



THE BOEING 737MAX TRAGEDY

BACKGROUND INFORMATION AND HOW AIRCRAFT INVESTORS ARE AFFECTED

EXECUTIVE SUMMARY

- In May 2017 Boeing delivered the first Boeing 737MAX ("737MAX") to an airline – Boeing's goal was to further reduce the operating cost and the fuel burn to compete with the newly launched Airbus rival, the Airbus A320 new engine option family ("A320neo")
- In March 2019, after two 737MAX aircraft crashed under similar circumstances with 346 people losing their life, a worldwide flight ban was imposed on this aircraft type
- Following the grounding of the aircraft type all major regulatory bodies have been carrying out extensive technical assessments of this aircraft, before allowing the 737MAX rejoining the fleet
- Currently, appraisers' expectations for residual values and lease rates remain broadly in line with previous expectations
- On the understanding that all problems with the 737MAX will be solved, KGAL is convinced of the future success of this aircraft
- Building a diversified aircraft portfolio will limit individual aircraft risk

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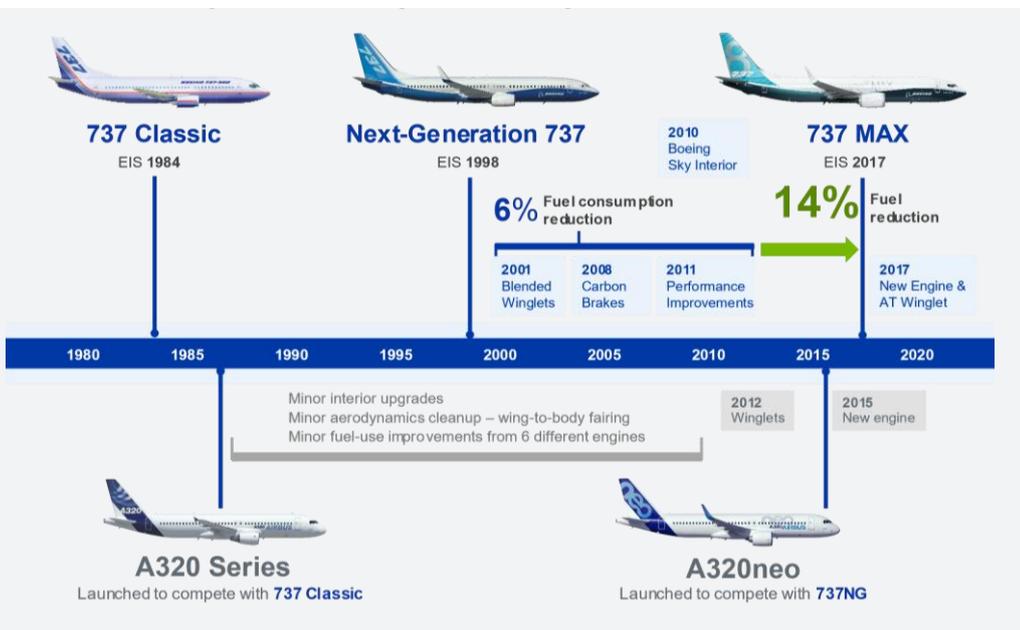
1. BACKGROUND

In March 2019, after two Boeing 737MAX aircraft crashed under similar circumstances within five months, a worldwide flight ban was imposed on this aircraft type. A total of 346 people lost their lives in the disaster in Indonesia in October 2018, and in Ethiopia in that March.

Boeing 737 Next Generation Family (“737NG”)

Development of the 737NG, the predecessor to the 737MAX, was initiated in 1993 and was an improvement of the existing Boeing 737 Classic. Deliveries of that aircraft type started in 1998, with the last 737NG being delivered in June 2019. With a total of 7,086 orders the program was a great success for Boeing and its customers. The aircraft is still the backbone of many airlines narrow body fleets and is highly valued for its performance, reliability and low operating costs.

737NG is still the backbone of many airlines narrow body fleets



Source: The Boeing Company Corporation

Boeing 737MAX

The 737MAX is a new aircraft type based on the existing 737NG models. The aircraft development started in July 2011, after Boeings greatest competitor Airbus announced its new generation mid-range aircraft, the A320neo family. Boeing’s goal was to further reduce the operating cost and the fuel burn to compete with the newly launched Airbus rival.

