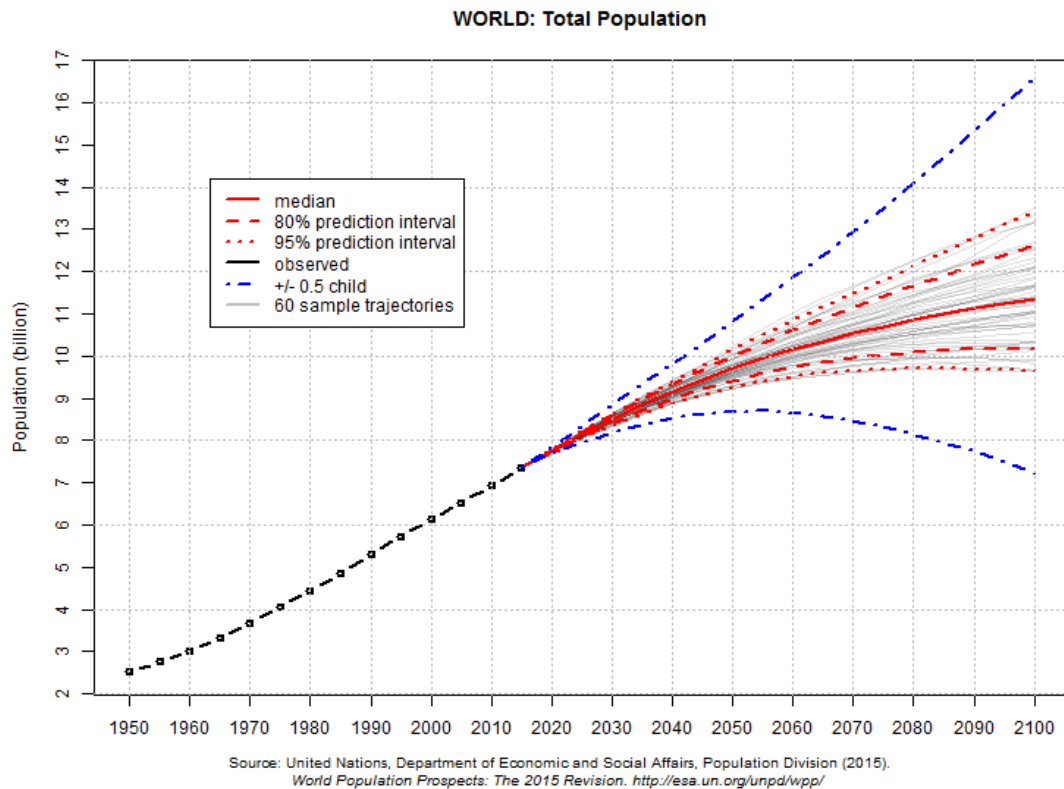
From the above it can be concluded that, today the number of transaction for aircrafts on the used market is about steadily growing and expected to become four times the number of purchases of new aircrafts, this large scale of transaction is due to aircraft and engine leasing. Evidence shows that lessors are actively engaged in the purchase of new aircraft and their acquisitions have increased rapidly in recent years, reaching today about one third of new aircraft deliveries. Equally the aforesaid has resulted in that the lessors are today more active in the secondary market since they lease out each aircraft (or engines) several times during it's useful lifetime.

4.2. Growth projections

The core purpose of the document is to assess the growth abilities of the aircraft engines, yet it is obvious that these aircraft engines form part of the aircraft and therefore the growth will depend on this industry growth. This industry growth is subject to two core elements, a) the development of the aviation industry as a whole and b) on the development of income. In phases of strong economical growth the number of airline passengers tend to increase, whilst it tends to decrease when economical crisis arise or a given economical recession is ongoing. Yet the continuous growth of the air travellers is undisputable and the observations are the only shortfall occur for a limited time and may to some extend be considered regional.

¹² PWC Aviation Finance 2013 "Fasten your seatbelts" <http://www.slideshare.net/SedaESKILER/aviation-finance-fasten-your-seatbelt>

From a demographic perspective the growth of air travellers may continue to grow over the next decades, in particular since the world population remains growing and moreover the income per capita also continuous to grow. According to the United Nations forecasts are that the current population of about 7,5bn will grow to close to 9.bn by 2035.



13

Figure 3: World Population

The distribution of population growth will thereby form an interesting aspect for the future assessment of growth potential for the industry. Globally the trend of de-urbanisation will foster the creation of a growing number of mega cities, mostly expected in the developing geographic areas, such as - but not limited to - West Africa and South East Asia, where a delocalisation within the labour sector is the driving force. Similar to the here below example of income increase per capita on its affect of urbanization, it may be expected that other geographic areas will be facing similar effects on the access of income by their population.

¹³ <http://esa.un.org/unpd/wpp/Graphs/Probabilistic/POP/TOT/>

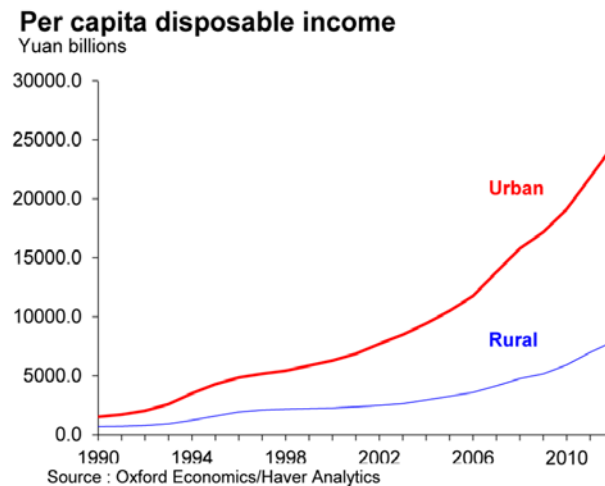


Figure 4: Example of China’s development on disposable income through urbanization

4.3. The Economic Footprint of Aviation

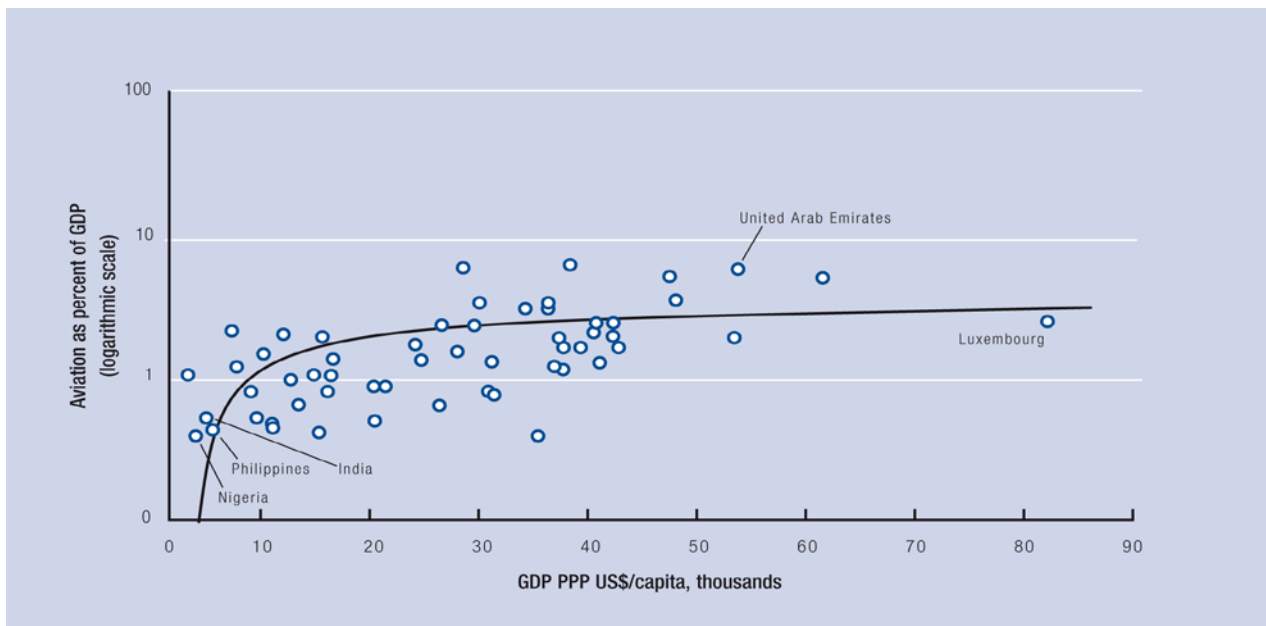
Extending the thought of growth potential, the author would like to liaise the growth potential to the role aviation assumes in enabling the economic growth and provides various economic and also social benefits. The domestic resources used to deliver all such services reflect the aviation sector’s direct impact on jobs and GDP in any given nation. The industry segment’s economic footprint is in fact summing up the direct contribution, “the output” and the number of jobs that are directly created within the segment as well as the output and number of jobs supported by the spending of those employed by the aviation industry’s direct and indirect workforce. The latter are representing the aviation supply chain, which include businesses such as fuel suppliers, catering companies and foodstuff suppliers, construction companies, taxis and bus operators and the likes. The aviation industry supply chain supported 9.3 million jobs worldwide in 2010 and contributed US\$ 618 billion to global GDP in the same year. The economic activity of those individuals supports jobs in other industries as well. Globally the aviation industry was estimated to be US\$288 billion in 2010 and together these channels provide the aviation sector’s total impact of jobs and contribution to GDP – over 22million jobs and US\$1.4 trillion in GDP.¹⁴

The aforesaid revealed the direct correlation of the aviation industry as a financial contributor to an economy, remains to be said that also the industry takes an active role in the greater economic dependence on aviation. For example countries like Iceland or New Zealand, which are geographically isolated, or nations that have, without these geographical characteristics, rebuild their economic pillars upon aviation and air transport. This has been seen specifically in countries

¹⁴ IATA « the economic benefits of aviation and performance in travel and tourism competitiveness index » chapter 1.4. p58

like the United Arab Emirates, Jordan, Israel, Japan and in Europe Ireland in which aviation is important contributor to the economy.

In accordance with the study to assess the national contribution of aviation to the respective economy, performed by Oxford Economics in 2010 on 80 plus nations, in a majority of the developed nations studies it was found that at least 2% to GDP was contributed by aviation. Suggesting that the aviation industry and a high level of development mutually reinforce each other. Here below figure shows that many countries with lower levels of development have aviation sectors that contribute less than 1% to the GDP. The opposite is the case for nations with higher levels of development where aviation makes a more significant impact. Notably the outstanding position of **Luxembourg**, upon which one can infer that a well established air transport industry will play a role in facilitating growth in a nation's standard of living. The outstanding GDP generated by Luxembourg in terms of aviation is of course to be considered in the right relevance; the presence of an International giant such as Cargolux having a fleet of 22 B747 freighters (one of the largest aircraft of its type) will cause a spin off effect on the statistical figures. Cross board and greater regional impacts are hence not fully corresponding to the exposed values.



Source: Data from Oxford Economics, 2010.

Note: These data present the GVA of the aviation sector, including direct, indirect, and induced impacts.

Figure 5: The aviation sector as percentage of GDP and GDP per capita¹⁵

¹⁵ Oxford Economics 2011 "the Economic Benefits of Aviation and Performance in the Travel & Tourism Competitiveness Index" http://www3.weforum.org/docs/TTCR/2013/TTCR_Chapter1.4_2013.pdf

4.4. Correlation of GDP and Air traffic Passengers

From the aforesaid it has been exposed that the aviation industry leaves a footprint that takes a direct impact on the GDP, nevertheless the opposite is not less important and is eventually forming a circle of dependencies. The below figures aim to demonstrate that the development of air transport, and in particular the major chunk i.e. the transport of passengers by air, stand in direct relation with the GDP development. Needless to mention that the number of passengers is not related to the growth of GDP alone, obviously the growth of the world population and a globalisation process that has taken strong impacts on the rise of the aviation industry.

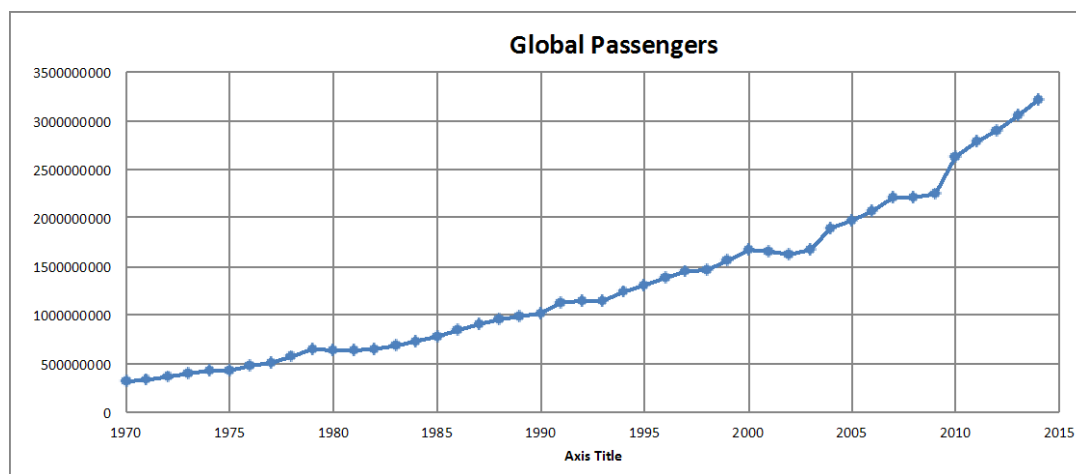


Figure 6: Global Passenger development¹⁶

It may be stated that the development of the Air Traffic Passengers is closely related to the development of income. The enabling impact of air transportation by economic drivers such as increases of income or whether they are generated by the economic activities that are dependant on the availability of aviation services. It is difficult to precisely quantify the impact of aviation simply because the inability to securely isolate them from other uncontrolled variables, such as globalization or institutional effects. In order to obtain a somewhat measurement tool, a combination of quantitative econometric model applying qualitative techniques, as applied by professional survey firms on airport catchment areas, would be required. These measurements would be allowing the evaluation of impact of changes in air transport usage on tourism, trade, local investment and productivity improvement.

¹⁶ Source: own presentation

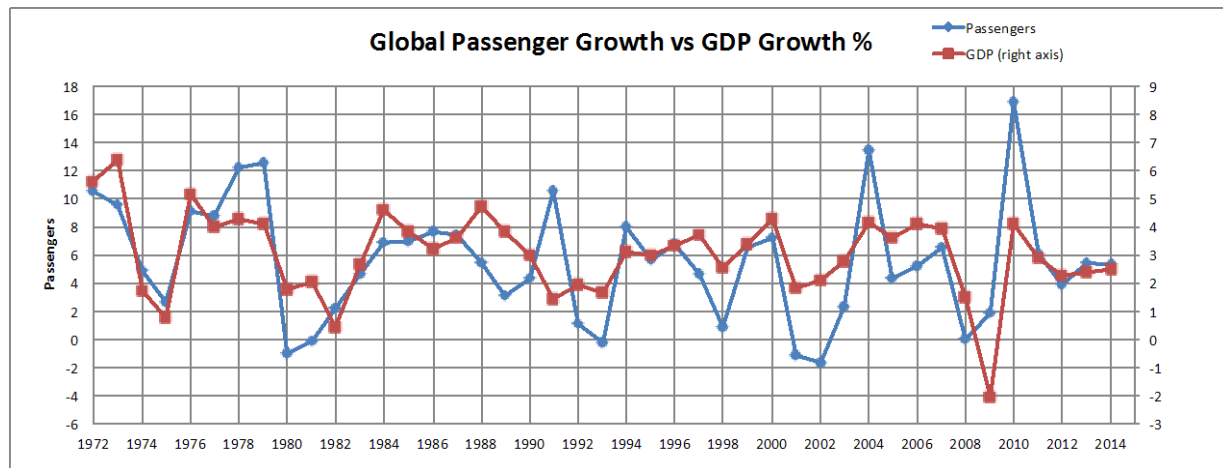


Figure 7: Passenger Growth vs. GDP Growth¹⁷

The growth process is expected to continue over the next decades, as world population and income per capita is expected to continue to grow, albeit a much lesser pace as forecasted, as the economic activity in the world economy remains lackluster, with little prospect for a turnaround in 2016. The prolonged period of slow global growth poses a challenge to the implementation of the 2030 Agenda for Sustainable Development, as financing constraints continue to remain formidable.¹⁸ Despite of disappointing forecasts and corrections on previous forecasts the indication of GDP will, to a certain extend, remain a reasonable reliable indicator. GDP growth in the least developed countries is forecast to reach just 4.8 per cent in 2016 and 5.5 percent in 2017, well below the Sustainable Development Goal target of “at least 7 per cent GDP growth”. In per capita terms, the slow down in GDP growth in many developing regions is particularly stark. In Africa, GDP per capita growth is expected to average just 0.4 per cent during 2015-2017.¹⁹

From an UN perspectives the GDP growth rates may be interpreted as disappointing and short falling on the expectations, however in the opinion of the author there may as well have been shortfalls in the accuracy of the target setting. For example are the GDP dependencies of natural commodity prices of many African countries enormous, taking its toll on the current and unexpected lows in, but not limited to, oil prices. While at the global level the impact of a shift in the oil price is minimal, it can be expected to have a significant impact on the distribution of income across regions. The oil-exporting economies of Africa, the CIS and Western Asia would

¹⁷ Source: own presentation

¹⁸ UN World Economic Situation and Forecasts “Global growth prospects”
http://www.un.org/en/development/desa/policy/wesp/wesp_current/2016wesp_update.pdf

¹⁹ UN World Economic Situation Prospects dated 12May2016
http://www.un.org/en/development/desa/policy/wesp/wesp_current/2016wesp_update_pr_en.pdf

benefit from a higher oil price. The impact on fuel-importing economies would be more modest, and would be most evident in inflation.²⁰

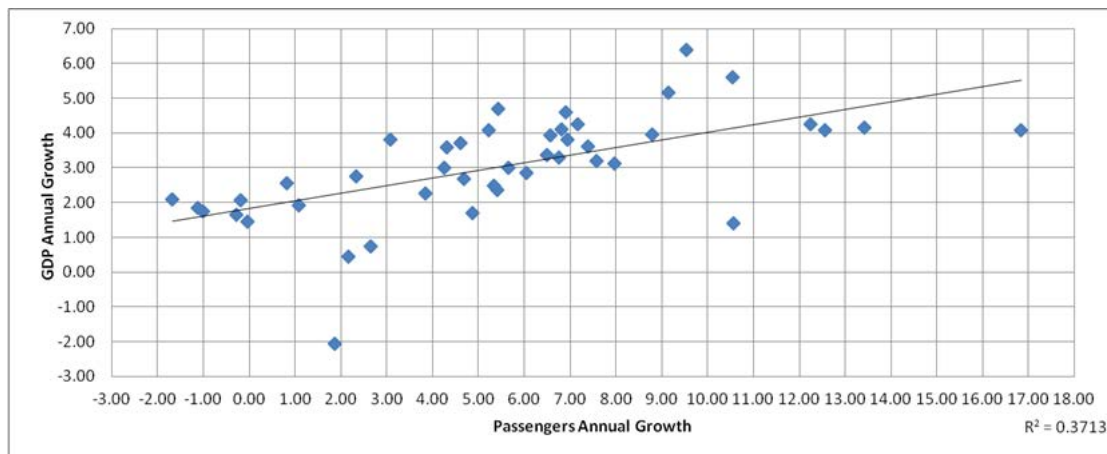


Figure7: Correlation GDP vs. Passenger growth²¹

When comparing the growths for each year in one graph then following picture appears R^2 is not high, only 0.37 but it is a clear correlation visible between the growths. Yet the extreme peaks seen in 2008 in GDP drop against a massive increase of passenger growth can be explained through market environment impacts during these periods, remarkable remains how the trends are following each other.