In order to achieve these goals, the following technological enhancements were introduced to the new Boeing aircraft:

- The introduction of a new engine type with a larger diameter and higher bypass ratio resulting in a fuel burn improvement of 11% – 12%
- Aft fuselage aerodynamic improvements to reduce drag (fuel burn improvement approx. 1%)
- Advanced winglets for a natural laminar airflow (fuel burn improvement approx. 1.8%)

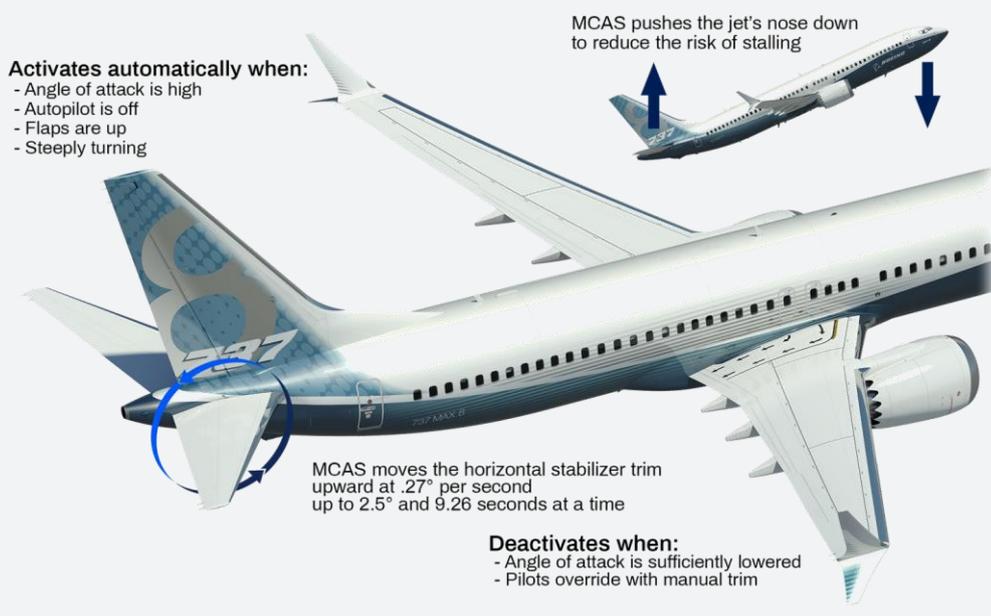
With these new technologies Boeing claims an overall fuel burn improvement of approximately 14% compared to the 737NG. This is in line with the efficiency improvements Airbus achieved with the introduction of the A320neo. In addition to these changes Boeing had to design and implement a completely new manoeuvring system to ensure the certification requirements were met in all flight stages.

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Introduction of the Manoeuvring Characteristics Augmentation System (MCAS)

The newly introduced CFM LEAP-1B engines have a larger diameter compared to the predecessor engines and in order to give the necessary ground clearance, the engines had to be repositioned compared to the predecessor engines. This change had an impact on the aircraft's center of gravity, as well as on the manoeuvring characteristics of the aircraft during low speed operation with a high angle of attack (mainly during climb after takeoff).

Due to a larger engine and the resulting aerodynamics, a vortex flow could create additional lift which could result in an abnormal pitch and subsequently lead into an aircraft wing stall. As a result, Boeing introduced the MCAS to give automatic nose down stabiliser input during elevated angle of attack phases, emulating the flight characteristics of the previous model.



Source:
<https://theaircurrent.com>

2. 737MAX GROUNDING AND NEXT STEPS

After the second fatal crash of this aircraft model, aviation authorities around the world grounded the 737MAX fleet mid-March 2019 and ultimately an emergency order by the Federal Aviation Authority (FAA) of the United States was established. It was evident that the MCAS System had been activated during both accidents. Investigations revealed deficits in flight crew training (most of the crews were not aware that the MCAS exists) and in the software of the MCAS system. A malfunctioning AoA sensor (Angle of Attack Sensor) could activate the MCAS system erroneously, as seemed to have happened during the two crashes.

Boeing is currently working together with the FAA on a software update to gain the re-certification for the 737MAX model. This redesign will result in the MCAS relying on data from two sensors, instead of just one. The system will also be adapted so that the pilots can over-rule the decisions of the system. In addition, all pilots will receive detailed training on how to use the MCAS.

Boeing is currently working together with the FAA on a software update

It remains to be seen whether there will be more audits of the aviation authorities themselves, in the certification and approval of commercial aircraft, and whether the current practice of delegating examination tasks to the manufacturer will be restricted.

After successful implementation of these steps and certification by the US FAA, an approval by other international aviation authorities will be needed. Based on our current understanding, we believe that this will happen, at the earliest, end of 2019, beginning of 2020.

Currently, regulators worldwide are debating the extend of further mandatory simulator trainings for 737MAX pilots. Aviation authorities are considering whether pilots need to fly on a simulator or just complete less-expensive online training. Mandatory flight simulator training could further delay the return to service of the 737MAX fleet.¹

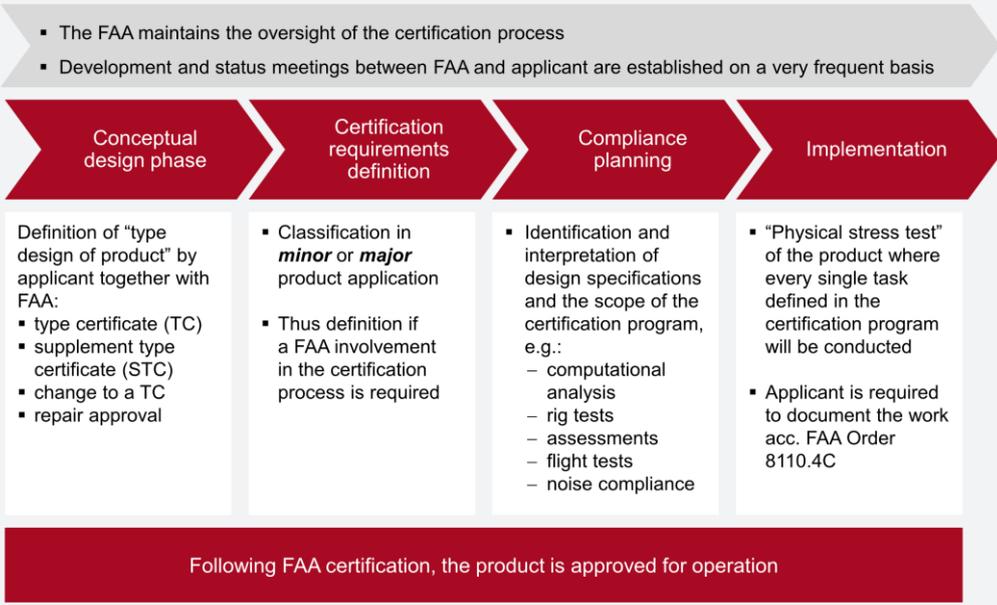
3. SNAPSHOT OF THE AIRCRAFT CERTIFICATION REGULATIONS

With the two 737MAX fatalities, a public debate about aircraft safety has gained general interest with some people challenging the sufficiency of the safety mechanisms, causing this closer scrutiny of the certification process of new aircraft, such as the 737MAX.

Every stakeholder taking part in the design, production, operation or maintenance of aircraft equipment needs to hold an approval certificate by the Civil Aviation Authority (CAA), the regulator of the country where the stakeholder is performing its business. In Europe, the European Aviation Safety Agency (EASA) is the government entity responsible for regulatory compliance whereas in the United States, the FAA is the rule making entity.²

The chart below illustrates the main steps of the aircraft certification process by the FAA, which is the responsible certifying agency for the U.S based manufacturer Boeing.

STEPS OF CERTIFICATION PROCESS (SIMPLIFIED)



¹ Ishka's take on Boeings MAX crisis

² Title 14 of the Code of the Federal Regulations (CFR) implements the aviation regulations into federal law. The certification of aircraft equipment is defined by Part 21 of the FARs and addresses the roles and responsibilities of applicants, certificate holders, and the FAA. This framework includes each stakeholder's role in the certification process and continued airworthiness, as well as the FAA's role in developing standard policies and guidance. Furthermore, where Part 21 of the FARs defines the responsibilities, the FAA Order 8110.4C prescribes the procedures the FAA has to follow on certification processes of aircraft equipment.

Due to the new aircraft design fundamentally changing the aircraft flight characteristics, in terms of weight and trim, compared to the predecessor 737NG, Boeing and the FAA categorised the 737MAX as a new type certificate and subsequently applied the major change process.