Taking into account the above, an aggregated trend indication shows that there is a correlation between air travel and GDP; yet growth rates and their mechanisms there behind differ for the individual economy. Governments play an important role in this relationship, that is in particular the case for less developed regions, where policies are able to influence both economic and aviation attributes regulatory and infrastructure investments.

4.5. Selective opportunities for Luxembourg

The air transport industry has a substantial economic impact, both through its own activities and as an enabler of other industries. Whether its contribution is direct or indirect induced upon the total revenues generated from this industry. Luxembourg has various opportunities to benefit of the catalytic impacts of the industry, at present most significant value generator from the industry is represented in the direct transport of passenger and cargo.

²⁰ UN World Economic Situation and Forecasts "Global growth prospects"
http://www.un.org/en/development/desa/policy/wesp/wesp_current/2016wesp_update.pdf

²¹ Source: own presentation

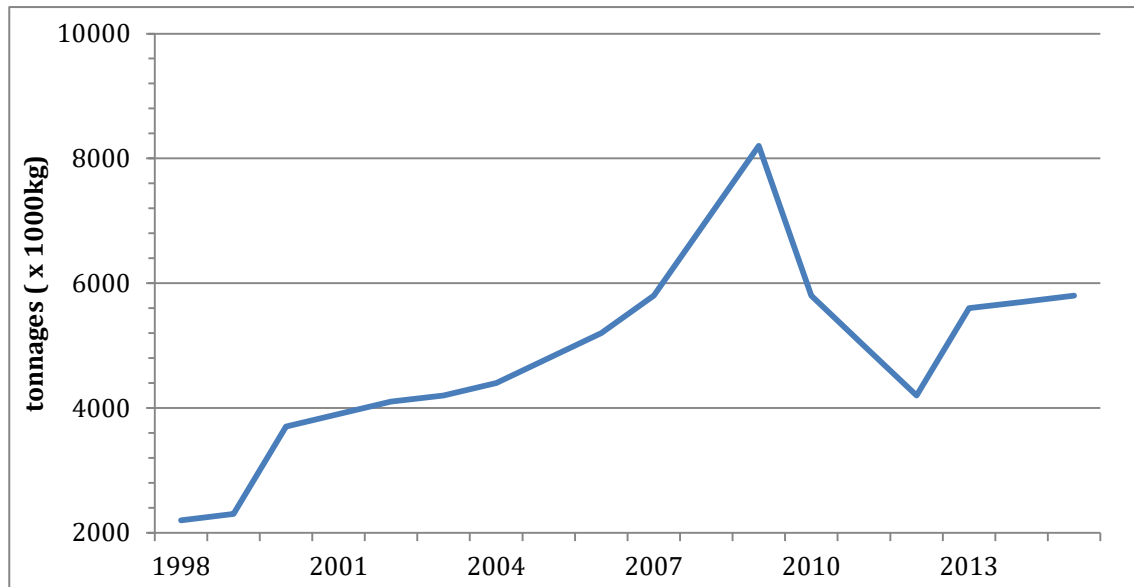


Figure 8: Luxembourg Cargo Volumes in M-Ton²²

Admitting that outlooks to generate more volumes in cargo and passenger traffic look prosperous, yet the capacities of Luxembourg are limited, and environmental constraints are serious. In particular the community's objection and resistance to abandon the night curfew²³ will continuously remain the main obstacle, primarily for cargo carriers; and in a lower degree to passenger operations.

With regards to the latter category: yes - new records on Luxembourg's passenger traffic have been set!²⁴ Fact is however that the passenger catchment area has its geographic limitations and that the lion share of the growth went to non-resident operators, leaving modest return of value to the Luxembourg economy.

There is a clear distinction between air cargo logistics and aircraft and aero engine leasing; which is that the air cargo economy does not create any spin off effect or synergy to Luxembourg as a finance place. Furthermore, as the above figure reflects, the air cargo industry very vulnerable on economic trade flows. Economic crisis as seen in 2008 have an immediate effect on the global trade, as the air cargo industry is not committed to long term portfolio engagements it has become very much dependant on day-to-day trading situations.

²² Source : « Trading Economics » <http://www.tradingeconomics.com/luxembourg/air-transport-freight-million-ton-km-wb-data.html>

²³ Compte-rendue réunion de la « Commission Consultative Aéroportuaire » 03.11.2015 p. 2&3

²⁴ Luxemburger Wort "Lux-Airport expects 6% growth" <https://www.wort.lu/en/luxembourg/air-travel-lux-airport-expects-6-percent-growth-new-destinations-in-2016-568fc7200da165c55dc50dc7>

In particular Luxembourg has manoeuvred itself into a situation where it is increasingly competing with gateways such as Amsterdam and Frankfurt. Being a purely transit airport with little to no locally added logistic values Luxembourg could face the risk that it will be even increasingly exposed to platform competition. In addition the increasing market growth of Integrators (TNT, FEDEX, UPS and DHL) and new kid on the block Amazon²⁵ -a giant actor in E-commerce transport- will indisputably form another challenge in Luxembourg air cargo industry and air cargo in general.

5. Engines are the better choice

Aircraft engine leasing, as well as a large chunk of associated business, has proven to be highly effective and to be an economical alternative for most operators. Whereas previously smaller operators were inclined to be the main beneficiaries of leasing their engines, due to the lesser engagement of capital, today even large operators, who own the majority of their engines, recognise the strategic advantage of leasing this asset rather than to own it.

Unlike cars or trucks aero-engines bear different characteristics, whereas a car engine is designed to remain its entire life in the car, (the frame) aero-engines are nowadays forming a replaceable component of an aircraft. Subject to the network operated by the airline, the airline may conduct an "engine policy" in which the airline is selective upon the engine types to be installed upon their fleet. Contrary to the car and truck manufactures; aircraft manufactures do not manufacture aero-engines, this is a different producer. Therefore as an example: a Boeing B747 aircraft can be delivered with any of the suitable engine brands (PWC, GE or Rolls Royce) allowing the airline to make their individual choices.²⁶ As performances of the various aero-engines are related to more specific operational features, airlines nowadays spend more focus on these criteria.

In order to connect the opportunities that the asset would present to Luxembourg a profound understanding of the "Aircraft Engine Lease Return Process" will need to be elaborated. This chapter aims to deepen into the segment and visualise the modus operandi of this very particular segment within aviation, of which the public opinion may conclude that the engines of an aircraft form an indivisible part to the entire aircraft, similar to wings or leading edges.

²⁵ Süddeutsche Zeitung 18.3.2016 "Amazon im Drachenboot" <http://www.sueddeutsche.de/wirtschaft/amazon-im-drachenboot-1.2936938>; ATSG Press Lease 9.3.2016 : Air Transport Group Confirms Deal with Amazon to Operate Air Transport Network, <http://www.atsginc.com/Press-Releases/2016/pr2016-03-09.html>

²⁶ Pratt & Whitney Press Release 27.9.2011: Cargolux Airlines Selects Pratt & Whitney Engine Management Program

Less is true, during the life cycle of an aircrafts its engine will be replaced several times, the intervals are subject to aircraft type, utilization and eventually to regulatory or commercial requirements. But unlike a car or truck the engines are considered, nowadays more than in the early days of aviation, to be a removable component.

5.1. Engine lease market is growing faster

Whilst the aircraft leasing has become an industry standard, the aero-engine leasing has been less historically, and yet each aircraft carries a minimum of two engines, but operators owned rather than leased their engines, this includes the spare engines. As engines over time have become more powerful and technically more sophisticated, they have also become more expensive, not only to acquire but also to maintain. Similar to aircraft leasing the aforementioned benefits of engine leases relate to cash constraints on commercial aircraft operators and the costs associated with their ownership. Aircraft operators have become more cost-conscious and today they utilize their financial resources differently in this capital-intensive business.

Value of Commercial Jet Airframes, Installed Engines, and Spare Engines, \$b

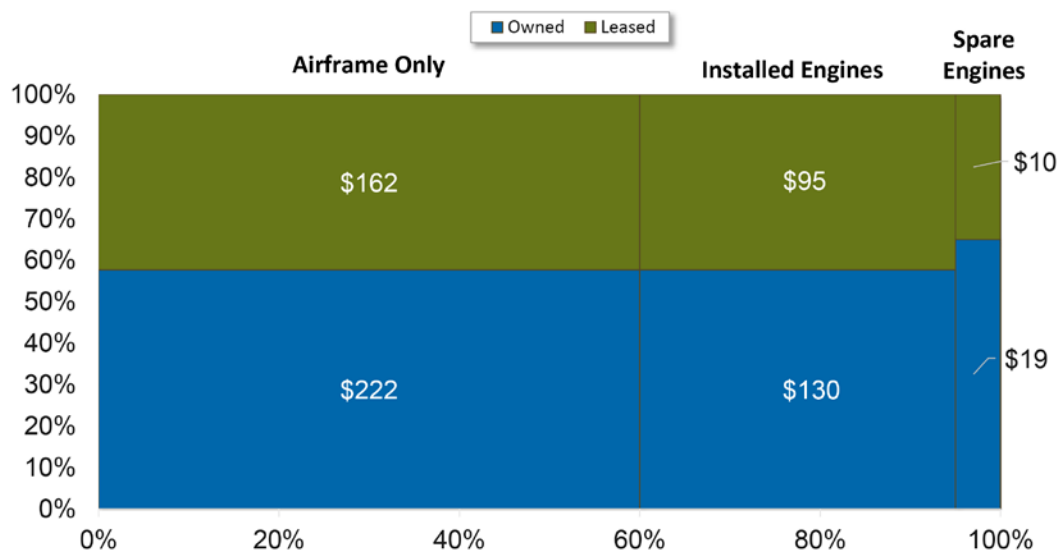


Figure 9: Size of aero-engine market²⁷ Source: ICFI

Engine leasing has matured to a specialized business and has evolved into a discrete sector of the commercial aviation market. As the consequence of the increased values the actors of this segment are dependant on access to capital and moreover in-depth technical competences in order to compete successfully.

²⁷ ICFI Airfinance « The importance of Engine Values »

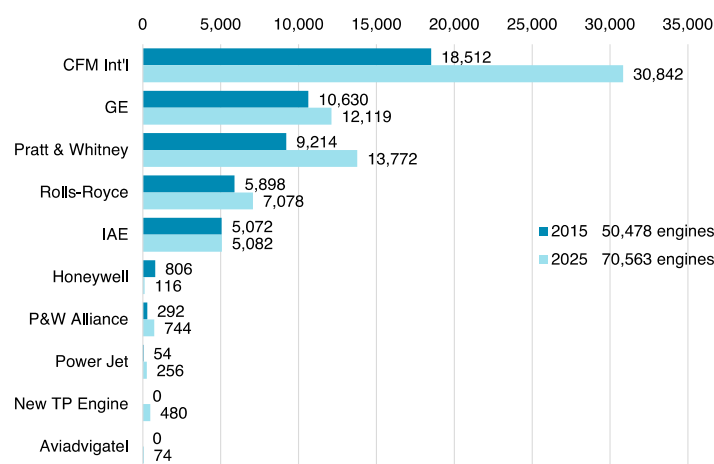
The key drivers to boost the engine lease markets are:

- The number of commercial aircrafts, and therefore engines in the market; and
- The proportion of engines that are leased, rather than owned, by commercial aircraft operators.

It is expected that both drivers are simultaneously increasing over the next 15 years, and beyond.

The global air transport jet and turboprop engine fleet will grow by more than 20,000 net new engines by 2025

**2015-2025 Engine Fleet Forecast
by Engine Manufacturer**



Key Fleet Forecast Highlights

- Global engine fleet will grow on average 3.4% over the full forecast period.
- Today, the top 3 engine manufacturers are CFM Int'l, GE, and Pratt & Whitney
- CFM International's fleet has the greatest market share (36.7%)
 - More than 15 points larger than the next largest fleet
 - CFMI's installed base will widen the gap by 2025
- Pratt and Whitney also makes large gains over the next ten years, increasing their fleet size by nearly 50%

The growth outlook, however, varies widely from region to region

© CAVOK

Figure 10: Global aero-engine fleet trend²⁸

5.2. The Engine value equation

While fuel burn is the largest and most variable operating costs in air transport, maintenance costs are still very substantial and remain one of the key areas where saving can be made. The non ability for operators to influence on fuel costs, other than taking measurements with marginal effect like hedging, implementing a fuels burn policy for crews or taking advantages of network destinations to carry 'payload-fuel' the operator will not be able to make any significant changes

²⁸ CAVOK-Oliver Wyman « Global Fleet & Market Forecast »

by himself. In the airline industry it is the maintenance management that will remain one of the key areas where savings can be made. For Lessors, the management of maintenance costs, and with a growing importance, engine maintenance is paramount. For the operator engine-related expenses accounts for around 45 per cent of the total maintenance costs, but for the lessor, who will be only considering the heavy maintenance and condition of limited-life parts (LLPs), engines can account for more than 80 per cent of their exposure.²⁹

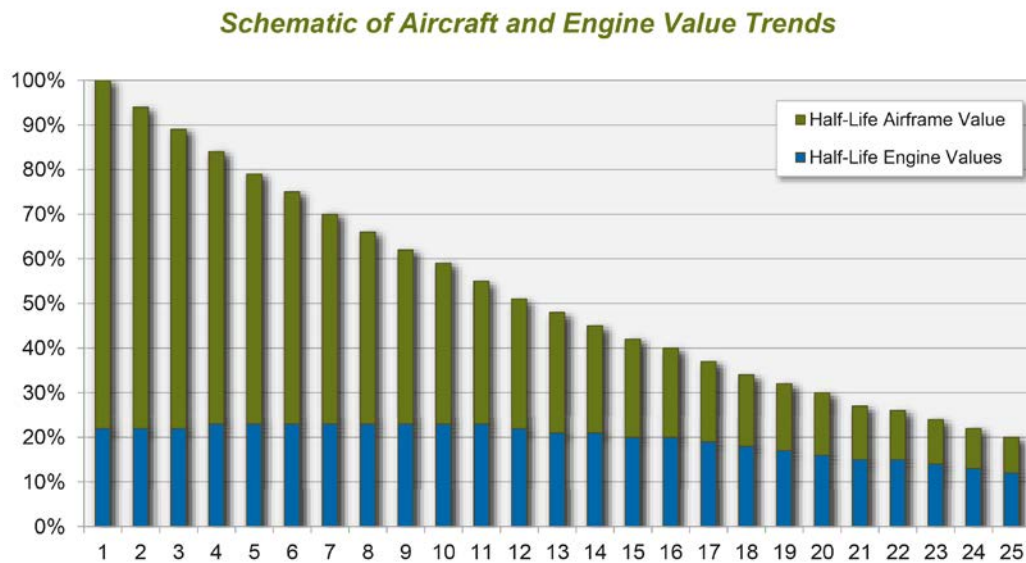


Figure 11: Aircraft vs. Engine Value ³⁰ Source: ICFC

Definition of Half-Life': (HL - sometimes known as half-time) is a standard appraisal industry term to indicate that no value adjustment has been made for the actual maintenance status of the aircraft. It thus enables a comparison to be made between values of aircraft of different types and ages using a common denominator. It does not indicate that the aircraft is half-way through its useful life.

Half-life assumes that the airframe, engines, landing gear and all major components are half-way between major overhauls and that any life-limited component (for example a cycle limited engine) has used up half of its life.

5.3. Engines have higher level of standardisation than Aircrafts

The engine lease market is dependant on only two fundamental drivers.

1. The number of commercial aircrafts, and therefore engines, in the market, and
2. The proportion of engines that are leased, rather than owned, by commercial aircraft operators.

²⁹ The Engine Yearbook 2015 p. 62 «The engine value equation»

³⁰ ICFI Airfinance « The importance of Engine Values »

As described herein before the overall market expectations are that both drivers will increase over the time. As supplement to the two drivers the spare engine segment, however this segments represents hardly 10% of the entire engine volumes and is therefore taken in to consideration, but it may not form a driver.

Given the aforesaid the comparison of the engine portfolio versus an aircraft, or also referred to as airframe, can be found in the significant difference of standardisation. Whereas each operator will determine its specific cabin lay out, applying specific “inflight entertainment” systems, seating and passenger class configurations (first-business-economy) and thereby aiming to differentiate their products from competitors, non of these is applicable for the aircraft engines.

Taking into account the limited amount of engine OEM’s and moreover the limited ability to interchange these engines across the various aircraft types; it is only logical to conclude that the field actor have implemented a high degree of standardisation.

Taking into account the aforesaid, one can conclude that there has been (or will be) a resurgence of interests in older assets, in particular taking into account the drop of the Brend Curde price. Older engines may not compete with their newer rivals on fuel burn efficiency; yet in the overall Direct Operating Costing they will not be recognised as cost prohibitive elements. In other words: the low(er) cost of fuel is causing more airlines to extend engine leases on older assets, leading to better value retention for these engines.

5.3. Engines have more value generator

The value of the engines are greatly depending upon their condition, the maintenance services performed on them during the period of operation and more specifically the numbers of hours and cycles used during the period of operation, which will than determine the operational value at a given moment.

Consequently the values will be determined by the condition of the engines, whereas the ability to continue to lease or sell the engines on favourable terms may become adversely affected. This creating additional room for generating more values on the asset for either other market players or side businesses of the lessors.