4. REACTIONS AFTER THE SECOND FATAL CRASH

4.1. Regulatory Bodies

While China made the first regulatory decision to ground the 737MAX series, other aviation agencies and airlines followed. The FAA, the certifying agency of the 737MAX, initially affirmed the aircraft's airworthiness, moving to ground it two days after the Ethiopian Airlines crash, based on new evidence of similarities between the two accidents.

After the grounding was initiated, the FAA organised a Joint Authority Technical Review (JATR) to conduct a review of the certification of the automated flight control system on the Boeing 737MAX. The JATR is comprised of a team of experts from the FAA, EASA and other international aviation authorities.

In June 2019, the FAA published an update on the most recent issues:

“The FAA is following a process, not a prescribed timeline, for returning the Boeing 737MAX to passenger service. The FAA will lift the aircraft’s prohibition order when we deem it is safe to do so. We continue to evaluate Boeing’s software modification to the MCAS and we are still developing necessary training requirements. We also are responding to recommendations received from the Technical Advisory Board (TAB). The TAB is an independent review panel we have asked to review our work regarding 737MAX return to service.”³

4.2. Airlines

Around 380 737MAX have been delivered to almost 50 airlines. Immediately after the 737MAX grounding, Boeing stopped deliveries of this aircraft type. The U.S based manufacturer has currently a total order book of approx. 4,500 aircraft. Most of the airlines that intended to order the 737MAX aircraft had already placed their orders.

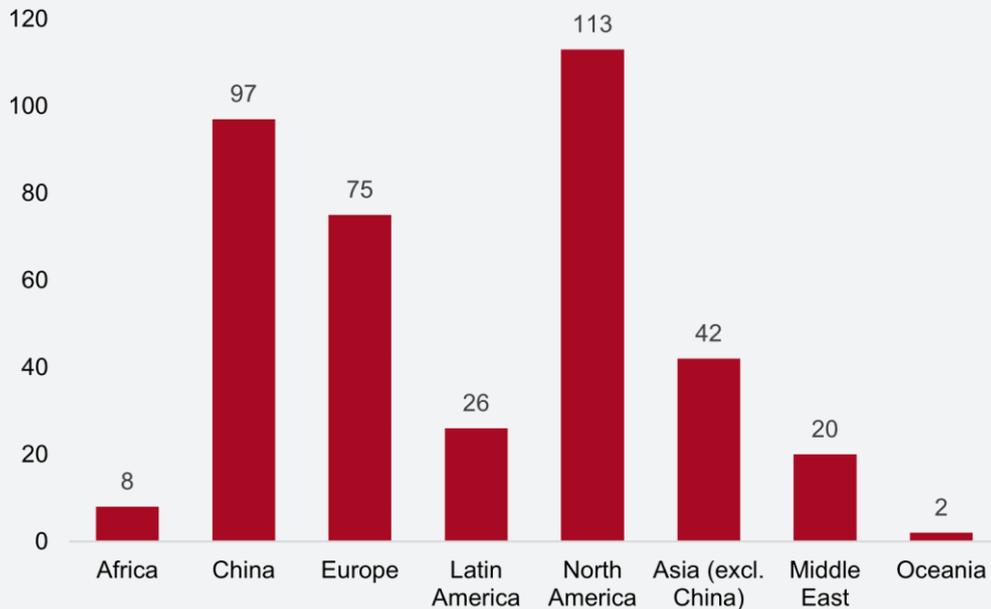
It remains to be seen whether Boeing will offer some form of discounts to incentivise airlines to order the 737MAX once the current issues are solved and the 737MAX fleet returns to service.⁴

As shown in the next chart airlines all over the world are affected by the current grounding of the entire 737MAX fleet. Airlines based in China, North America and Europe are among the most affected operators.

³ FAA Statement vom 6/26/2019 4:45 p.m.
<https://www.faa.gov/news/updates/?newsId=93206>

⁴ Boeing Order & Deliveries (June 2019)

Grounded 737MAX⁵



⁵ Airfinance Journal Fleettracker

Airlines worldwide are faced with the problem that the public has lost their trust in the 737MAX series. It can be assumed that before the 737MAX will fly again that this aircraft type will be the most assessed and most carefully tested among all aircraft, as the regulatory bodies and Boeing have an inherent interest to restore their credibility and trust among the public.