Value generators within the asset portfolio could be:

1. Shop visit coverage by MROs
2. OEMs protecting and managing product aftermarkets

3. Parts traders optimize value by burning off green time resulting in a fast churn on the engine portfolios.

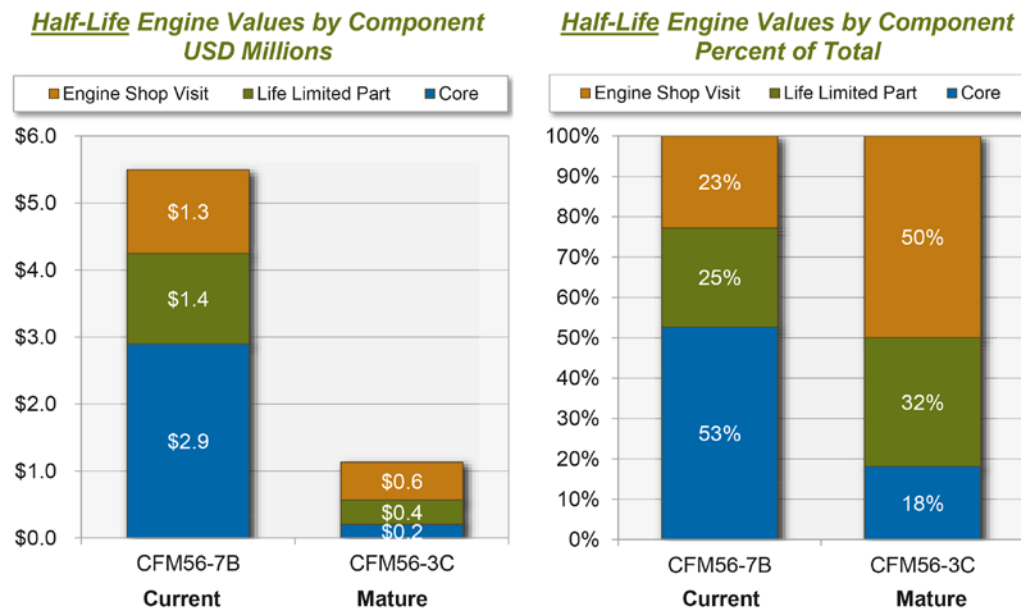


Figure 12: Added Value Graph³¹ Source ICFI

The value of a particular model of engine is heavily dependent on the status of the aircraft type on which it is installed. Values will tend to remain stable for as long as the host aircraft for the engines as well as the engines themselves are still being produced. Contrary to the airframe, the engines may even maintain a more stable value, or even rise in value, if the host aircraft is no longer manufactured as long as there are sufficient feed stock for the host aircraft. Engines will only begin to decline, rapidly, once the host aircrafts will be phased out in significant numbers.³²

5.3. OEMs dominate the market

Engine original equipment manufacturers (OEMs) are much more directly involved in the after-sales and MRO markets than their airframe counterparts. A look at the revenue streams that are generated by engine maintenance gives an indication as to why this might be the case. This explains why manufacturers are prepared to sell their engines at virtually cost price.

³¹ ICFI Airfinance « The importance of Engine Values »

³² Willies Leasing Corporation Annual Report 2014, p.5,6
https://www.willisleasing.com/pdf/annual-reports/WL_2014_FullAR.pdf

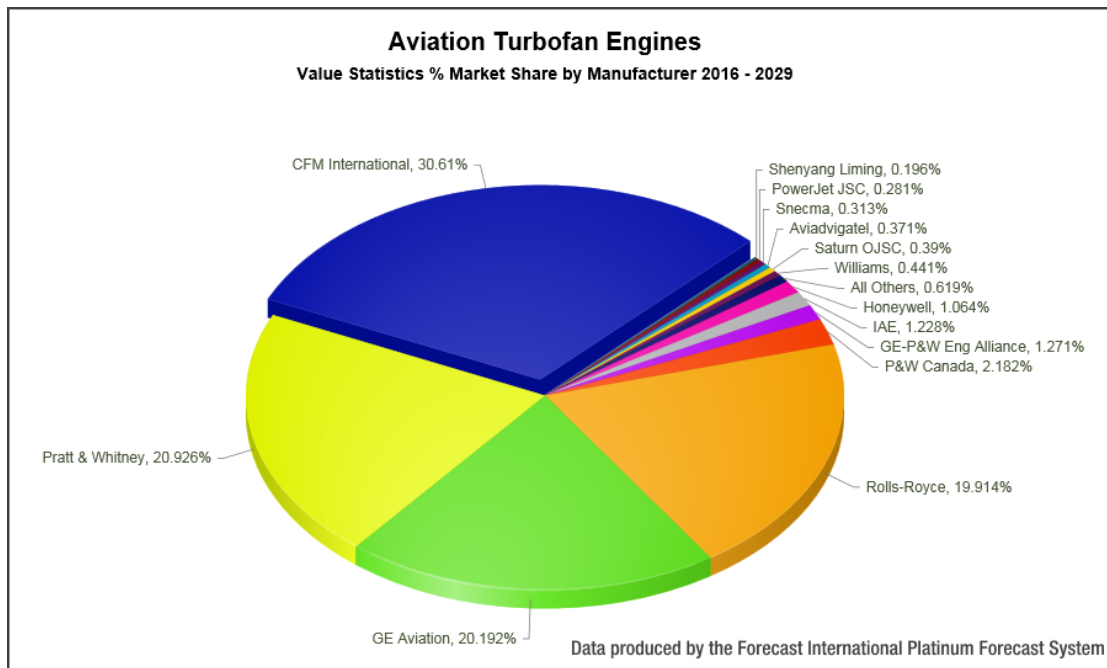


Figure 13: OEMs Market Share

The commercial aerospace engine original equipment manufacturers (OEM) industry, like the aircraft OEM industry, is highly consolidated. It is characterised by high entry barriers due to high costs and long development cycles of new engine programmes (over five years). Though commercial aircraft engine programmes and production levels are closely tied to the aircraft cycle, they are less cyclical than the aircraft OEMs because they generate revenues throughout the life of the engine (usually around 30 years) through aftermarket sales—spares and engine maintenance, repair and overhaul (MRO) operations. Engine OEMs typically generate four to five times the value of the engine through aftermarket revenues.³³

The cost of maintenance is important. Though it represents a smaller piece of a typical airline's budget than labor and fuel, engine maintenance is often the largest controllable cost. With escalation on OEM materials commonly exceeding 5 percent per year, rising maintenance costs could even swing an airline from profit to loss³⁴. For airlines, slowly enabling OEMs to control the maintenance market is like taking the family car to the local dealer for any kind of work, from major repairs to oil changes. If every car owner relies only on the dealer for maintenance, the low-cost neighborhood auto shops cannot survive, and the €30 oil change vanishes.

³³ Société Générale Investment Strategies "the aftermarkets drive aerospace engines manufacturer's growth" 4.2.2015
<https://www.privatebanking.societegenerale.com/en/strategy/equity-solutions/equity-research-watcher/the-watcher-details/news/aftermarket-drive-aerospace-engine-manufacturerse-growth/>

³⁴ Oliver Wyman Aviation - Risk Journal Volum3 "Manufacturers take on Maintenance"
http://www.oliverwyman.com/content/dam/oliver-wyman/global/en/files/archive/2013/CH_4_Manufacturers_Take_on_Maintaenace.pdf

The current generation aero-engines (CFM International's CFM56, IAE's V2500, Rolls Royce's RB211 and earlier Trent variants) are on the verge of being replaced by engines with the next generation technology, driven by the need for reducing fuel consumption, emissions and noise levels. The phase out of current generation engines is expected to happen during 2016-18. This would lead to a huge installed base of mature engine programmes and increased shop visits and spares growth. As the high-margin spares and services business mostly drive OEM's profits and cash flows, the increase in installed base of mature engine programmes should lead to higher aftermarket revenues for the OEMs. However, the increase in revenues would be partially offset by higher learning costs due to the initial production ramp up of newer engines (CFM LEAP, Pratt & Whitney 1000 series, Rolls Royce Trent XWBs).

According to international consultancy firm ICF International, the global engine MRO market is expected to grow at a 2012-22 CAGR of 4.1% to reach USD 34bn by 2022 driven by a steady growth in airline passenger traffic (up 5.6% YTD, as of November 2014).³⁵

The backside of the medal is; as the maintenance, repair and overhaul market is crucial to an aero-engine's value, smart, or cash-rich airlines are actually choosing to purchase the asset as an own investment tool.

5.5. Regulation is required

Dominance in an industry segment may lead to abusive terms and conditions, and regulators are prompt to react upon such allegation, once raised. So the case when IATA (International Air Transport Association) has become a complainant in the investigation, which is being led by the European Union's directorate general for competition. (DG-COMP). Stating that there is a deep concern for their members; there are relatively few equipment vendors resulting in too little flexibility in negotiating for the after market services. Equally have aero-engine investors been raising concerns about the residual values of their asset are affected by the OEM's behaviour. As the investigation process is on going, the EU's competition team is gathering information about the aftermarket, the various actors are anxiously awaiting whether the EU will launch a formal investigation or not. In any case its conclusion will further increase this very debate.³⁶

³⁵ ICF Intl: "Aero-Engines Americas Market Forecasts and Key Trends"
<http://www.icfi.com/insights/presentations/aviation/2015-aero-engines-americas-market-forecast-february>

³⁶ Airfinance Journal May 2016 "EU probes the OEM/MRO Market" p28/29.

For example the EU-Commission is in particular asking about CFM56 engines built by a joint venture of General Electric Co. and France's Safran SA, as well as auxiliary power units made by Honeywell Inc. Both components suppliers have huge market presence, the CFM56 is the only engine offered on the Boeing 737 single-aisle plane and one of two options to power Airbus A320s. The two aircraft are the workhorses of global airline operations.

The Commission is trying to gauge whether suppliers are abusing their market position as Engine maintenance remains the biggest repair bill for airlines and last year represented about 40% of the total to keep fleets flying, ICF International says. It expects engine repair costs to rise 3.5% a year through 2024 excluding inflation.

For engine makers, contracts to repair engines, which often stretch many years, are typically the most lucrative part of their business. For some engines, options to find third-party vendors to maintain the equipment are limited, helping assure healthy profitability for the suppliers³⁷

6. An expanding opportunity on Engine Lease market

6.1. Increase of Aircraft operating leases

Both markets, Aircraft and Engine operating leases are growing as a percentage of their total fleets airlines are turning increasingly to "operating" leases, in which they really are renting the planes, for a few years at a time, with a leasing company bearing the risk of any slump in their second-hand values. Over a third of the world's airline fleet is now rented (see chart figure: 2 p.8.) and the proportion is likely to keep growing. Prospects for the leasing businesses are strong, airlines lack cash to finance their big plans for fleet renewal, and they cannot borrow cheaply to buy new planes. Deals in which airlines sell part of their existing fleet to a lessor and rent it back are becoming more common.³⁸

6.2. Spare engine leases

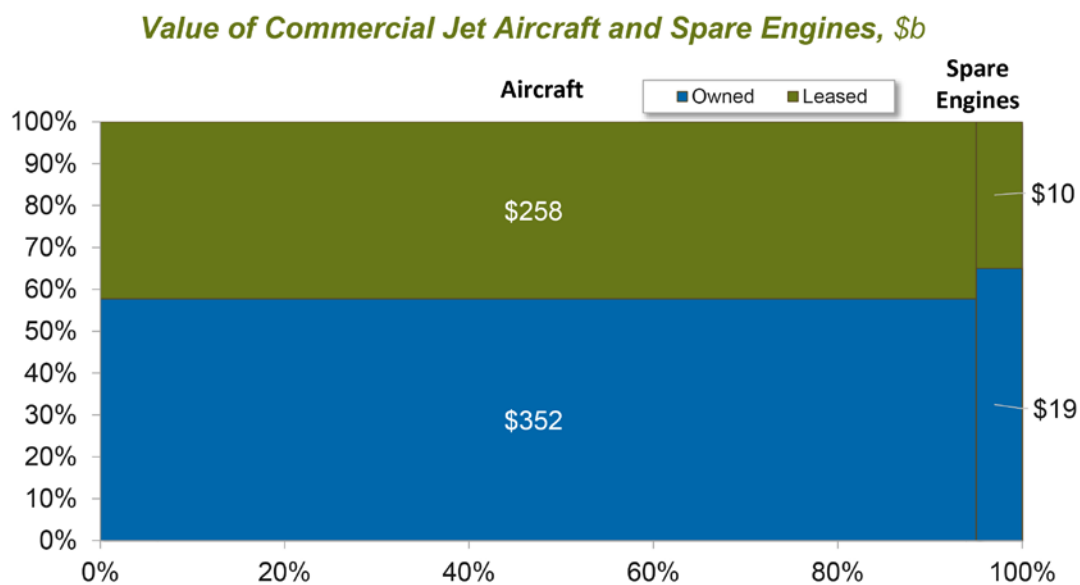
Spare engines provide a supportive element to installed engines in the event of a routine or other engine maintenance or unscheduled overhaul. The number of spare engines needed to service any fleet is determined by various factors, which can include:

³⁷ The Wall Street Journal 25.10.2015 "Europe Mulls aircraft parts competition investigation amid airlines complaints" <http://www.wsj.com/articles/europe-mulls-aircraft-parts-competition-investigation-amid-airline-complaints-1444919179>

³⁸ "The Economist: Aircraft Leasing: Buy or rent" <http://www.economist.com/node/21543195>

- The number and type of aircraft in any operators fleet
- The geographic location of such operators and their destinations
- The number of spare engines an aircraft requires in order to fully ensure the coverage of unpredicted and scheduled overhauls.

In accordance with industry analysts forecasts the percentage of leased engines is expected to increase significantly over the next 15 years, as engine leasing follows the worldwide aircraft fleet and the aforesaid significant cost associated with it and the emergence of the new niche focused airlines which even more intensively use leasing in order to obtain their capital assets. Consequently this may lead that commercial operators are increasingly considering their spare engines as an important capital asset, where leases will form the more attractive solution than a capital lease or even ownership of spare engines. A qualified estimation of the author would conclude that than 35 to 40% of the spare engine market may very well fall under leased engine.



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Figure 14: Value share of Aero - Engines

³⁹ Air Finance Journal "Events - Aircraft and Engine Trading & Remarketing Day 2015"
<http://www.icfi.com/insights/presentations/aviation/2015-aircraft-engine-residual-values>

7. Engines are attractive aviation assets.

Let's come straight to the point why: From an ownership perspective the **aftermarket is so important!**

Certainly in comparison with airframes and even more so in the high profile passenger airframe segment, while the asset preservation modus from the technical perspectives are settled through the application of the “Maintenance Reserves”, a prepaying provision modus during which the lessor transfers cash onto the lessors account to ensure the availability of funds for upcoming maintenance works; the marketing preservation is left unattended. Meaning that at end of leases or in the event of a long-term operation of the aircraft, the newer aircraft models will have increased in attractiveness in terms of passenger comfort and thereby create a competitive advantage that will eventually take its impact on the asset value.

A maintenance reserve provision ensures that the airline, the lessee, has sufficient cash to meet its high cost maintenance obligations. Here the lessor sets aside money from the operating lease dedicated to maintenance, this does not include any cabin and galley related items. However the costs of rebranding can be huge, there is typically little change left from \$8 million for a wide-body aircraft after new seats, overhead bins, galleys, inflight entertainment systems, overhead lockers and the like have been replaced.⁴⁰

But banks need to manage their risk; consequently they need to assess and analyse the risks that their portfolio is about to undertake. These risks are increasingly intensified by the complexity of the industry pared with political interests Financial Leases are set forth in the manor that the Lessee will acquire the aircraft at the end of the Lease. In that case the state or condition of the leased asset at the end of lease period will not be as important as if the asset will be returned for re-marketing.

To summarize the attractiveness for financial institutions to focus on aircraft engines more as a separated asset than being part of an aircraft as a whole the following bullet point can provide the arguments:

7.1. Long economic life

40 years plus is common for engines and OEMs offer long-term maintenance plans to enhance asset values.

⁴⁰ « Maintenance Reserves » Air Finance Journal November 2003.

7.2. Unit Price is lower than the aircraft price

Which enables a diversification of portfolios to be build up and risk can be spread over several types.

7.3. Cash Flows are more predictable

Lease rates show lower volatility than aircraft and maintenance reserves provide cash collaterals.

7.4. Engine values are more stable than aircraft values for life.

Cabin layout and technology is driving the aircraft values significantly, whereas demand for engines is not reliant on industry health and growth alone. Shop visits renew values periodically and this more than airframe.

7.5. End of life engine value is greater than the aircraft value

Active used parts markets and sum of parts are often greater then the whole airframe.

8. Engines win the residual value battles

8.1. Total engine values as % of total aircraft value

Though the engine aftermarket space is competitive due to the presence of multiple third-party vendors that offer spares and services to airlines, the OEMs retain a major share of the business by incorporating long-term service agreements (LTSA's) and by utilising better technology complex engine parts (which makes it difficult for third parties to reverse engineering). CFM International accounts for a 36% share of its current spares and services business. Nearly 80-85% of CFM's next generation LEAP⁴¹ engines (20-25% for CFM56) and about 85-90% of the Rolls Royce Trent engines are being bundled with LTSA's that usually last for over 10 years. LTSA's should enable the OEMs to gain considerable market share in the aftermarket business in the long term.⁴² The below graph illustrates the sustainability of the values of the engines compared to the airframe, yet it is to be stated that the overhaul costs and replacement of LLPs (life limited parts) represent a cost to sustain these values. Seen from the perspective of the engine owner, that would be part of the lease conditions towards the actual operator. Consequently it is the operator that maintains the value of the engines.

⁴¹ LEAP = Leading Edge Aviation Propulsion

⁴²Société Général Investment Strategies "the aftermarkets drive aerospace engines manufacturer's growth" 4.2.2015
<https://www.privatebanking.societegenerale.com/en/strategy/equity-solutions/equity-research-watcher/the-watcher-details/news/aftermarket-drive-aerospace-engine-manufacturerse-growth/>

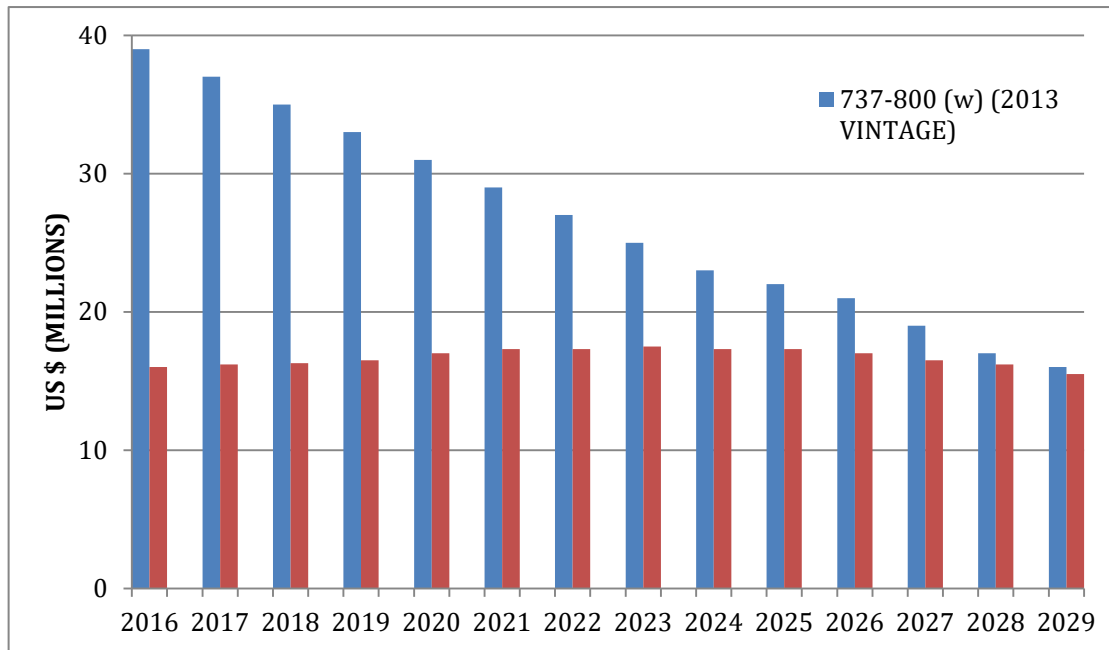


Figure 15: TOTAL ENGINE VALUE RELATIVE TO AIRCRAFT VALUE

Future Base Value 2016-2029 @ 1.0% inflation (aircraft) and 2.5% inflation (engines) ⁴³

8.2. Different interfaces with different perspectives

Towards the engine leasing industry there are three major interfaces that each have their particular perspective on the values:

1. **The Financial Institution** that is attracted to the asset classes and anticipates to see growth and have an interest in improving the balance sheets of the airlines (Operators).
2. **Part traders** that have an interest, in and contribute to, maximizing the values of the assets once detached from the mainframe, thereby they are building a network with key players in the field and have an interest in augmenting the service portfolio. Part Traders are in general interested to see the values of entire airframes decrease but there against have an interests in valuating the individual components of the Aircraft and/or Engine.
3. **MROs** assume the role of a competitive tool to extend the values of the engines, by overhauling these and by replacing (some) minor components reinstate the value. De facto MROs supplement the leasing companies and alternatively they undertake leasing as a secondary business that does not represent the core business of the MROs.

⁴³ Avitas/Airfinance Journal May 2016 "Engine Survey 2016 - Lease of Life" p. 6

8.3. The Engine Lessors Market Place

Companies that lease aircraft to airlines are increasingly focusing on engines and also becoming more active in the element of MRO. The engine leasing industry has changed significantly in the recent four to six years, what previously has been considered as a rent extension for older equipment has given way to short-term deals that burn off the remaining service life of a turbofan before teardown, so called “Green Time”. This has eventually reduced lessors’ maintenance concerns, but accurate knowledge about an asset’s service history can still be the difference between a wise investment and a burden on the balance sheet. This is what could be defined as the knowledge based capital of Engine Lessors.

The aviation leasing market is now about 25 years old and approaching full maturity. Like aircraft, engines are established as alternative assets, while a growing pool of lessors offer sale-and-leasebacks, short-term contracts and green-time operations, which seek to monetize the remaining service life on older equipment. By generating this specific knowledge has been created by a dedicated industry branch that has developed competences, and unlike previous focus set on aircraft leasing, generated the aforesaid specific know-how on how to capitalize best on the engines, its aftermarkets and repairing ability.

Unlike aircrafts, these competences have identified that there is a fundamental difference in how spare engines — which account for the power plant leasing market — are utilised. Engines have a life and maintenance cycle independent from the airframe. As a consequence, airlines require a stock of spare engines to replace installed engines during both planned and unplanned engine removals.

Engine Lessors are actively helping airlines to improve their balance sheet and diminish their risks. Airlines will focus on managing their core operation and that is flying, furthermore they are actively fostering to reduce and de-leverage their risks by outsourcing.

As elaborated upon before, airlines are increasingly interested in sale and leaseback of their assets, equipment and inventories. Nowadays airlines tend to focus on their balance sheet and costs. These two types of removal, each of which has its own level of unpredictability, make managing spare engines and optimising their utilisation a greater challenge from both the asset management standpoint of the lessor, and the operational perspective of an airline trying to avoid cancellations. Consequently taking into account the aforesaid, the competence and knowledge of the engine

lessors will allow these to put focus on the values of the services they actually render to the airlines industry. Lessors have proven to be equally or better to source finance, identify new market needs and value added services that will support the airlines requirements, and allow these to concentrate on their operating role.

8.4. Spare Engines demands growth in parallel

The market requirements for engines and as a consequence of the higher flexibility will also drive up the demand for spare engines used by a much larger portfolio than at the times when airlines owned and stored their own engines and in particular spare engines.

Interfaces:

- **Lessors** will place the engine capacity in the market and specialize on the assessment of their portfolio.
- **Financiers** will place their capital in the ownership and of engines as an attractive and risk limited business.
- **OME's** offer spare engines, their management and control with regards to the enhanced service packages.
- **Operators** (Airlines), will not consider spare engines as their ownership nor will it form their core business. Engine pools are available and work well for the majority of the airlines (and to some extent to the lessors).
- **MRO's** Loan engines as a benefit to their portfolio the airlines, it does not form their core business but they are confronted to the operational issues of spare engines.

Part Two

9. History of Luxembourg and aviation

Luxembourg has actually quite an extensive history in aviation, which dates back to the 1930's when Luxembourgish aviation pioneers chose the site of Findel to practice their passion. The war delayed the project, and it was only in 1945 that Findel Airport started its operations that was eventually opened in 1946. From grass runway, traffic growth lead to the construction of two new runways in early 1950: one from 2000 by 60 meters and the other from 1600 by 50 meters. In 1954, the main runway was marked and extended to 2830 meters. These measures finally allowed the Grand Duchy of having an international airport that can handle day as well as night flights.

This expansion of the airport was partly due to the company "Luxembourg Airlines" which was renamed as Luxair in 1962. In 1970, the year of the birth of the cargo operator Cargolux. A new terminal was built in 1975 and in 1976 and the new cargo centre has been inaugurated. In October 1984, the main runway was extended to 4,000 meters and in the 1990s a new control tower centralizing air traffic control and radio engineering was put into service.

On the passenger side re-development took off by the first stone-laying of the new terminal A that was laid on December 17, 2003, less than 5 years were needed to carry out this engineered structure, and thereby enabling Lux-Airport to handle up to 3 million passengers in this modern and functional terminal, offering passengers advanced technologies in terms of quality, safety and security, sustainable development and passenger reception ⁴⁴. Nowadays the airport of Luxembourg has been largely recognised ⁴⁵, by politicians and population alike, to be an indispensable part of the country's economical development and yet in the view of the author the "Zenith" of the purpose it yet to be reached.

9.1. The Root Cause

Around 1950 the Icelandic government was worried about some safety issues and decided to split the local routes and gave all the good routes to Icelandair and the rest to Loftleiðir. This decision

⁴⁴ LUX-Airport Historic <http://www.lux-airport.lu/en/The-airport/History.56.html>

⁴⁵ Luxemburger Wort "der fliegende Wechsel" 12-5-2012 <http://www.wort.lu/de/business/fliegender-wechsel-ein-kommentar-4fb21704e4b01658a39186c1>

forced Loftleiðir to leave the local market and concentrate on international routes and they became highly successful on transatlantic routes flying from the US via Iceland to Luxembourg. In 1970 Loftleiðir however needed to sell their CL-44 but could not find any buyers so they contributed their CL-44 aircraft to the foundation of Cargolux Airlines in Luxembourg⁴⁶. On 4 March 1970, Loftleiðir, Salén, Luxair and some private interests founded Cargolux and started operations from the newly established home base at Luxembourg airport with a handful of Canadair CL-44 freighters, laying the ultimate foundation for Luxembourg's aviation history⁴⁷.



Figure 16: Cargolux CL44 “The swingtail” registered in Iceland

Ever since Luxembourg's leading role in the air cargo transportation had been growing to such an extent that Luxembourg is now found on top of the maps of major cargo airports and, as publically known, ambitious targets for the future have been set both for Luxembourg Airport as for Luxair/Cargolux⁴⁸.

Yet the Luxembourg aviation community did, in the view of the author, not capitalize to the maximum of its abilities. The local actors have, for their individual purposes, created an environment of that will serve almost exclusively the legacy operators of which Luxair and Cargolux are regarded to be each of their kind "THE" legacy carrier of Luxembourg.

⁴⁶ Loftleiðir, First customer to buy the commercial version of the CL44
<http://www.cl44.com/cl44/operators/loftleidir.html>

⁴⁷ Cargolux history <http://www.cargolux.com/about-us/profile/history>

⁴⁸ “Luftfracht legt wieder zu » Luxemburger Wort 21.1.2016

9.2. Luxembourg airport development



Figure 17: Luxembourg Cargo Terminal 1973 and today

Today Luxembourg airport has grown to a substantial size, the two major pillars of its undertaking are the transport of passenger and cargo by air. Luxembourg Airport serves some 70 destinations for some 2.7 million passengers in 2015 and some 80 full freighter destinations⁴⁹ are yearly generating 750.000 tons of airfreight.⁵⁰ The airport has been seeing much more political support since the subprime crisis in 2008, as cargo volumes dropped (see figure 8) and the importance of the airport as an economic value for Luxembourg have manifested itself amongst the establishment.

From an aero technical perspective the development have been modest, other than a self-serving maintenance hangar for local carriers no specific anticipations have been envisaged. Yet the airport would offer an adequate facility to extend its activity into this segment.

⁴⁹ LUXAIR "Cargo Schedule of Cargo Flights July 2016"

⁵⁰ LUX-Airport press release 28.6.2016 "Airport City Master Plan"

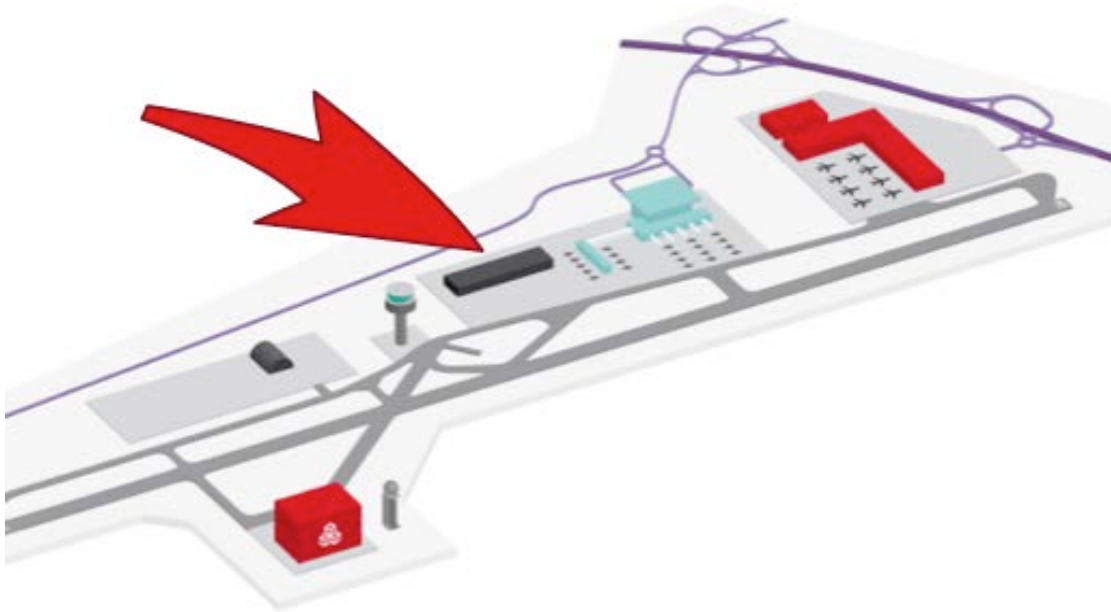


Figure 18: Airport facilities that could become an "Aero-Engine Centre"

The envisaged location of the former "Luxair Cargo Centre" and former Cargolux Hangars are yet to find their re-utilisation. Whilst part of the Hangar are being used for garaging high profile Business Jets of the local operator Lux-Aviation, no other destination has been announced for the somehow 22.000sqm for storage and hangar. Recently published "Airport City Master Plan" foresees a substantial improvement of accessibility for air passengers, consequently ruling out cargo handling activities and heavy logistic purposes of the former cargo centre, as they would jeopardize the aforesaid in absence of direct motorway access for trucks. There against a storage and preservation area for aero-engines, far less frequented than daily air cargo movements, would contribute to the valuation and diversification of the airport and complete the missing link between real and virtual aero-engine asset management.

10. Luxembourg's shadowed development

In parallel to the development of air cargo industry the author is of the opinion that the Luxembourg actors facilitated in parallel to other countries legislation changes serving their own specific needs. A good indicator is that aircraft oversight costs and costs of aircraft registration in Luxembourg are significantly more attractive as in Ireland. Yet the Leasing Industry fosters Ireland as "the" attractive platform, whereas the registry fees for aircrafts and aero engines as well as the oversight competences are key elements for operational leasing companies as it affects their ability to promptly and for short terms operational purposes, such as Ferry Flights, bridging

between two lease agreements or simply sustaining the leases on Special Purpose AOCs held by the Leasing companies, precisely held for the aforesaid purposes.

Example:

| Air Operator Certificate Fee for B747-400 MTOW 397 tons | Luxembourg | Ireland |
|---|-------------------|----------------|
| Annual Airworthiness Surveillance one A/C € | 54463 | 106786 |
| (Annual Airworthiness Surveillance two A/C €) | (94825) | (213572) |
| | | |
| AOC Surveillance/Renewal | 10120 | 50453 |
| 1 time A/C registration fee | 80 | 961 |
| | | |
| 1st inspection for issuance of airworthiness cert. | 17175 | 106786 |
| plus add taxes, travel, hotels, hourly fees for the inspectors etc. | | |

Figure 19: Civil Aviation Fees Luxembourg vs Ireland⁵¹

This example shows quite significant the difference between what is perceived to be attractive and the reality in Luxembourg. The above table may clearly indicate that regulators in Luxembourg have adhered to continues requests from their operators to mitigate these costs, whereas in Ireland it may indicate that the tax leverage it is granting is being repaid in airworthiness fees.

⁵¹ Memorial B-n°35 19 avril 2011, Irish Civil Aviation Authority (IAA) "Continuance Fee Calculator valid 2011"

11. Platform competition

Whilst Japan, Singapore and China (Hong-Kong) are coming to join the party of platform competition this chapter will focus on the intra-European competition.

If and when a French member of parliament, M. Nicolas Dupont-Aignan, in an interview refers to Luxembourg as a "Rogue State" and Ireland and the Netherlands as a "Parasite State"⁵², it becomes clear which countries (within the EU) are battling for platform competition. Yet Ireland seems to have won the Aviation battle over the Netherlands and the not participating of Luxembourg. The reasons appear to be quite simple, Luxembourg had neither resource to spend in order to develop this industry sector, nor did it have a track record history in this segment, as its aviation industry was busy transporting goods around the globe, and this quite successfully.

There against the Dutch aviation industries traces its roots back to the foundation of Fokker⁵³ (1911-1996) in the Netherlands, whereas the Irish aviation industry was boosted by the foundation of Guinness Peat Aviation in Shannon back in 1975, by former Aer Lingus Managers Guinness Mahon and Tony Ryan.⁵⁴ Last named became later the famous co-founder of Ryanair⁵⁵ in the early 1980's, which will need no further addressing; aforesaid forming the core elements for Ireland to become one of the world's leading centres for aircraft lessors. In the meantime Ireland has build a long and successful tradition within the aviation and aerospace industry and it is being respected worldwide. The industry in Ireland employs over 25.000 people in airlines, airport, maintenance, financial services, manufacturing and in the aviation technology.⁵⁶

11.1. Aviation Leasing in Ireland

Ireland has become the "place to be" for aircraft (and to some extend aero engine) leasing and has become a true world leader, Irish based aircraft leasing companies manage \$ 150bn in assets accounting for 19% of the global fleet (19.000 aircraft).⁵⁷ Nine out of the world's top ten leasing

⁵² In an interview with EurActiv France, the MP called Luxembourg a "rogue state", because it "allows the creation of trusts that hide the identity of their shareholders, which costs everybody a lot", while the Netherlands and Ireland are "parasite states" according to him, because "they offer favourable fiscal conditions to enterprises".
<http://www.euractiv.com/section/euro-finance/news/luxembourg-is-a-rogue-state-ireland-a-parasite-state-says-french-mp/>

⁵³ History of Fokker <http://www.fokker.com/company/history>

⁵⁴ GE Capital History <http://www.fundinguniverse.com/company-histories/ge-capital-aviation-services-history/>

⁵⁵ Irish Times "Tony Ryan: ingenious, driven, reckless, avaricious" <http://www.irishtimes.com/culture/books/tony-ryan-ingenious-driven-reckless-avaricious-1.1531778>

⁵⁶ FAEI "Submission of the aviation finance and support industry" July 2013 p. 3

⁵⁷ Ireland Aircraft Leasing Companies Directory

<http://irishaviationresearchinstitute.blogspot.lu/p/ireland-aircraft-leasing-companies.html>

companies currently operate in Ireland; mainly their operations are spanning the industry value chain from sales to asset management and technical services. What is it that makes Ireland so attractive, also in Ireland Lessors are obliged to comply with general standards of trading laws - so why Ireland?

- Irish Government actively supports the industry
- Highly developed and efficient, pro business regulatory regime
- Disproportionally high number of world class lease arrangers, asset marketing personnel and legal and tax advisors
- Highly educated, English speaking workforce
- Low rate of corporation tax, with generous entitlement to expenses deductions and capital allowances
- Favourable withholding tax regime.⁵⁸

So Ireland offers significant advantages to aircraft leasing operators based on two outstanding features: a) taxation policy and b) competence heritage of industry individuals (Guinness Peak Aviation). The sector is today contributing significant returns to Ireland.

The competence heritage in Ireland has, in the opinion of the author, represented the strongest feature of Ireland merging into today's market position. Yet, according to many industry specialists the Tax Regime is the underlying growth factor, it can not be denied that it was the summary of competences in Ireland that made Ireland what it is today in this industry. The knowledge on how to facilitate a tax regime that would so efficiently return value is prevailing the result of putting such tax regime in place. The key competences in question here are:

- Asset Management competences
- Regulatory competences (e.g. Civil Aviation, Finance Authority)
- Technical competences on the valuation of the Asset
- Financial competences on global lease constructs
- Taxation competences on global level.

Ireland has been able to take ultimate benefits of what began with a single actor i.e. Guinness Peak Aviation and continued to develop know-how and competences. Ireland's reputation as a centre of

⁵⁸ Deloitte "Aircraft Leasing in Ireland" p. 3

excellence for the aircraft leasing sector remains strong. The question is will that be the same for the aero-engine sector?

11.2. Weakness of Ireland as a Platform

Ireland's leasing industry is focused on airframe where aero-engines do not account significantly. Industry experts put Tax often as the prime reason for having been able to establish today's market position in Ireland. However, it is questionable that taxation alone can elevate to such a leading position. Competences are the key elements in Ireland, and ever so often growth has a limit and a price; Ireland could be facing the peak of their growth. Chief Executives in the Irish Leasing Industry claim the following items as principal obstacles to further growth⁵⁹:

1. Increasing competition from other countries (Singapore, UAE, UK, Malta)
2. Hiring of key personnel has become problematic due to personal taxation regime in Ireland. (52%)
3. Graduates and Post-Graduates education directed at the sector needs to be significantly increased.
4. Lack of Irish financing to aircraft/engine leasing activities. New finance structures must be facilitated.
5. Ireland must continue to grow its tax treaty network, which is a critical asset for the industry.
6. Financial regulation is increasing cost and prevents certain types of activities taking place in Ireland or through Irish companies.
7. Support to the MRO industry and facilitate availability of MRO services at short notice.
8. Certain CAA fees are too high and are enforcing leasing companies to look outside of Ireland, such as for registration of short-term periods.
9. Quality concerns on the Irish CAA may undermine the compliance to air safety regulation, which would become detrimental to the leasing industry.⁶⁰

Last items (8 & 9) could be a consequence of their own success; it is often observed that regulatory authorities have difficulties to follow the pace of development of their industry.

Can Luxembourg mitigate the concerns of the executives? It's possible!

⁵⁹ Federation of Aerospace Enterprises in Ireland "FAEI submission on behalf of the aviation finance and support industry 2013" p24

⁶⁰ Federation of Aerospace Enterprises in Ireland "FAEI submission on behalf of the aviation finance and support industry 2013" p24

11.2. Asset Management competence

Asset management, and in particular when addressing aviation asset that are extremely complex and sensitive in terms of value retention, which goes beyond the known patterns of depreciation, variation evidenced by the wide scatter of resale point and broad percentile bands.