Depending on each individual contract between the manufacturer and the airline, it might not be possible to cancel an order of an aircraft after a purchase agreement has been signed. It would only be possible:

- To cancel so-called “provisional orders” as the Saudi Arabian budget carrier Flyadeal did in July 2019
- To request a cancellation of the order in connection with a replacement order of other aircraft types of the manufacturer as in the case of Garuda airline
- To cancel an order, if the individual contract between the manufacturer and the airline has a special “Late Delivery Period” clause, which states that the buyer can step away from the acquisition contract, if the aircraft is not delivered within a certain period of time

Generally speaking, if the aircraft has been assigned a Manufacturer’s Serial Number (MSN) it is difficult or even impossible to cancel an order.

However, some airlines, like British Airways, believe in the long-term success of Boeing and the 737MAX series. International Consolidated Airlines Group (IAG, parent of British Airways) signed a letter of intent at the Paris Air Show to order 200 Boeing 737MAX aircraft.

It is believed that the deal contains a substantial discount. Generally, manufacturers provide discounts on bulk orders and are known to provide various incentives (e.g. the option to swap delivery positions or switch between aircraft variants or types).

Before the 737MAX will fly again it will be the **most assessed and most carefully tested** among all aircraft

5. IMPACT ON MARKET

It is clearly imperative to the FAA and Boeing to solve the problem with the 737MAX. Resulting in, airlines and the aircraft leasing market remaining convinced of the success of this aircraft model as it belongs to the most fuel efficient and modern aircraft types worldwide.

Its predecessor the 737NG family is currently, along with the Airbus A320 classic engine option family (“A320ceo”) aircraft, the most operated model in the narrow body market. In addition, the NG and MAX models have the same type rating from a cockpit crew perspective, encouraging airlines to remain consistent with one manufacturer, rather than change their fleet equipment.

5.1. Implications On Residual Values And Lease Rates

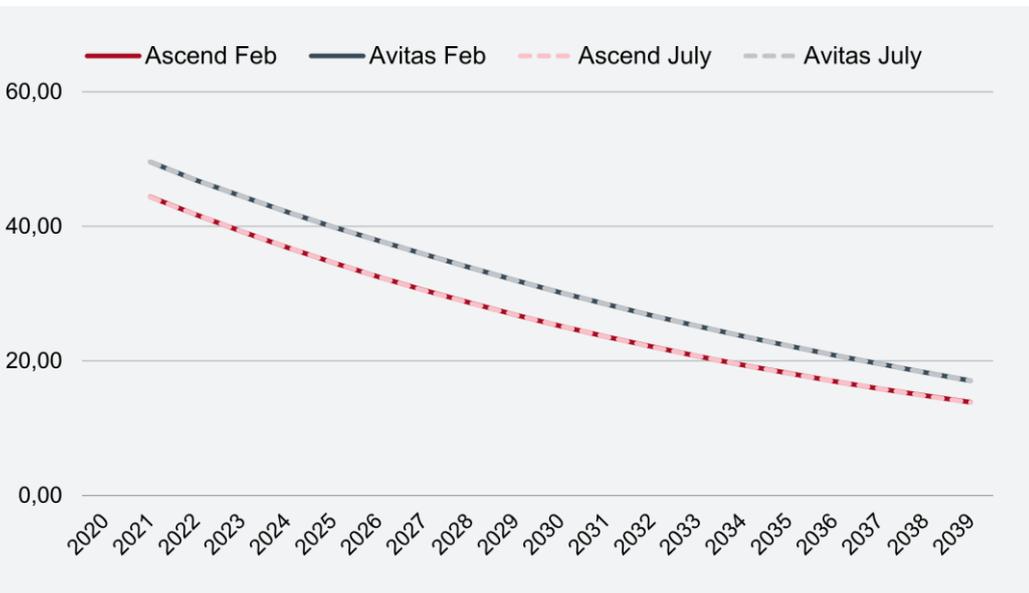
To date, it is notable that appraisers have not made any changes to their opinion of the residual values, depreciation rates, economic life, etc., of the 737MAX. Given that both the MAX series as well as the Airbus neo family are sold out for at least six years, there is an undeniable need for the additional aircraft, such as the 737MAX.