Some assets retain their values better than other, in this category of asset prices are not made public and transactions undertaken could be similar, yet the prices may differ for e.g. on two identical aero-engines being placed with different operators under different maintenance programs.

12. Opportunities for Luxembourg

The afore described market environment will provide a series of opportunities upon which Luxembourg's aviation industry could anticipated upon. It is to be cleared that the focus on the opportunities in this document are limited to - although in bigger scale - the aircraft engine market.

Thereby the expertise present today in Luxembourg is surprisingly strong in many fields, this would contribute to diversify its economy and set focus to capitalize the benefits.

Aircraft financing has had certain mystique in the past and was only a few actors originated aircraft and aero engine finance, the exclusivity of the market changed for the financing parties that realized that these transactions were not extraordinarily different from other equipment financing. Finance managers require however experienced asset managers, attorneys, and other specific resources, so the related anxieties will become manageable. In the eyes of the author the aforesaid forms the core element of why Luxembourg has not been manifesting itself more within the Air Finance environment, even though these resources maybe present but limitedly available to develop an air finance industry on its own.

12.1. Sourcing Finance

Aircraft and aero-engine lessors are increasingly looking to the debt capital markets as a source of funding; given the increase of capacities in this sector and given the capital intense nature of their business. In recent years aircraft/engines lessors completed near-record levels of financings in the primary securities markets assessed by airlines; and this more intensively. Market observers are

reporting that approximately USD 17bn of aviation related debt securities issuance were sold in the US capital market in 2015, which represents more than 20% increase over 2014.⁶¹

Airlines have been issuing enhanced equipment trust certificates (EECTs) and unsecured bonds, while lessors have been issuing unsecured bonds and sponsoring aircraft and engine asset backed securitisations (ABS). The drivers of this increased use of debt capital markets financing, were primarily the current low-interest-rate environment, followed by the continuous increased demand on air transport, fleet growth or renewal and last but not least the regulatory changes. The latter refers to the regulatory changes, which are shifting debt-financing markets, and supporting increased demand for the debt capital markets instead of bank balance sheets. The reform measurements of the Basel Committee on Banking Supervision, commonly known as Basel III, anticipating to strengthen the risk management of the banking sector.

12.2. Enhanced Equipment Trust Certificates (EECT)

Securizations of aircraft/engine leases have always been an important, if not the most important, element when sourcing aviation capital. EECT financing provides access, particularly to the U.S. and growingly to European capital markets, opening up a significant and new source of capital for the air transportation industry. There are two basic structures for securitizing aircraft leases: the enhanced equipment trust certificate ("EETC") securitization and the portfolio securitization.

12.2.1. EETC Securitisation

An EETC securitization enhances the creditworthiness of traditional equipment trust certificates ("ETCs") secured by lease receivables and the leased aircraft as follows: First, the issuer of the EETCs is bankruptcy remote (and insulated from a bankruptcy of the lessee) to the satisfaction of the rating agencies. Second, the EETCs are trashed to take advantage of the expected residual value of the aircraft, i.e., the lower the advance level, the higher the rating. Third, the lessee provides a liquidity facility to ensure the continued payment of interest on the EETCs during the remarketing period following a default.⁶²

The term of the liquidity facility in an EETC securitization relies on the ability of a lessor to repossess an aircraft from a bankrupt lessee under section 1110, if the lessee does not elect to perform. The principal issue in doing an EETC securitization will be the availability of "section

⁶¹ "Aviation Debt Capital Markets Are Growing: An Overview of Recent Trends" Vedder Price
<http://www.vedderprice.com/aviation-debt-capital-markets-are-growing-overview-of-recent-trends/>

⁶² Guide to Capital Markets: Aircraft Lease Securitisation <http://pages.stern.nyu.edu/~igiddy/ABS/bowers2.html>

1110 equivalent" repossession rights (known as Alternative A to the CTC), i.e., the ability to repossess and remarket the leased aircraft in a time frame comparable to that allowed by the Cape Town Convention.⁶³

The foregoing enhancements to traditional ETCs allow EETCs to have credit ratings significantly higher than the corporate credit rating of the lessee, particularly at lower advance levels. Thus, a sub-investment grade borrower can issue investment grade debt and, an investment grade borrower also can reduce its borrowing costs with the lower pricing for higher grades of debt.

12.2.2. Portfolio Securitisation

In contrast to the EETC structure, a portfolio securitization relies on a diversified portfolio of aircraft on operating leases to a number of airlines, both in the U.S. and in other countries. Rather than enhancing a single corporate credit, the ratings of the debt securities issued in a portfolio securitization are based on the existence of a worldwide aircraft leasing market and the projected residual values of the aircraft in the portfolio. The actual levels of the ratings depend on a number of factors, including the age, initial value and diversity of the aircraft in the portfolio, the diversity (both individually and geographically) of the lessees of the aircraft and (to a much lesser extent) their credit quality, the initial level of lease rents, assumptions as to the timing and costs of defaults and remarketing and other relevant factors. Credit support in a portfolio securitization is tailored to the particular needs of the aircraft and lessees involved, e.g., coverage for potential Eurocontrol liens, major maintenance costs, compliance with noise regulations and similar factors.

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An important element in portfolio securitization is the quality of the servicer of the portfolio, in monitoring the performance of the lessees and in re-leasing and selling the aircraft both at the normal expiry of leases and in the case of lease defaults.

12.2. The Financing & Markets

When evaluating aircraft loans, it is typical to consider the cash flows from the disbursement of the initial loan amount, principal repayments, interest and margin payments, fees, and calculate the net present value (NPV) or the internal rate of return (IRR). In an operating lease, we take the

⁶³ The Cape Town Convention and Capital Markets: Air Canada's First EETC Offering

<http://whoswholegal.com/news/features/article/31036/the-cape-town-convention-capital-markets-air-canadas-first-eetc-offering/>

⁶⁴ Guide to Capital Markets: Aircraft Lease Securitisation <http://pages.stern.nyu.edu/~igiddy/ABS/bowers2.html>

initial purchase price of the aircraft, rental payments, interest, maintenance reserve payments and expenses, and the sales proceeds from a sale at the assumed residual value at the end of the lease term to calculate the NPV or IRR. Taxes, refinancing terms and capital rules can also be accounted for. Based on internal targets, terms can be structured to meet criteria to accept or reject a proposed transaction.

The limitations with this approach are that 1) the contractual debt service or rental payments are sometimes interrupted when the airline defaults, 2) the aircraft value at the end of the term, or when a default occurs, is not necessarily what was assumed at the outset, and 3) the interest rate may change over time and thus affect the net present value. These uncertainties create risks - default risk, aircraft value risk and interest rate risk. Therefore, the NPV and the IRR are not static numbers, but ranges or probability distributions of possible outcomes. The bond markets are turning into a regular funding platform for airline companies which have in the past relied heavily on export credit agencies and commercial banks lending to finance deliveries of aircrafts and nowadays also engines. Strong credit protections and legal frameworks make it more attractive to source finance in the form of aircraft finance bonds.⁶⁵

12.3. Air Finance Products

In the context of aviation property a lease is defined as: *"a contract by which one owning such property grants another one the right to possess, use and enjoy it for a specific period of time in exchange of payment of a stipulated price, referred to as rent"*⁶⁶

Aircraft and Engine Leases are classified as being either operative or true leases on the one hand and finance or capital leases on the other hand. The simplified difference is the whether the owner of the Aircraft, or Engine, rents what is his or if the owner of the money is renting the money for the asset, and thereby has an indirect ownership regulated by e.g. default clauses, pledges, etc. In the one case the aircraft/engine is accounted for as an asset in the books of the lessor and on the other case the asset is accounted in the books of the lessee.

12.3.1. Aircraft or Engine Loan

The basic aircraft backed loan is directly to the airline, with full corporate recourse and secured by a mortgage over the aircraft/engine as shown in the schematic to the left. Terms range from 3-15 years and the loans are typically amortizing. The currency is often US \$, lenders find comfort in

⁶⁵ PK Air Finance discussion notes 12.2013 "Modelling Aircraft Loan & Lease Portfolios"

⁶⁶ Donal Patrick Hanley "Aircraft Operating Leasing" p. 13

lending in the currency that, by convention, is the currency in which prices of aircraft/engine are quoted and traded. For carriers with little or no US \$ revenue, this constitutes a currency mismatch. Baskets of currencies could well minimize the mismatch, both for the debtor and the creditor.

12.3.2. Operating Lease

The Operating Lease is a rental agreement where the airline (the Lessee) pays for the possession and usage of the aircraft/engine over a contractual term. The periodic rent is meant to cover economic depreciation, interest and a return to the Lessor who is the owner of the aircraft/engine at all times. Supplemental rent is often paid to cover maintenance expenses. The operator pays all other operating costs. The term is typically 3-12 years. At the end of the lease term, the lessee has to meet specific return conditions with regard to the maintenance status, so that the aircraft/engine can be leased out again to the next operator.

12.3.3. Finance Lease

In a Finance Lease, the airline typically pays a sizeable first rental, the term is longer than for an operating lease, and the lessor has granted the lessee a fixed price purchase option at maturity. In economic terms, the Finance Lease is equivalent to a loan with a non-recourse balloon, but differs in legal terms in that the creditor keeps legal title until the call option is exercised, rather than having a mortgage over the aircraft.

12.3.4. Investor Loan

An Investor Loan is a loan to the owner of the aircraft, but not the operator. Instead, the investor leases the aircraft to the airline. In addition to the mortgage over the aircraft, the lender gets an assignment of the lease as security. The cash typically flows directly from the lessee to the lender. When the borrower is a Special Purpose Company (SPC), the balloon payment effectively becomes limited recourse, and the lender looks to the value of the aircraft as the source of final repayment.⁶⁷

Remains to be stated that there are numerous versions of Investor Loans, each of them having a specific purpose. E.g.

- Pooled Investor Loan
- Syndicated Investor Loan
- Tranched Investor Loan

⁶⁷ PK AirFinance discussion notes 12.2013 "Modeling Aircraft Loan & Lease Portfolios"

In any of the above forms the loan will be taking the structure of a bond, that makes is relevant for trading and factoring on capital markets.

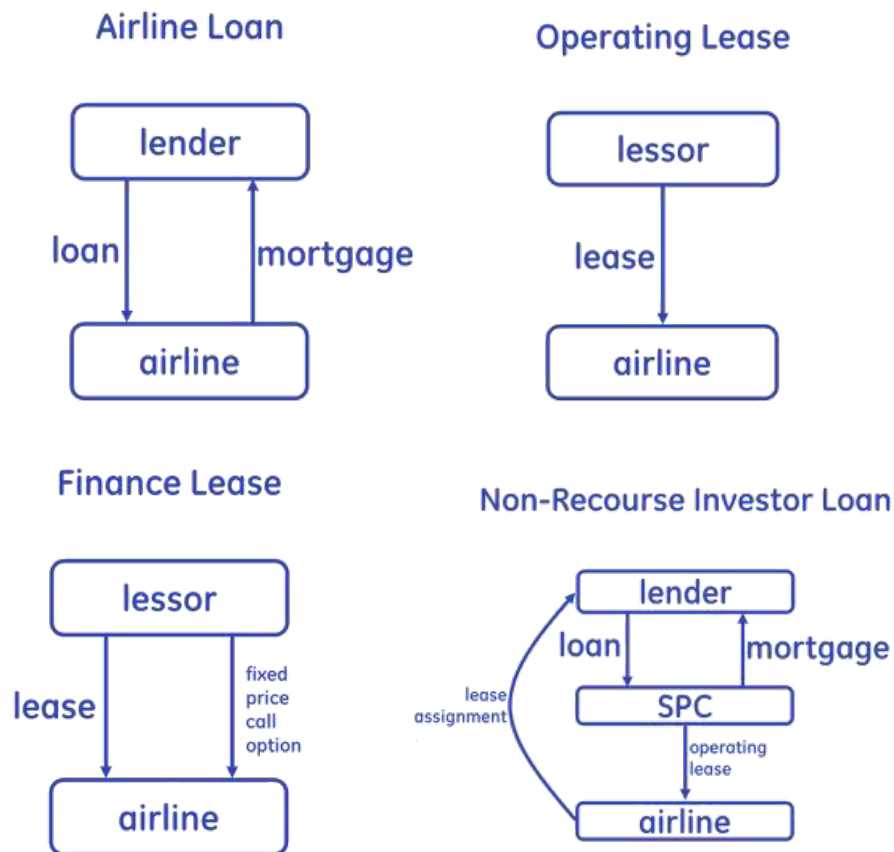


Figure 20: Lease & Loan Structures⁶⁸

13. The role of Cape Town Convention

Financing an aviation asset (may it be an aero-engine or airframe) means financing a mobile asset of which repossession is a process that becomes effective when lessees of an aircraft fail to respect their contractual obligations as set forth in the aircraft/engine lease agreement. The first hurdle to tackle will be prove of ownership or evidencing and exercising a pledge. Subject to the contents of the 'Default' clauses agreed between the parties, an event may occur that such a default arises. When actions to enforce performance of the agreement or to recover the damages for the breach of the agreement fail, the lessor (or rightful owner of the Aircraft or Aero Engine) may take possession of the aircraft.

⁶⁸ PK AirFinance dicussion notes 12.2013 "Modeling Aircraft Loan & Lease Portfolios"

For mobile assets it is particularly difficult to enforce the repossession, for the obvious reason related to its location. It is being assumed that the lessee of the mobile asset continues the operation of its network whilst the lessor will undertake to enforce repossession of its aircraft. Consequently it will be uncertain where and when an asset can be repossessed, in particular when the Lessee becomes inoperative in relation with the default clause, E.g. Bankruptcy, Loss of Operating License or similar.

Consequently a Universal Convention to facilitate repossession and more over the process with regards to the clarification of the rightful owner forms a solid legal foundation to reassure that pledged assets would remain under the control of the rightful owner. Said Universal Convention is referred to as "The Cape Town Convention" (CTC).

The Cape Town Convention is an international instrument purpose designed to achieve a commercial objective: to facilitate efficient forms of asset based financing. The latter will be enabling airlines to be financed in much less restrictive manor as it has been done before. One of the main issues with financing mobile assets is the fact that the asset is uncontrollable in terms of its location. Moreover aircraft parts or engines are today even subject to removal from the airframe and are today being stored and even added to certain spare part pools. The most important characteristics of the Cape Town Convention are the ability to give providers of finance a much greater confidence in the decision to grant a credit, enhance the credit rating of aircraft receivables and thereby reducing the costs of air finance of an airline.



Figure 21: Cape Town (SA)

The most fundamental characteristic is the possibility to anticipate on a much more differentiated manner to insolvency of airlines and the related property rights of the aircrafts and its related parts. The Cape Town Treaty other main characteristic includes providing the creditor with effective and prompt remedies in case of default or insolvency of the debtor, mainly in terms of a time definite process to repossess the asset and the clearly stipulated terms of the final determination of a claim.

The Cape Town Convention replaces in fact a previous Convention:

“Convention on the International Recognition of Rights in Aircrafts”⁶⁹

Main obstacles for the application of this convention was the fact that the aforesaid convention regulated the right of ownership of entire Aircraft and did not consider Spares like ‘Landing Gears’ or ‘Aircraft Engines’ as removable commodities of the airframe. The increasing trend in the industry to separately lease or purchase engines, this as a consequence of an increased variety of engines models, created an obstacles in the financing of the those components. In particular if these were to be financed by separate vehicles.⁷⁰

The aviation industry fosters mainly high valuable commodities, not simply the entire airframe is subject to financing and/or leasing but nowadays the individual parts and elements of the aircraft are being purchased and sourced separately. Taking into consideration the macro economic impact that the industry contains in general, the globalization of the world requires equal access and ability to financing. Especially less developed economies take advantage of instruments that the Cape Town Convention contains. Financing Assets is always paired with securing the Asset, in one form or the other. The CTC has been designed -and become - an efficient tool for financiers to put hands on what is theirs!

Luxembourg has been one of the first EU Members to ratify the CTC, on June 9th 2009,⁷¹ an understatement of its commitment and ability to facilitate financing of its aviation industry.

⁶⁹ ICAO http://www.icao.int/secretariat/legal/List%20of%20Parties/Geneva_EN.pdf

⁷⁰ Aircraft Repossession and Enforcement: Practical Aspects, Volume 2

By Berend J. H. Crans, Ravi Nath Publisher Kluwer Law Intl
ISBN 978-90-411-3251-2

⁷¹ Memorial du GDL A-159 of July 3rd 2009

14. Asset Backed Securities

Almost naturally investors scour the fixed-income hunting ground for strong yields, one sector is likely to be moving more into focus: **Asset Based Securities**.

As a consequence of the subprime crisis in 2008, various governments responded in creating more supervision and more transparency in the financial markets. Securitisation has been subject of many discussions amongst the financial actors, eventually to see a growing interest in securitised products as investors discover the various advantages of these products - and trust them!

The European Central Bank (ECB), as a token to regain markets confidence and to reinstate securitisation as a key-high level funding method, supports this revival in Europe. A new class of high quality, simple, asset-backed securities (ABS) that could benefit from lighter capital requirements is being promoted as a key pillar of the new EU- securitisation framework. The **Luxembourg** financial centre has become a prime venue for securitisation in Europe and today hosts 25% of all European securitisation transactions and it has become the domicile of choice for 900+ Securitisation Vehicles (SV).⁷²

Historically, asset securitisation was based upon structured financing of mortgage pools, in the meantime securitisation transactions have matured to a significant sector of the European capital markets and is recognising innumerable types of collateral as receivables. (Including mobile assets such as: trains, airframes, aero-engines, etc.)

Luxembourg has managed to position itself very comfortably in the securitisation market ever since the introduction of the Law of 22 March 2004 "the Securitisation Law", no fewer than 1064⁷³ securitisation vehicles were established in Luxembourg by the end of March 2012. Pursuant to Article 1 of the 2004 Law securitisation means "the transaction by which a securitisation undertaking acquires or assumes, directly or through another undertaking, risks relating to claims, other assets, or obligations assumed by third parties or inherent to all, or part of, the activities of third parties and issues securities, whose value or yield depends on such risks". The 2004 Law set up a specific legal framework in Luxembourg governing asset securitisation in a broad sense, as defined in the 2004 Law⁷⁴. The securitisation undertaking may assume those

⁷² Publication Brochure Luxembourg Stock Exchange: "Listing Asset-Backed Securities"

⁷³ PWC "Securitisation in Luxembourg" <http://www.pwc.lu/en/securitisation/docs/pwc-securitisation-in-luxembourg-2016.pdf>

⁷⁴ Memorial A-N°46 29.3.2004

risks by acquiring the assets, guaranteeing the obligations, or by committing itself in any other way.⁷⁵

These structures are set up as "normal" commercial companies or as specialised investment funds. The steady rise of number of securitisation vehicles demonstrate, that despite of the international financial crisis, the goal set by the EU is to create an attractive legal, regulatory, and tax framework for securitisation, this has especially been achieved in Luxembourg. Currently the main asset classes are customer loans, auto loans, lease receivables, trade receivables, but also other securities in repackaging deals or structured investment products.⁷⁶ Aircrafts and Aero-Engines are being considered to be included in the aforesaid classes.

14.1. Legal forms of securitisation vehicles

A typical model of the Luxembourg investment fund regime under the Securitisation Law is the introduction of securitisation vehicles in the form of a corporate entity, as well as in the form of securitisation funds. These are managed by a management company and then governed by the respective regulation that could take either of the below legal forms:

- "Société Anonyme" (SA = equivalent to a public limited company)
- "Société à responsabilité limitée" (s.à.r.l. = equivalent to a private limited liability company)
- "Société en Commandite par Action" (S.C.A. = partnership limited by shares)
- "Société coopérative organisée comme une S.A." (a cooperative company, organised as a public limited company)

Securitisation companies are not subject to a minimum capital requirement, other than the minimum share capital dependant on the legal form, (which ranges from €12.500.- to €31.000.-). This minimum share capital is applicable for the entire legal construction and not bounded for each single compartment.

The SPV structures are adoptable, in other words; it is possible to structure securitisation transactions as a single structure or as dual structures. Where in a single structure one securitisation vehicle purchases the asset and issues the securities. On the other hand, two or more vehicles will be constituted to purchase the asset. In the aforesaid scenarios it is very well possible that a compartment segregation of the securitisation vehicle is established, which requires simply a

⁷⁵ CSSF :What is the definition of "securitisation" under Luxembourg law?
https://www.cssf.lu/fileadmin/files/Titrisation/FAQ_titrisation_231013_eng.pdf

⁷⁶ PWC "Securitisation in Luxembourg" <http://www.pwc.lu/en/securitisation/docs/pwc-securitisation-in-luxembourg-2016.pdf>

statement in the articles of incorporation, of which each compartment could be liquidated separately, without necessary liquidating the whole vehicle. A typical characteristic of that emphasizes on the great flexibility securitisation transactions in Luxembourg can provide.

A Luxembourg model of securitisation vehicle can be comprised of various compartments:

- Separate entities
- Compartment liquidation without vehicle liquidation
- Single liquidation
- Investors and creditors segregation
- Tranching⁷⁷

Subject to what legal form of vehicle has been selected, the Luxembourg Law does not contain any specific provisions with respect to the accounting. Securitisation Vehicles established in Luxembourg are due to adhere merely to the Luxembourg GAAP, which already in itself offers a significant flexibility to preparers of the annual accounts. The choices differ:

1. Luxembourg GAAP under the historic cost model
2. Luxembourg GAAP under the fair value model
3. IFRS (International Financial Reporting Standards) as adopted by the EU.

14.2 Forms of Securitisation Transactions

Within the form of a "true sale" transaction, the originator sets an asset (Aero-Engine) into a securitisation vehicle (A), whereas within the scope of a "Synthetic" transaction the originator buys credit risk protection through a series of credit derivatives (B & C) without transferring the ownership and liability of the underlying asset.

⁷⁷ PWC Securitisation in Luxembourg

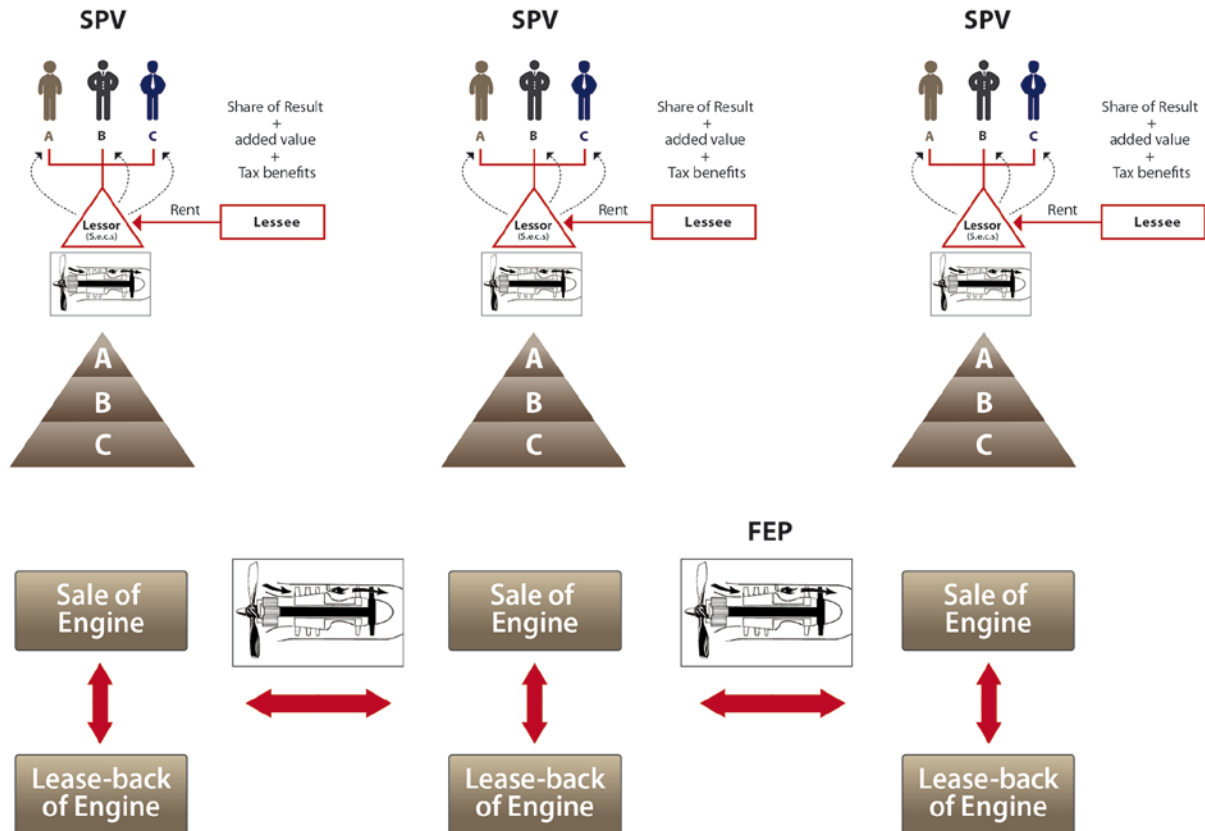


Figure 22: Model of SPV construction and interfaces⁷⁸

The above figures visualises the exchangeabilities of the Special Purpose Vehicles; this model is well acquainted in Luxembourg. The model is workable for sales and lease-back of assets to be placed in the respective Vehicle under the partnership limited by share a given shareholder (A) could represent the same individual as the "Lessor" which would warrant that the end-user of the asset will be in one form his own customer. Consequently the liability of shareholders B+C would be based upon their respective investments only without further solidarity amongst the other shareholders with regards to their liability of the asset. The underlying advantage of such constructions would be the advantages granted by:

- Acquisition of the good through securitisation title;
- Allowing the lessee to dispose of new Assets limiting the risk to the value of the Asset;
- Allowing the investors of the funds to dispose the Asset at a credit warranty title;
- Allowing Luxembourg based investors to benefit from investment tax credits.⁷⁹

⁷⁸ own presentation

⁷⁹ Memorandum ATOZ Tax Advisers Luxembourg 2005 p2/6. Under Article 152bis de la loi du 4 décembre 1967

In addition, the above-visualised model will facilitate the transfer/trading of the asset under the same terms between equal legal structures, or compartments, without affecting the status of the asset.

An entire sale of the Vehicle or benefits of the Fix Exchange Program of aero-engines by OEMs could be facilitated through the application of the above model.

Constraints to the model will however be that local (Luxembourg) funding will be required as to take full benefit of the tax credit benefits. This will be easier available with limited commodity prices of aero-engines as with entire new aircrafts.

14.3 Taxation and tax neutrality

As seen in the previous chapters Tax is a major component with regards to choice of location, and given the rat race of the tax attractiveness amongst the main aviation locations in Europe, the aspect of tax neutrality of a SPV appears to be overlooked, or to say the least did not make it to the top of the selection points of the main stakeholders.

The Luxembourg corporate income tax and municipal business tax are at an aggregate tax rate of Luxembourg City nowadays 29.22% this in comparison with e.g. Irish corporate taxation levels of 12,5% appears to be the number one reason to select Ireland as the main location for lessors. Clearly the success of intense applications on the capital market is dependant on their tax regime. So at first glance the choice of location is clear, yet the author is of the opinion that one needs to take a deeper look into the Tax Neutrality of securitisation vehicles, and more over the analysis of each relevant structural feature of a securitisation transaction that will incur the (strong) possibility that minimum or total tax exemption can be applied.

Ireland there against, applies a standard corporation tax of 12,5% on trading income, however in practice Irish Tax deductions will equally to Luxembourg reduce or eliminate the taxable profits in Ireland altogether. The important detail here is that non-trading income is currently taxed in Ireland at the rate of 25%, whereas the Irish tax authorities are of the view that the control of the trading activities at an operational level must occur in Ireland and be carried out by employees or directors of the company physically present in Ireland and able to demonstrate the requisite skill and expertise⁸⁰.

⁸⁰ Flynn O'Driscoll Business Lawyers Dublin "Ireland - A Location for aircraft Leasing" p 2.

Luxembourg offers tax credits for qualifying investments in enterprises situated in Luxembourg and for eligible assets physically used in another country within the European Economic Area (EEA). Eligible assets primarily consist of depreciable tangible goods other than buildings, livestock and deposits (fossil or mineral) and vessels operating in international traffic. A global investment tax credit of 7% of the acquisition price of investments made during the year is available, subject to a ceiling of EUR 150,000 and 2% on the investment amounts exceeding EUR 150,000. A supplementary investment tax credit of 12% of the acquisition value of qualifying investments made during the tax year also is available. Any unused credit may be carried forward for 10 years.⁸¹ In addition Luxembourg is contemplating to reduce its corporate tax from 21% to 18%, which would result in an overall tax rate of 26.01% for the financial years 2018, (including solidarity & municipal business tax in Luxembourg City)⁸².

Remains the issue of "Foreign withholding Taxes" to be addressed. This represents a significant cost to the leasing industry, in particular on cross boarder transactions and the management of this cost is an important factor in the choice of the location. Both Luxembourg and Ireland claim to have established an excellent network of tax treaties (Luxembourg 77⁸³; Ireland 74⁸⁴) agreements that provide each in their particular contents and purpose.

Given the here aforesaid proximity, it remains opaque to what extend the two benchmarked countries compete on tax benefits, yet from the above it can be concluded that the actual choice of location should not entirely depend on taxation benefits, in particular that both tax regimes offer sufficient escape holes and have a fairly equal network of double tax agreements. Taking a distance in this document from future speculation on taxation policies, the author will however want to underline, that in his opinion Taxation and Tax evasion are not eligible parameters to sustain an economy, nor will these issues be able to form the prime purpose of an undertaking; they merely tend to deprive executives on making objective assessments location advantages.

14.4. Investment Products on Based Securities

Asset Based Securities and Mortgage Based Securities are both created by securitisation, and investors may by the causes of the financial and subprime mortgage crisis of 2008, have eschewed from this investment tool. The lingering stigma surrounding ABS stems from the unprecedented

⁸¹ Deloitte "Luxembourg Taxation & Investment"

<http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Tax/dttl-tax-luxembourgguide-2013.pdf>

⁸² PWC "Securitisation in Luxembourg" 2016 p 40

⁸³ Administration des Contributions Directes http://www.impotsdirects.public.lu/conventions/conv_vig/index.html

⁸⁴ Revenue - Irish Tax and Customs <http://www.revenue.ie/en/practitioner/law/double/double-taxation-agreements.html>

losses suffered by mortgage-backed securities during the housing downturn. But with regards to aviation it can be noted that not all structured finance is equal. The significant advantage of Mortgage and Asset Based Securities in aviation is the mobility. Whilst the real estate crisis tends to affect regions and in a certain perspective contaminate even the healthy elements, aviation assets can, and do, move from one developing area to another area. Leasing companies have been contributing to exactly this ability by their global presence and it is their prime objective to ensure that their asset value is not decayed.

14.1. Mortgage

An aircraft, and since 12.12.2008 in Luxembourg, also an aero-engine without further annexation to the airframe, i.e. solely and independently, can be the subject of various liens; i.e. rights to retain possession of the aircraft to discharge a debt and rights of detention which will have priority over a financier's mortgage over such aircraft even though the liens arose after the date of such mortgage. Some liens, or rights of detention, can apply to fleets of aircraft operated by the same operator. Despite the fact that attempts have been made to establish the rights of owners and financiers on an international level (e.g. with the Cape Town Convention), these have some way to go in establishing, for example, uniform laws and procedures for the recognition and enforcement of aircraft mortgages and priorities of liens. As elaborated in Part 1, the value of an aircraft, and in particular the engines, are heavily dependent on the condition and re-possession process of its "belongings". Therefore, from the perspective of the financiers, it is vital to know where the aircraft to be financed will be registered and whether the financier can certify its interest it has in the aircraft or engines. For this purpose registry of mortgages has become an industry standard for ABS. The financier must also be satisfied that the laws of the state of registration will recognise the proposed form of mortgage, particularly if it is governed by a different law. Some financiers will only recognise a mortgage as security if it is governed by local law and is in a particular form and language.

An aircraft and aero-engine is a collection of parts, which need regular and extensive maintenance or replacement, and unless the appropriate maintenance is undertaken and where required, replacement parts of the appropriate type, manufacture, modification status, utility and remaining life are installed, the value of the aircraft could be severely reduced. The major elements of an aircraft (the airframe and the engines) will be manufactured by different entities so that the benefit

of any warranties and customer care arrangements in respect of them will need to be assigned to a financier separately.⁸⁵

In Luxembourg the corresponding law on recognition of rights on aircrafts had been conducted in accordance with the law of 29 March 1978, of which two articles may be of specific relevance in this context:

***Art 19** L'hypothèque constituée sur des parts indivises de l'aéronef est assimilée à l'hypothèque grevant l'aéronef lui-même.*⁸⁶

***Art 52** Les actes dressés en exécution de la présente loi sont passible ou exempts des droits de timbre, d'enregistrement, de transcription et d'inscription,sont perçus aux taux fixés pour les actes de vente visé à l'article 13 de la loi du 29 mai 1906 concernant les habitations à bon marché....*

In short the mortgage registry was under the law of 29 March 1978 only possible for entire airframes (with specific spares & engines attached) and more important the registry of the mortgage was subject to a stamp fee equal to that of real estates.

In the spirit of the "Cape Town Convention" as to facilitate the financing of the aviation industry the stamp fee have been exempted and merely a registration fee of EUR 12.50 is due to the "enregistrement des hypothèques". The motives stated in the "avant projet de la loi au 11 décembre 2006" Art 52 indicate clearly the purposes of the CTC and like other European countries, (i.e. the Netherlands and Ireland) consequently the transaction is exempted of the stamp fee.⁸⁷ Upon implementation of the articles of law as set forth in the Memorial N° 182 of 12.12.2008, *disposition finales*:

***Art 19** L'hypothèque grève, dès lors qu'ils appartiennent au propriétaire de l'aéronef ou du bien aéronautique, tous les accessoires, pièces et équipements qui y sont posés, intégrés ou fixés, ainsi que tous les manuels, les données et les registres y afférents et les moteurs d'avions sauf si ces moteurs sont inscrit séparément.*

***Art 63** 1. Les actes entre vifs, à titre gratuit ou onéreux, translatifs ou déclaratifs de droit réels et les baux sur des biens aéronautiques ou des aéronefs sont **exempts** des*

⁸⁵ Fieldfisher "A guide to Aircraft Finance" June 2008
<http://www.fieldfisher.com/pdf/A-guide-to-aircraft-finance.pdf>

⁸⁶ Memorial "A" No 17 of 01.04.1978

⁸⁷ "avant projet de la loi 11 décembre 2006" art 52 p.59

droits proportionnels d'enregistrement et de transcription.

*2. Les actes entre vifs, à titre gratuit ou onéreux, translatifs ou déclaratifs de droit réels, prise de garantie ou de bail sur un bien aéronautique ou d'autres actes relatifs à l'une de ces opérations peuvent être présentés à la formalité de l'enregistrement, et le bordereau d'inscription établi, en langue française, allemande ou **anglaise**.*⁸⁸

Thereby Luxembourg has knowingly, or not, made in the view of the author a significant step towards an open competition with platforms such as Ireland and the Netherlands, by facilitating the mortgage registry and ownership registry of:

- a) Engines separately
- b) No levies of stamp fees
- c) Applying the English language for documents.

Another motive of waiving the stamp fee can be liaised to the Luxembourg ambition to create an attractive environment for the maritime sector, publicly referred to as "Pavilion Maritime" a proposal of law⁸⁹ to waive stamp fee and mortgage registry fees for vessels as well as aircrafts and aero-engines; it can be concluded that this was undertaken in anticipation to remove a financial burden for the suffering of the two local carriers.

⁸⁸ Memorial A N°182 du 12.12.2008 (art 19 & 63)

⁸⁹ Projet de loi n° 5698, 2007

Premier bureau des
hypothèques Luxembourg



GRAND-DUCHÉ DE LUXEMBOURG
MINISTÈRE DES FINANCES

VOL 11
NO 2/179

Bureau de la conservation des hypothèques aériennes
CERTIFICAT D'INSCRIPTION
dans le registre des droits sur aéronef

| | | |
|--|---|---|
| 1. Marques de nationalité et d'immatriculation LX - WAE | 2. Constructeur et désignation de l'aéronef donnée par le constructeur BRITISH AEROSPACE BAe ATP - F | 3. N° de série de l'aéronef 2037 |
|--|---|---|

4. Nom du propriétaire **TRIDENT AVIATION LEASING SERVICES (JERSEY) LIMITED**

5. Adresse du propriétaire **PO. Box 727, St. Pauls Gate New Street St. Helier JE4 8ZB JERSEY**

6. Il est certifié par les présentes que l'aéronef ci-dessus désigné a été dûment inscrit dans le registre des droits sur aéronef conformément à la loi du **8 décembre 08** concernant la reconnaissance des droits sur aéronef.

Luxembourg, le **- 9 DEC. 2011**

73321



Le Conservateur
des hypothèques aériennes,
Guillaume KERGER

Premier bureau des
hypothèques Luxembourg



GRAND-DUCHÉ DE LUXEMBOURG
MINISTÈRE DES FINANCES

VOL 5
NO 293

Bureau de la conservation des hypothèques aériennes
CERTIFICAT DE RADIATION D'INSCRIPTION
dans le registre des droits sur aéronef

| | | |
|--|---|---|
| 1. Marques de nationalité et d'immatriculation LX - WAE | 2. Constructeur et désignation de l'aéronef donnée par le constructeur BRITISH AEROSPACE ATP | 3. N° de série de l'aéronef 2037 |
|--|---|---|

4. Nom du propriétaire **TRIDENT AVIATION LEASING SERVICES (JERSEY) LIMITED**

5. Adresse du propriétaire **PO. Box 727 St. Pauls Gate New Street St. Helier JE4 8ZB JERSEY**

6. Il est certifié par les présentes que l'inscription portant sur l'aéronef ci-dessus désigné a été rayée dans le registre des droits sur aéronef.
Le certificat d'inscription (duplicata) a été dûment remis au soussigné en exécution de l'article 10 de la loi du **8 décembre 08** concernant la reconnaissance des droits sur aéronef.