Appraisers seem to continue to have confidence that the FAA and Boeing will fix the issues in the near future. Despite the current issues, and for the reasons mentioned above, airlines are not stepping away from the 737MAX in large numbers. Other aircraft types have been grounded before (even though the groundings were not of the same scale) and returned to service with no impairment of residual values. Appraisers’ are continuing to base their assumption of residual values on the fact that the aircraft is airworthy and compliant with all major airworthiness authorities worldwide. However, in the event of a continuing grounding of the 737MAX into 2020, we expect a reassessment of residual values of the 737MAX would be necessary.⁶

Appraisers have not made any changes to their opinion of the residual values

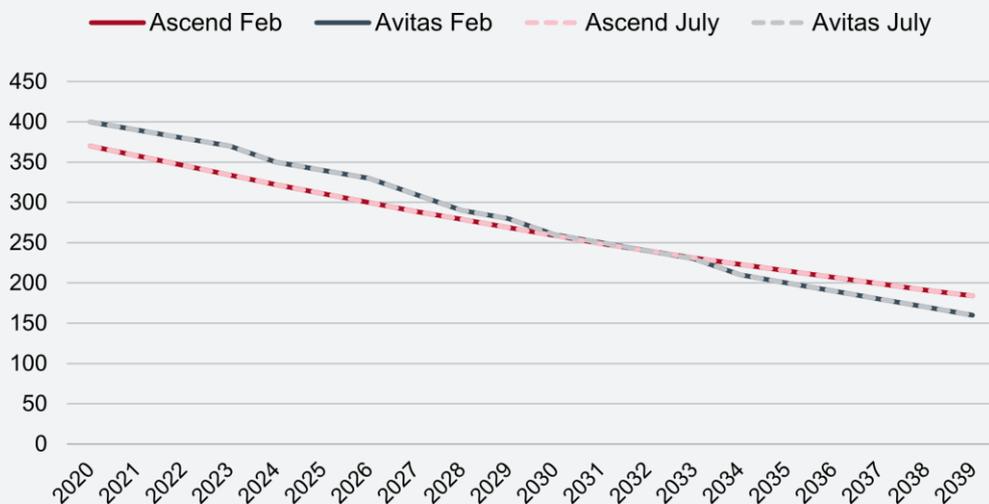
As there are currently no 737MAX RfP (request for proposal) in the market, it is rather difficult to assess whether the current 737MAX grounding will have an impact on lease rates or residual values assumptions in the long-term. Looking ahead to consider 737MAX aircraft manufactured and delivered in 2021, we do not see appraisers changing their assumptions for residual values and lease rates. The chart below shows values from the appraisers *Ascend and Avitas* from February 2019 and July 2019. We can see that residual values as well as lease rates for the underlying aircraft remain unchanged.

Forecasted Residual Values 737MAX (in USD millions)⁷



^{6,7} Statement from Avitas, Avac, Ascend (July 2019)

Forecasted Lease Rates 737MAX (in thousand USD)⁸



⁸ Statement from Avitas, Avac, Ascend (July 2019)

5.2. Leasing And Manufacturer Market

Generally, the supply of aircraft is relatively inelastic and very predictable as it is a response to demand from airlines which is identified well before the aircraft are needed to be operational. The construction of aircraft takes a long time and there are only two main suppliers; Boeing and Airbus. Operators have quickly reacted to the grounding and the stop of new deliveries by reducing services, postponing new services and using other aircraft types to fill the void. In addition, the lack of a 737MAX in service will reduce the number of retired aircraft in 2019, as they will be operated longer than initially planned.⁹

Consequently, one short term effect has been on lease rates and values for older, current generation 737NGs and A320ceos. The grounding has left a small capacity shortage that airlines have tried to fill with short term leases of similar sized aircraft. Older 737NG's and A320ceos have been in high demand to fill in capacity and as such, lease rates have increased as owners of these aircraft seek to make short-term profit from the spike in demand for limited supply.¹⁰

The market for new aircraft does not offer a lot of choices to airlines. Customers looking for new technology narrow bodies in the next five years have few alternatives due to Airbus' and Boeing's full order books. The market still sees huge appetite from lessors looking to buy the Boeing option – presumably on sale/leaseback deals. This demand might take some time to materialise, but if the aircraft returns fully certified and cleared for service, Boeing should see reinvigorated interest from investors and airlines.