Luxembourg, le **- 5 SEP. 2013**

73322



Le Conservateur f.f.
des hypothèques aériennes,
Marc SCHREINER

Figure 23: Sample of Registry Certificates

15. All in one and more

The focusing on weakness that Luxembourg is confronted with will usually be harder to mitigate than to play the core strengths that Luxembourg has in this domain. From the aforesaid chapters we understand that the two main weaknesses that Luxembourg holds are the lack of competences

present in Luxembourg, and this mainly on the air financing side, and in particular when financing the non-Luxembourg airlines (i.e. Luxair and Cargolux). Yet these competences will be alleviated by the strength its financial and geographical location holds. In the view of the author the strengths outweigh the weaknesses by far.



Figure 24: Focus on strengths - not weaknesses

Infrastructures available and/or not optimal used, Luxembourg is exposed to some environmental problems that is limiting its abilities to grow. So alternative value generator will need to be brought to the table.

15.1. Logistics

Luxembourg's international airport is one of the leading freight airports in Europe and home of Cargolux, a Global leading all-cargo carrier. Along with China Airlines, Yangtze River Express, Qatar Airways, and Atlas Air, Cargolux offers multiple daily destinations to all continents, transforming Luxembourg into an ideal gateway to global markets. Luxair Cargo, with its modern and well-equipped air-freight handling facilities moving 1.2 million tons a year, offers secure (TAPA certified), efficient and speedy ground handling that enables jumbo freighter planes to be

customs cleared and unloaded in record time. Trucks are literally a minute away and can reach 60% of the EU's GDP in less than a day.⁹⁰ At present times some 80 to 90 cargo flights are being scheduled to arrive Luxembourg per week⁹¹. Mostly B747 with a capacity of up to 120 tons per flight and sign point in directions to yet beat the achieved results of three year consecutive high in cargo volumes.⁹²

Whereas there is no traceable evidence of the numbers of aero-engines shipped via Luxembourg, due to the non-specification of the commodity as "Aero-Engine" and "Engine" by the Luxembourg customs, field specialist confirm that the number of Aero Engines flown via Luxembourg has seen a steep increase.⁹³

Whilst German leading engine manufacturer MTU laid the foundation stone for a purpose-built, advanced logistics centre on its company premises in Munich. Starting in January 2015, the brand new two-story building with a surface area of 4,400 square meters⁹⁴, Luxembourg could position itself as a logistic hub and spoke for aero-engines, as market demand is on the rise. MTU expects up to the year 2016, there will be a marked increase in assembly and production materials for the individual engines and modules. The number of items received that pass through incoming logistics will rise by some 30 per cent. Storage capacity volumes, too, will be expanded by some 20 per cent as a result of the expansion.⁹⁵

Similar to aero-engine producers and MROs global logistic players such as DHL Global Airfreight⁹⁶, Kühne & Nagel⁹⁷ as well as Bolloré⁹⁸ are setting more growth in the transport of aero-engines and anticipate actively on the need of aerospace companies for dedicated engine-

⁹⁰ Luxembourg for Business "Air Freight"
<http://www.luxembourgforbusiness.lu/en/invest/sectors/logistics>

⁹¹ Luxair Cargo Schedule of Cargo Flights July 2016

⁹² Air Cargo News: "Luxembourg cargo on a three year high" <http://www.aircargonews.net/news/single-view/news/luxembourg-cargo-on-a-three-year-high.html>

⁹³ Luxair Cargo statement

⁹⁴ Aviation Pros " MTU Aero Engines Lays Foundation Stone for New Logistics Centre"
http://www.aviationpros.com/press_release/11376145/mtu-aero-engines-lays-foundation-stone-for-new-logistics-center

⁹⁵ Aviation Pros " MTU Aero Engines Lays Foundation Stone for New Logistics Centre"
http://www.aviationpros.com/press_release/11376145/mtu-aero-engines-lays-foundation-stone-for-new-logistics-center

⁹⁶ DHL "Specialized Aviation Transport"
http://www.dhl.com/en/logistics/industry_sector_solutions/aerospace_logistics/specialized_aviation_transportation.html#.V4Tutq7caC4

⁹⁷ Kühne & Nagel "K&N Introduces KN EngineChain" 2016
http://www.kn-portal.com/about_us/media_relations/news/show/?cHash=82ceef69b688f5f1d17c25e4f305b54c&tx_knnews_pi1%5Buid%5D=3862

⁹⁸ Bolloré Logistics "Integrated solutions upstream and downstream of aerospace supply chains"
<http://www.bolloré-logistics.com/en/Pages/NEWS/Aerospace.aspx>

handling services. More specifically to aero-engine logistics the regulation is quite generic and is confronted with afore addressed asset value management of aero-engines. One undisputable argument in favour of Luxembourg as a gateway for aero-engines is that the transport of aero-engines require "main-deck capacity", a capacity which the Luxembourg gateway is fully focused upon as only full freighter operators solicit the Luxair Cargo Centre⁹⁹.

15.2. Storage

Luxembourg holds unused and "prime facilities" for the storage of aero-engines, right at the vicinity of the cargo centre. The old cargo centre will position itself ideal for the exploitation of new activities that would interact in the positive resounds of the aero-engine domain.

What would be the preambles for an engine storage and possibly positive impact on the logistic positioning of Luxembourg Airport?

Almost all airline companies maintain a couple of engines as standby for quick replacement. These engines are very expensive and are usually needed in emergencies in case of engine failure. The jet engines are generally stored in a room in/near the hangars at airports. While being stored outside they are damaged due to corrosion. Ferrous material like iron and steel corrode in presence of moisture. Electronic equipment and components also suffer from micro-corrosion. Uncontrolled humidity in the storage rooms is the single major cause of corrosion. A certain amount of water vapor is always present in the air. This water vapor or moisture in the air is measured in terms of relative humidity (% of RH). The basic problem arises from the fact that water vapor will condense, on any surface, colder than the dew point temperature of the surrounding air mass. Also, sudden changes in temperature, within the room affect the internal humidity environment and lead to condensation on any surface. This subsequently leads to corrosion. In pure air almost no iron corrosion occurs, at relative humidity even up to 99%. However, pure air is rarely encountered in practice. Contaminants present in the air like Sulphur dioxide, particles of charcoal etc. enhance the corrosion rate.¹⁰⁰

⁹⁹ Luxair Cargo Schedule of Cargo Flights July 2016

¹⁰⁰ Smart Cargo Engine Storage Manual

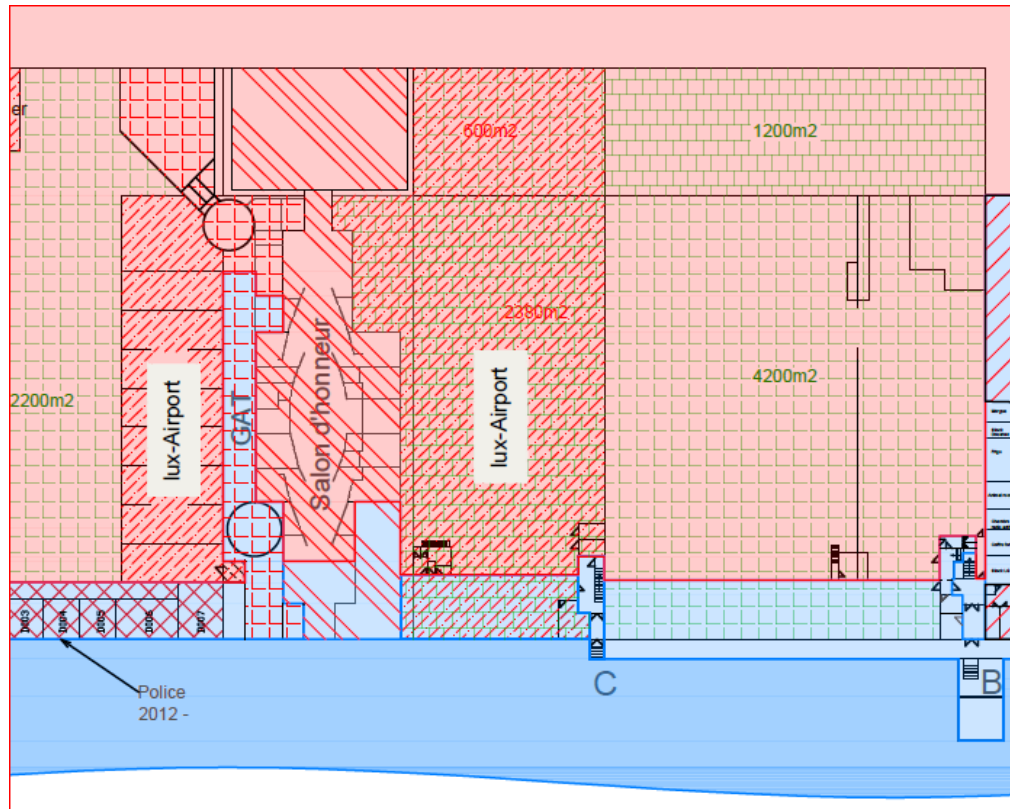


Figure 25: "For Rent" Bonded Warehouse with Ramp Access - An opportunity.¹⁰¹

(see also Figure 18)

15.3. Knowledge is Power

The realisation to embrace the financial abilities present in Luxembourg to facilitate engine leasing and financing must be supplemented with a technical know-how of this very specific market. Logistic know-how is presently judged to be sufficiently available and efforts are being undertaken to increase this know-how¹⁰². Whilst the knowledge generated on aerospace and aviation engineering is not short of competences either, than it should become feasible to generate local competences that will be able to design dedicated solutions needed to enhance certified processes that ensure:

1. Aero-Engine Management and Value Assessment
2. Facilitate Aero Finance Structures
3. Implement and Execute logistic excellence with key actors
4. Facilitate Storage and Maintenance of Stored Assets.

¹⁰¹ Lux-Airport "Available Facility" ready 2017

¹⁰² BS Good S Luxembourg & DGM Luxembourg S.A. <http://www.bsgoods.lu/training-programs/>
 UNI.LU "The University of Luxembourg is set to create a centre for research, teaching and knowledge transfer in logistics to support Luxembourg's development as a transport and logistics hub in Europe."
http://www.wen.uni.lu/fdef/news/university_to_create_logistics_research_centre_with_mit

15.4. MRO

MRO stands for **M**aintenance **R**epair and **O**verhaul, part of the maintenance is done by the operators themselves, under own Part M and/or Part 145 regulatory licences. Traditionally maintenance has been perceived solely as the obligation of the operator, which explains why main legacy carriers have extensively and successfully developed own MRO organisations that today account to the leading actors on the market. Examples of main operators that have established themselves in the Top Field of the MRO Organisations:

Clearly they are being flanked by neutral MRO's such as ST Aerospace and Haeco or AAR, yet the

| 2014 Airframe Maintenance hours and Revenue | | | |
|---|---|--|--------------------------------------|
| Company | 2014 Third-Party Airframe Maintenance Hours | Total 2014 Airframe Maintenance Hours* | Total 2014 Third-Party MRO Revenue** |
| ST Aerospace | 12.0 million | 12.0 million | \$1.5 billion |
| Haeco | 9.4 million | 11.7 million | \$1.5 billion |
| AAR | 4.9 million | 4.9 million | \$460.0 million |
| AFI KLM E&M | 702,000 | 3.6 million | \$3.8 billion |
| Lufthansa Technik | not disclosed | 3 million | \$4.8 billion |
| Gameco | 1.1 million | 2.9 million | not disclosed |
| Turkish Technic | not disclosed | 2.9 million | \$745.0 million |
| Evergreen Aviation Technologies (EGAT) | 1.6 million | 2.2 million | \$465.0 million |
| Aviation Technical Services | 2.0 million | 2.0 million | not disclosed |
| Sabena Technics | 2.0 million | 2.0 million | \$397.6 million |
| Almost Top 10 | | | |
| Aeroman | 1.8 million | 1.8 million | not disclosed |
| Mexicana MRO | 1.7 million | 1.7 million | \$48.0 million |
| Flightstar | 1.6 million | 1.6 million | \$110.9 million |
| GMF AeroAsia | 1.2 million | 1.6 million | \$264.0 million |
| TAP M&E | 1.3 million | 1.9 million | \$185.6 million |
| Etihad | 1.2 million | 1.2 million | \$275.0 million |
| SR Technics | 1.0 million | 1.0 million | \$1.2 billion |
| * Includes parent airline figures when applicable | | | |
| ** Includes airframe, component and engine MRO | | | |

Figure 26: Top Ranking Aviation MROs' ¹⁰³

¹⁰³ Aviation Week May 2015 "Top 10 Airframe MRO Providers" <http://aviationweek.com/mro/aviation-week-announces-top-10-airframe-mro-providers>

Knowing that the aviation market has been seeing various phases to which it has been forced to adapt to and as previously described, in chapter 4.5, the consequences hereof were that the aviation supply chain shifted. During the next decade the global commercial fleet is expected to grow to 40,638 in 2024 from 29,909 this year—which includes 20,672 new aircraft entering service and 9,143 retiring, according to Aviation Week data¹⁰⁴. As the aftermarket providers ramp up for new capabilities to service the next-gen aircraft, they are also deciding when to phase out MRO services for older ones.

Market trends have encouraged the main industry players to reposition themselves, eventually leading to a technology integration of their services. Within this changing market the industry today faces a perpetual challenge to strike the optimum balance between minimising operating costs, maximising fleet productivity (i.e. increase of flight hours and avoidance of technical downtime) and compliance to regulators requirements. Of which it is to be noted that last has been severely been challenging the aviation industry in recent years. Safety, Security and Airworthiness Compliance formed the core regulatory challenges to airlines.



Figure 27: Engine MRO

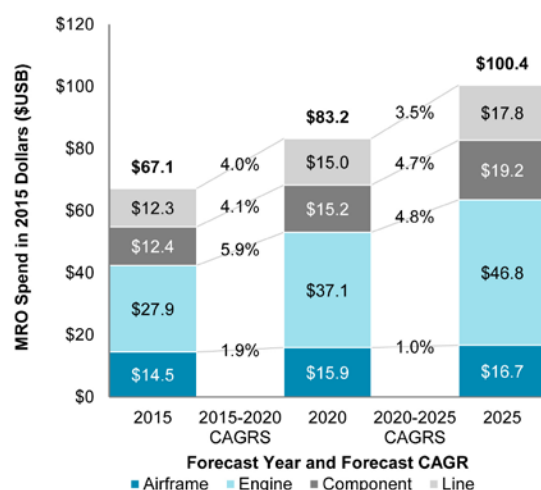
¹⁰⁴ Aviation Week May 2015 "Top 10 Airframe MRO Providers" <http://aviationweek.com/mro/aviation-week-announces-top-10-airframe-mro-providers>

On the other hand technical development has also increased in efficiency as OEM's constantly develop their technology. An example often being referred to is the "Automated In-Flight Maintenance Planning and Part Provisioning"¹⁰⁵ that allows operators to access aircraft performance in near real life time and anticipate immediately, on any malfunctioning of the airplane, even before it has landed and thereby be able to intercept consequential delays which than again result in a higher productivity. With regards to a spin off effect of efficient technologies to operators, one could be theorising that this could prove a further boom to the MRO industry, as airlines could adjust their fleet selection in order to achieve an extension on the operational life versus advanced technologies. New technologies are also offering MRO's new ways of lowering their costs and/or qualify for more outsourcing of airlines that will aim be focus and remain cost efficient on their core business. In the case of LCC this is already today visible that none of the LCC has established own maintenance activities.

15.4.1. Future Opportunities for MRO's

With tight profit margins as experienced today in the commercial aviation maintenance has become a cost driven market. Given the prosperous outlooks for LCC, and their non-willingness to create own maintenance facilities, as not being judged to form the core of their business the market potentials may look prosperous. However, especially the LCCs are known to be cost driven customers to MROs and may therefore result in lower profit margins despite higher turnover, an aspect that should not be overlooked when assessing platform and location situations.

2015-2025 Global MRO Market Size Forecast by MRO Segment



2015-2025 Global MRO Market Share Forecast by MRO Segment

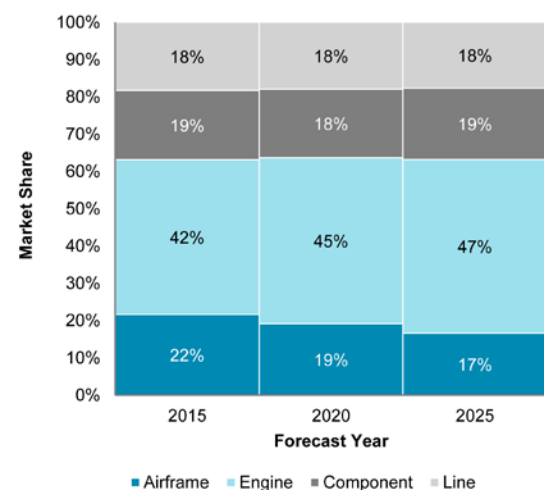


Figure 28: Global MRO Market Outlook 2015-2025

¹⁰⁵ Capgemini "Maintenance, Repair and Overhaul MRO- optimised MRO becoming a reality" 2014
https://www.capgemini.com/resource-file-access/resource/pdf/Maintenance_Repair_and_Overhaul_MRO_.pdf

The above graphic issued by industry experts "CAVOK/Oliver Wyman"¹⁰⁶ are forecasting a significant increase in the global MRO growth of 4.1%, yet the geographic mapping of where these increases can, or are expected, to be realized remains open. Nevertheless the interesting observation is the share of aero-engines in relation to airframe, other aeronautical components and line maintenance activities represents the most significant increase rep. shares. Evidencing the increasingly important role of an aero-engine in the industry.¹⁰⁷

Globally, the 2015 air transport jet and turboprop MRO markets are expected to be \$67.1B, piercing the \$100B milestone by 2025. This represents a healthy 4.1% compound annual growth rate (CAGR). The airframe, engine, component, and line MRO market segments each have a different growth profile:

Airframe MRO 2015 forecast is \$14.5B, increasing to \$16.7B by 2025. This represents a 1.4% growth rate, the slowest MRO segment during the forecast period. Airlines and their affiliated maintenance providers maintain a solid hold on this market. The airframe MRO market is considered a low-margin, labor-intensive segment.

Engine MRO is expected to be \$27.9B in 2015; growing at 5.3% annually it will reach \$46.8B by 2025. Unlike airframe MRO, the engine segment is largely contracted with the engine original equipment manufacturers (OEMs) having a large share of the market. Engine MROs, recognizing the value of the aftermarket, typically enjoy higher margin work.

Component MRO is forecast to be \$12.4B in 2015, growing to \$19.2B by 2025, representing a 4.4% annual growth rate. Like the engine MRO business, much of the component segment is contracted, though it varies greatly from one component type to the next. Similarly, the labor and material mix can vary.