Boeing has already announced that it will compensate affected airlines and lessors. In the second quarter 2019 the company recorded provisions of around USD 5 billion for potential customer compensation, resulting in it suffering its largest-ever quarterly loss in the quarter.¹¹

^{9, 10} Statement from Avitas, Avac, Ascend (July 2019)

¹¹ Ishka's take on Boeings MAX crisis

5.3. Impact On Investors

Generally speaking, the operational risk for lessors by investing and owning an aircraft is very limited as the airline has the sole right to use and operate the aircraft and consequently bears the operational risk. Furthermore, the aircraft are insured against total loss (no matter which

cause) via a hull insurance fully covering the bank debt plus the investor's equity. The amount insured (a so-called "agreed value") is adapted on a regular basis in line with the aircraft depreciation/amortisation and is constantly monitored for proper insurance. In addition, the operators are required to take out sufficient liability insurance against any charges arising out of liability claims caused e.g. by a crash. It is important to note that it is the operators/airlines themselves, not the lessor, nor an aircraft owning fund, that is required to take out insurance by law. As a consequence any fund shall not incur a losses from an event, such as a crash.

Since the lessees/airlines are obliged to pay the lease rentals regardless as to whether there is a grounding ongoing or not, there are no consequences for the lessor/investor as long as the relevant airline's credit allows the fulfillment of its contractual obligations. The lessor is not directly responsible for any operational items and is therefore not directly affected by these events. Nevertheless, lessors are responsible for monitoring the operations.

Drawing from KGAL's 40-year experience in aircraft financing, at KGAL we pursue a diversified portfolio approach, that is to say, our funds are diversified in terms of manufactureres, aircraft types, lessees, geographical region. This means that even in cases where one lessee defaults, in the event of such a grounding, the impact on a diversified aircraft portfolio is limited as shown in the next chart. Please note that none of KGAL's aircraft portfolio funds currently contains a 737MAX aircraft.

None of KGAL's aircraft portfolio funds currently contains a 737MAX aircraft

SAMPLE CORE AIRCRAFT PORTFOLIO WITH MORE THAN 20 AIRCRAFT



Scenario analysis for the default of a lessee with two aircraft representing 12 % of the portfolio after four years of investment¹

Business plan of the portfolio		Target IRR: 6.4 %	
Scenario 1: "Normal" market	<ul style="list-style-type: none"> Subsequent lease in three months New lease at the experts' mid case lease rate then effective Sale at normal conditions as scheduled 	5.9 %	- 0.5 %
Scenario 2: "Poor" market	<ul style="list-style-type: none"> Subsequent lease in three months New lease at the lower experts' lease rate then effective Market recovery until point of sale & sale at normal conditions as scheduled 	5.8 %	- 0.6 %
Scenario 3: "Normal" market	<ul style="list-style-type: none"> Early sale of both aircraft at normal conditions 	6.0 %	- 0.4 %
Scenario 4: "Poor" market	<ul style="list-style-type: none"> Early sale of both aircraft at "worst case" conditions 	5.8 %	- 0.6 %

The return refers to the presented example and does not purport to present growth forecasts or the expected development of the value of an investment in the asset class.

6. OUTLOOK AND OPINION OF KGAL & GOAL

The Boeing 737NG models have no MCAS system installed and therefore, the current grounding only affects the newest model 737MAX. Since their entry into service in 1998 the 737NG aircraft family proved to be a very safe and reliable aircraft. Due to the outstanding performance of the 737NG, these aircraft will remain an essential element of airlines narrow body fleet for many years to come.

In general, the 737MAX can be considered as one of the two most significant passenger aircraft worldwide (the other being the A320 family from Airbus). Boeing will work to resolve the current problems satisfactorily as soon as possible. We believe that eventually, the 737MAX fleet will return to service as a reliable and safe aircraft.

As the technical asset manager of KGAL's aircraft funds, GOAL executes aircraft inspections and closely monitors all technical issues. GOAL is also monitoring the current problem-solving process of the 737MAX very closely. On the understanding that all problems with the 737MAX will be solved, KGAL is convinced of the future success of this aircraft. As mentioned above, currently, in our KGAL funds there are no 737MAX aircraft, but after the technical problems have been solved, KGAL would generally still consider investing in this aircraft model.

On the understanding that all problems with the 737MAX will be solved, KGAL is convinced of the future success of this aircraft

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KGAL Group

To date, the aircraft fund investment volume realised by KGAL Group totals more than €7.4 billion. Since the initial aircraft fund in 1979, KGAL has concluded transactions for more than 800 aircraft, 81 private placements and other investment models, as well as 58 retail and three institutional funds. KGAL Group is a leading, independent investment and asset manager with an investment volume of €20.5 billion. The investments focus on long-term capital investments for institutional investors in the real estate, infrastructure and aircraft asset classes.

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