Line MRO is pegged at \$12.3B in 2015 and forecast to grow at 3.7% annually to \$17.8B by 2025. The nature of line maintenance is less prone to contracting, and because the work is labor-intensive and subject to limited ground times in a scheduled operation, the opportunities to take advantage of economies of scale are limited. Looking forward and beyond the short term

¹⁰⁶ CAVOK April 2016 "Aviation Maintenance Industry Outlook and Economic Impact"
http://www.cavokgroup.com/content/dam/oliver-wyman/cavok/files/20160405_OW_CVK_MRO_Americas_Presentation.pdf

¹⁰⁷ MRO Yearbook 2016 "Fair skies ahead" p. 2,3,4.

opportunities may arise in MRO's in providing more component and cabin modification services as the competition of cabin comfort increases between legacy operators and their middle east rivals.¹⁰⁸

15.4.2. MROs in Luxembourg

At this moment in time Luxembourg hosts four (4) MRO licenses (Part 145)

1. Luxair

is at this moment in time not promoting or undertaking third party maintenance, merely self-servicing their own B737 and Q400 fleet.

2. Cargolux

equally self-servicing their B747-400F/B747-8F fleet. In addition Cargolux handles a significant portfolio of third part maintenance, for which they hold EASA/FAA approvals for B747-400 /-8 as well as B777-200/300. Cargolux offers in addition Aircraft Maintenance Service Capabilities for Engine Maintenance, Components Shop and Specialized Services for Inspections and Analysis, as well as Line Maintenance Support for non-resident operators.¹⁰⁹

3. Luxembourg Air Rescue (LAR)

Luxembourg Air Rescue has recently (20.4.2016)¹¹⁰ inaugurated their new hangar facilities consisting of three units with a total area of 7200sqm, that can accommodate their fleet of 5 Helicopters and 5 Bombardier Learjet 35. LAR holds a Luxembourg approved Part 145 certificate and at present handles exclusively their own fleet, hence no third party works is provided.

¹⁰⁸ ARSA - CAVOK Global Fleet & MRO Market Economic Assessment March 2015 <http://arsa.org/wp-content/uploads/2015/03/ARSA-CAVOK-2015AssessmentExecSummary-20150330.pdf>

¹⁰⁹ Cargolux Airlines "Maintenance Servcies" <http://www.cargolux.com/maintenance/services>

¹¹⁰ Luxemburger Wort 20.4.2016 Neuer Sitz für die Air Rescue <http://www.wort.lu/de/lokales/in-findel-neuer-sitz-fuer-die-air-rescue-571768d31bea9dff8fa7669b>

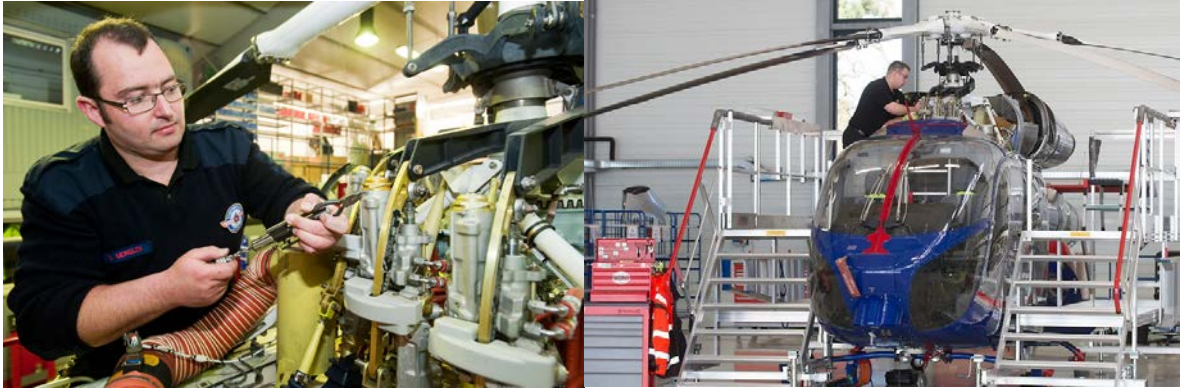


Figure 29: LAR Technician at work

4. GA Maintenance

Whereas the previous mentioned MROs are known to be engaged as MROs to the commercial aviation, GA Maintenance handles maintenance services for aircraft up to 5700kgs (a weight break point set by EASA as from which aircrafts will qualify as commercial aircrafts)¹¹¹.

Given the aforesaid abilities present in Luxembourg, additional actors in the field of MRO activities may be welcomed, however they are definitely not lacking and should in the "to get" box be ranked rather at the bottom than at the top.

16. Competence and Finance are key

Luxembourg should have an interest to further focus and acquire competences; the ability to grow part of its economy in the aero-engine sector is also dependant on capabilities and competences. There are numerous education centres in the vicinity of Luxembourg that would provide future competences of all levels.

¹¹¹ EASA "Operations in General Aviation" 2016 <https://www.easa.europa.eu/easa-and-you/general-aviation/operations-general-aviation#group-easa-related-content>

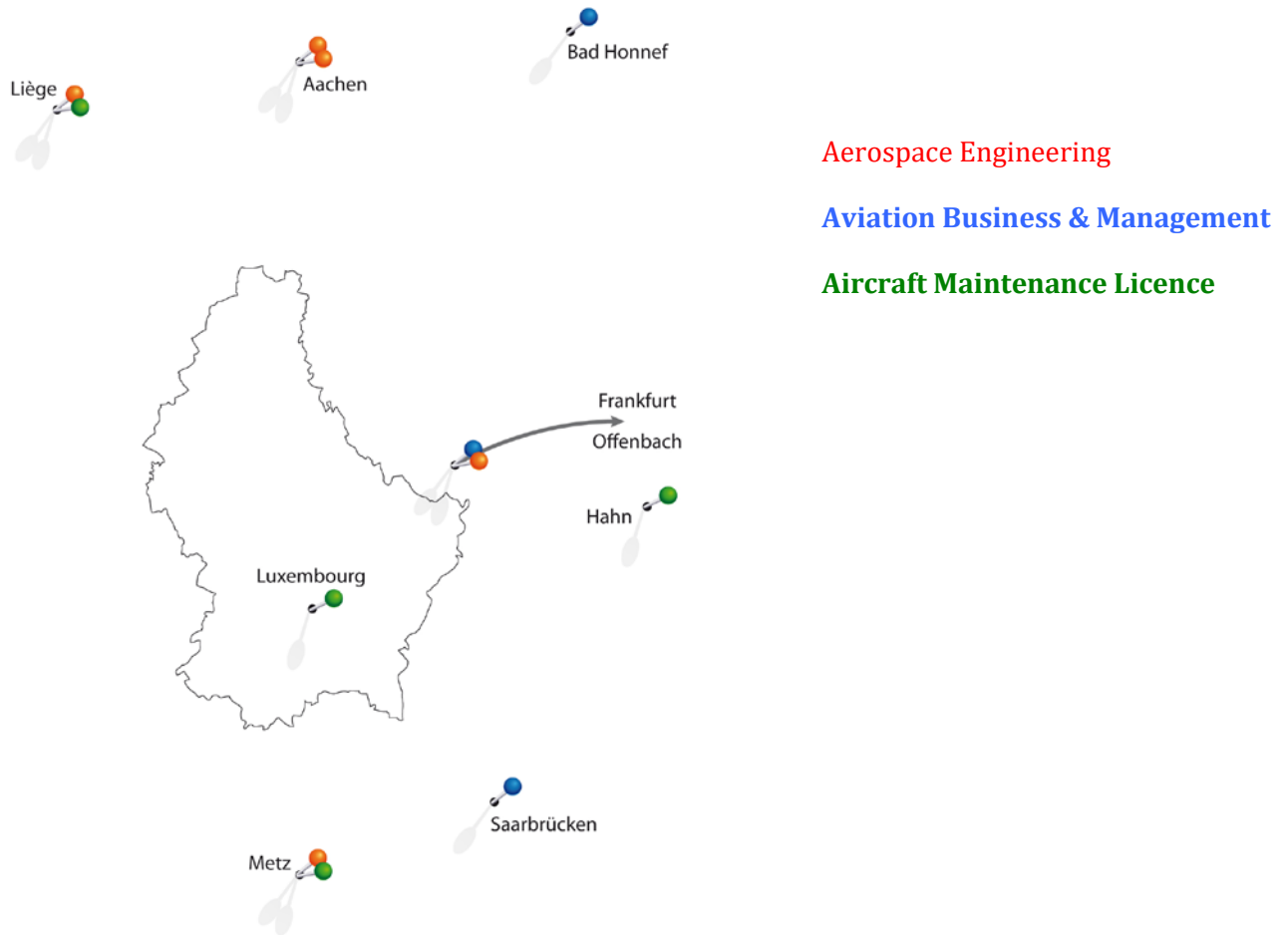


Figure 30: Competence in the Vicinity¹¹²

The underlying observation remains that expertise appears to be lacking in the air finance competences that are locally present. It may be that major financial institutions have specific departments, somewhere located around the globe, yet it appears that local interfaces are simply resilient to further processing and fostering that very activity. Confidence in aviation transactions by any investor is subject to an objective value assessment and the ability to critically forecast

¹¹² Own presentation

Fachhochschule Aachen: Master of Science; Bachelor of Engineering
 Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen: Master of Science
 Université de Liège: Ingénieur civil électromécanicien - aéronautique
 Ecole Nationale d'Ingénieurs de Metz: Ingénieur diplômé - aéronautique
 Hochschule für Technik und Wirtschaft des Saarlandes: Bachelor of Science
 IUBH School of Business Management Bad Honnef: Bachelor of Arts
 Frankfurt University of Applied Science: Bachelor of Art
 Lycée Technique Privé Emile Metz: Technicien d'Avion
 Berufsschule Offenbach/ Lufthansa Technik Alzey: Fachrichtung Treibwerktechnik
 Lycée Jean Zay, Metz: Bac Pro /BTS Aéronotique; Option Mécaniciens Moteurs
 Haitec Aircraft Maintenance, Hahn Airport: Fluggerätmechaniker

these values in the future. The complex aviation industry, and in particular when assessing aero-engine values, requires expertise that are reliably supporting the air finance investors. The typical aspects of competences at stake are:

1. Number of assets in service
2. Geographical distribution
3. Technical status of the aircraft and its product life cycle
4. Specifications and potential replacement products etc.

These are merely a few of the many core aspects that needs to be comprehended by the investor; whatever form of investor or purpose it pursuit, the understanding of the various contexts will need to performed. May these in the sense of aircraft or aero engine market, performance attributes, the outside influence of macroeconomic forces, like market demands and future market shifts. The ability to examine, and distinguish, which factors influence the value retention capabilities of an aero-engine are the core missing abilities found in the financial environment of Luxembourg, there running severely behind it's benchmarked competitor in this document; Ireland.

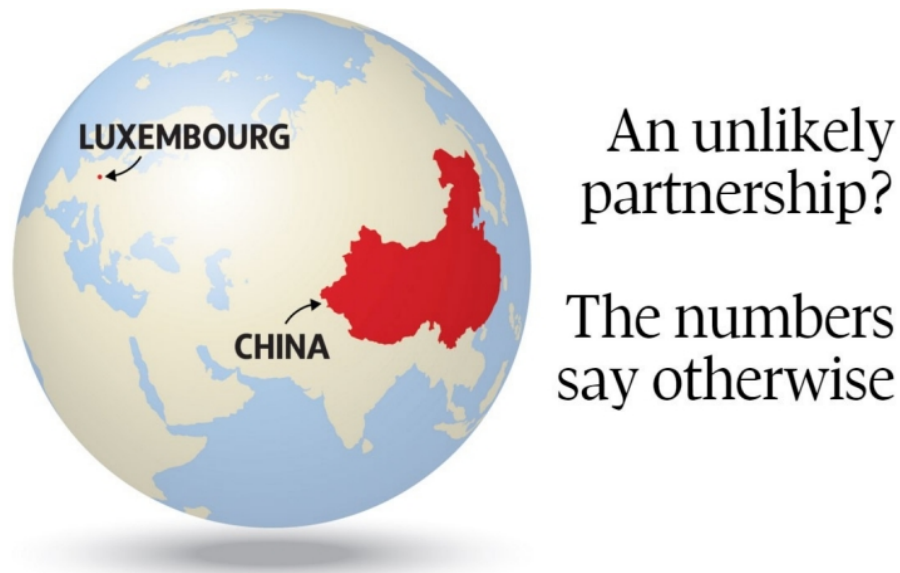


Figure 28: Luxembourg has become a powerhouse to Chinese bond listing¹¹³

¹¹³ Thomson-Reuters 03.10.2015 "Why is tiny Luxembourg key to China's global plans?"
<http://thomsonreuters.com/en/articles/2015/luxembourg-key-chinese-dim-sum-bond-listing.html>

Yet Luxembourg disposes of an excellent financial network, its relation to China in particular would grant phenomenal access to capital that would elevate Luxembourg to a significant aviation actor, in particular if a sector is still in infancy like the aero-engine leasing. It might seem curious that China, a country of 1.4 billion people, should even notice Luxembourg's half a million residents. But since Beijing's decision to establish the tiny country as one of a few global trading hubs through which the RMB is being gradually internationalised, Luxembourg has emerged as a heavyweight in RMB investment fund administration, dim sum bond ¹¹⁴ listing and facilitating investment into Europe.¹¹⁵

A clustering of the mentioned stakeholders in this document, to deeper assess their combined ability, paired with a political will to drive this segment forward will, in the view of the author, succeed to attract an interesting and fascinating segment to Luxembourg in which local competences can unfold and diversify from its knowledge based society into new industries - together.

With an access to all required levels of education in the vicinity of Luxembourg, ranging from Aerospace Engineering, Aviation Business/Management to Aircraft Maintenance Licencing, the potential of future competences are accessible and as generally known Luxembourg is an extremely vibrant one and residents enjoy one of the highest standards of living of all developed countries, ranking:

- 4th in the world for quality of life
- 1st for GDP per person
- Number one across Europe for disposable income.¹¹⁶

Leaving Luxembourg presumably as a top of the list destination for non-residents seeking a professional career in aeronautical engineering.

¹¹⁴ Dim sum bonds are bonds denominated in the Chinese yuan but issued outside of China.

¹¹⁵ Thomson-Reuters 03.10.2015 "Why is tiny Luxembourg key to China's global plans?"
<http://thomsonreuters.com/en/articles/2015/luxembourg-key-chinese-dim-sum-bond-listing.html>

¹¹⁶ Huxley Associate 2011 "Living and working in Luxembourg"
http://assets.huxley.com/CareerGuides/living_working_in_luxembourg.pdf

Conclusion

Aviation is an extremely capital intense industry, it requires huge amounts of funds and equally it requires huge amounts of know how - in all fields! Hardly any industry is more severely regulated and under such rigid scrutiny by its regulators, the reasons are obvious one small mistake can lead to disastrous consequences. What is most obviously applicable for flight operational is not less applicable for all other scopes within the industry, flight operations, maintenance, revenue management and not the least asset management; each link setting ultimate focus on their strengths within the chain of an industry where every micro movement will trigger macro effects.

The management of aviation assets has equally been set focus upon and gradually asset leasing has become one of the most important links for within this industry. Nowadays more than 40% of the operating aircrafts are being leased and this very trend is starting to follow for aero-engines. The aviation industry is set for growth as the economic footprints become more visible and aircraft orders (and long term order projections) are far from being pessimistic, duly acknowledged by either of the dominant aircraft manufacturers. Projections are that a little less than 40.000 airplanes will be operating to meet future air transport demands up to 2035, as urbanisation, world population and growth of GDP and income per capita keep growing. Taking into account the aforesaid, the air transport industries has a substantial economic impact offering selective opportunities for Luxembourg, other than the touch down and take off of cargo and passengers.

Aero-engines have proven to retain a much higher value then the airframes upon which they were mounted upon. Their secret is well hidden in the potential the aftermarket of the engines comprises. As aircraft leasing is on the rise and so are their engines. The opportunities the engine lease market is offering are echoed by a number of market actors:

- Financiers and Lessors; seeking reliable and yielding investments
- OEM's; seeking more value in the aftermarkets than in the commodity itself
- MRO; seeking to capitalize on the life span of an aero-engine
- Airlines; seeking to reduce their asset costs
- Logistic Service Providers; seeking their transport values.

Luxembourg's aviation history goes along with an ever open mind to opportunities that were being offered, somewhat by coincidences or but mainly because somewhat by global growth factors. The two main, and legacy, carriers have constructed an impressive field competence and driven by an unmistakable spirit of entrepreneurship, it is presumed that these operators were the driving forces to establish an attractive environment, fully suited their self-serving purposes. Thereby Luxembourg has, in the perspective of the author created for itself a platform that will - quite effortless - allow Luxembourg to compete with prime leasing platforms around the globe.

Benchmarking Luxembourg's aviation abilities against those present in Ireland, it can be concluded that minor obstacles, or otherwise formulated: a few weaknesses are to overcome, and Luxembourg will be fully fledged to compete as a platform for the aero-engine sector. Taking a close look upon the weaknesses of Ireland, one can extract that the prime concern of Irish industry experts is the lack of local financing activities in Ireland. Luxembourg is believed to mitigating this threat, as its access and connectivity to finances has formed the core economy of the country. Luxembourg disposes of excellent abilities and structures to secure, facilitate and optimise investments of aero-engines. Furthermore its characteristics ranging from the ratification of the Cape Town Convention, Mortgage Registry Instrument to Securitisation Vehicles and Taxation; Luxembourg stands nowhere far behind its perceived field competitor Ireland or the Netherlands.

With facilities available and competences grown and inherited by its two local actors Luxair and Cargolux, Luxembourg appears to be well prepared to batter for a prime position in the aero-engine industry. In fact these afore listed credentials are a merely a result of Luxembourg's excellent entrepreneurship which is has proven in the past and it is certainly able to continue it's "out of the box thinking" and anticipate on opportunities that are being offered. In the early 1980s the establishment of a Satellite company may have sounded as estrange as todays announcement of launching a plan to mine asteroids for minerals in space.

As promising the future innovations may be, there is an interest, and in one form or the other an obligation, to foster and expand those economies present. With significant storm clouds threatening cargo demands for Luxembourg, albeit growth has not stopped, it is believed that in the long term Luxembourg should diversify it's aviation sector and will need to continue to build facilities that will strengthen their potential. Key economic, demographic, and political factors to watch are:

1. Decelerating growth in China
2. Centrifugal forces on the EU
3. Ever declining effectiveness of monetary stimulus, as interest rates turn negative
4. Global popular disaffection with free trade
5. Disruptive human population movements.

The author is of the firm opinion that an **aviation cluster** should be organised by the responsible ministries for economy and transportation, a) to mitigate effects on these listed macro factors and b) to initiate the development of an economic and financial perspective of aviation. Focus should be laid upon:

- Existing local airlines bringing the necessary seed business
- Existing access to (local) capital
- Existing local infrastructure for logistics and storage of aero-engines
- Existing legal and taxation environment
- Existing local aviation financing and legal know-how.

The weakness of Luxembourg is that its financial sector is reported to be lacking the aeronautical specific knowledge, needed to properly assess the asset value and economical life span, creating an uncomfortable risks assessment for investor. The aviation cluster will form a tool or forum to mitigate this shortfall and actively contribute to generate the missing knowledge and competences.

The formation of such a cluster will create, apply and further develop practical and tailor made solutions of which the results aim that aviation will further contribute in diversifying Luxembourg's economy. By creating a differentiation of job competences, (engineering, asset management, etc.) followed by directly and/or indirectly GDP growth as a spin off of the economic footprint. Let's make Luxembourg an aero-engine Ireland!

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