



Path to certification of the Lilium 7-Seater Jet

By Yves Yemsi, Chief Program Officer, and Bhavesh Mandalia, Head of Airworthiness

In March 2021, Lilium revealed the development of the 7-Seater Lilium Jet, a unique aircraft design, technology and architecture that we discuss in more depth in [this blog](#). As always in aerospace and aviation, no aircraft enters active service without passing rigorous certification standards set by aviation regulators. Earlier this year, it was announced that Lilium are pursuing concurrent certification of the 7-Seater Jet with the European Union Aviation Safety Agency (EASA), the European regulator, and the Federal Aviation Administration (FAA), its US counterpart, through provisions under the Bilateral Aviation Safety Agreement (BASA) between the EU and US.

The purpose of aircraft certification, normally called 'Type-Certification' is to ensure that aircraft are designed and maintained at the highest and most meticulous safety and performance standards. The requirements for certification are published by governmental authorities (regulators) in each geography and have been improved and refined over several decades to ensure that all aircraft, particularly passenger aircraft, are 'airworthy'.



Fig. 1: Yves Yemsi, Chief Program Officer, and Bhavesh Mandalia, Head of Airworthiness

We both joined Lilium because we were inspired by an exciting and entirely unique approach to electric vertical take-off and landing (eVTOL) technology and with it the opportunity to help shape the future of sustainable and environmentally cleaner air mobility. Between the two of us, we have over thirty years' experience in obtaining certification for, and delivering some of, the world's most successful and complex commercial aircraft.

Bhavesh, who heads up Lilium's Office of Airworthiness, started his career with the Joint Aviation Authorities-approved design organization (a precursor to EASA), before moving on to set up the first EASA-approved aircraft design organization in Australia. He then transitioned to heading up Boeing's certification and design organization efforts in the UK and Ireland.

Prior to joining Lilium almost two years ago, Yves spent the last sixteen years at Airbus in various leadership roles, including leading Quality for the A350XWB program, one of the most successful programs at Airbus.

From our unique vantage points, we also saw a distinguished and experienced team working with regulators on a new set of standards in aviation - with the certification of Lilium's 7-Seater Jet at its core. Our colleague, Chief Technology Officer Alastair McIntosh, has previously discussed the technologies that underlie the 7-Seater serial jet in [his blog](#). Building on this, we wanted to share our ongoing progress in the development and certification of the 7-Seater Jet, including the critical aerospace processes that form part of it.

Philosophy: Designing with Certification in Mind

At Lilium, we have designed a new type of aircraft from the ground up with a certification mindset. Our matrix organizational structure has been constructed to ensure our program and product development processes are uniquely intertwined with the process of aircraft certification itself. This philosophy is critical to managing the risk of developing an aircraft which cannot be certified and commercialized. This is perhaps the single most important reason why an improvised 'startup' approach to aerospace development is unwise.

With this in mind, in 2017, we applied for an EASA Design Organization Approval (DOA), the regulatory approval required for organizations to design and certify new aircraft. This has ensured our processes have been developed within a regulatory framework from an early stage, further reinforcing our certification culture. In parallel, we have also applied for an EASA Production Organization Approval (POA) to enable us to manufacture and produce aircraft at scale. *Like the DOA, the POA is a fundamental requirement for all commercial aircraft manufacturers.*

And finally, prior to carrying passengers, the airline operating the Lilium Jet will require an Air Operator Certificate (AOC) or similar aviation operating authority. Lilium intends to work with a network of well-established suppliers and providers, including Luxaviation Group as recently announced, to serve as the holders of the AOC.



Fig. 2: Lilium employees testing components in preparation for the 7-Seater Jet

We are aiming to achieve Entry Into Service (“EIS” in industry parlance) in 2024, which is a fairly ambitious goal. At first glance, we recognize that our timeline may appear challenging, but we are confident in our program timelines, as explained below.

Program complexity and risk is driven broadly by 4 factors:

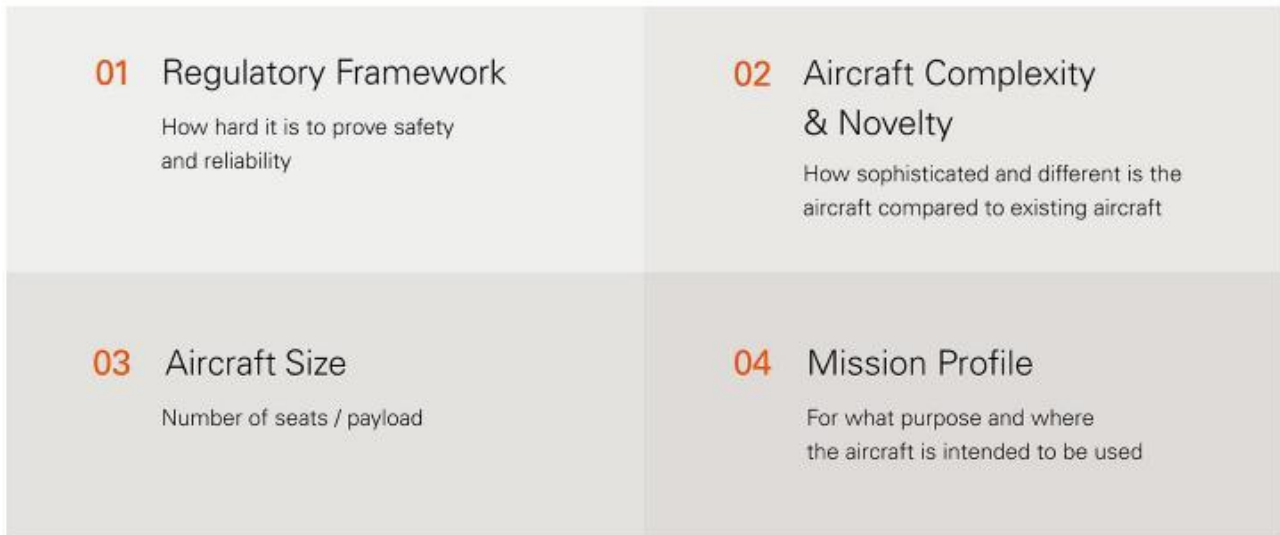


Fig. 3: the 4 factors that drive program complexity and risk

Our goal, therefore, has been to leverage existing aircraft design and certification principles, the inherent advantages of our aircraft architecture where possible, while at the same time actively working to mitigate downstream risks in areas that are novel or unproven in this new sector.

Firstly, we have invested a significant amount of time and focus in triangulating the precise requirements for certifying and designing both an aircraft and a design organization with certification as a core principle.

This has enabled us to prepare our teams to work in parallel with advances in regulation and rulemaking and has provided an advantage on how we scope our product. Although our aircraft showcases some novelties including electric propulsion and a thrust vectoring system for flight performance, control and manoeuvrability, we have been developing these technologies using our technology demonstrators over five years.

This knowledge and experience has driven our decision making on the sizing and architecture of our 7-Seater Jet, which has been designed using substantially fewer parts than the average commercial airliner (~ 30x fewer). This lower number of components and systems, when considered in comparison to a large commercial aircraft, means reduced timelines associated with detailed drawing, production and assembly integration of these components and systems. *Furthermore, fewer components imply fewer layers to validate and verify, which in turn means a reduced risk of major program delay.*

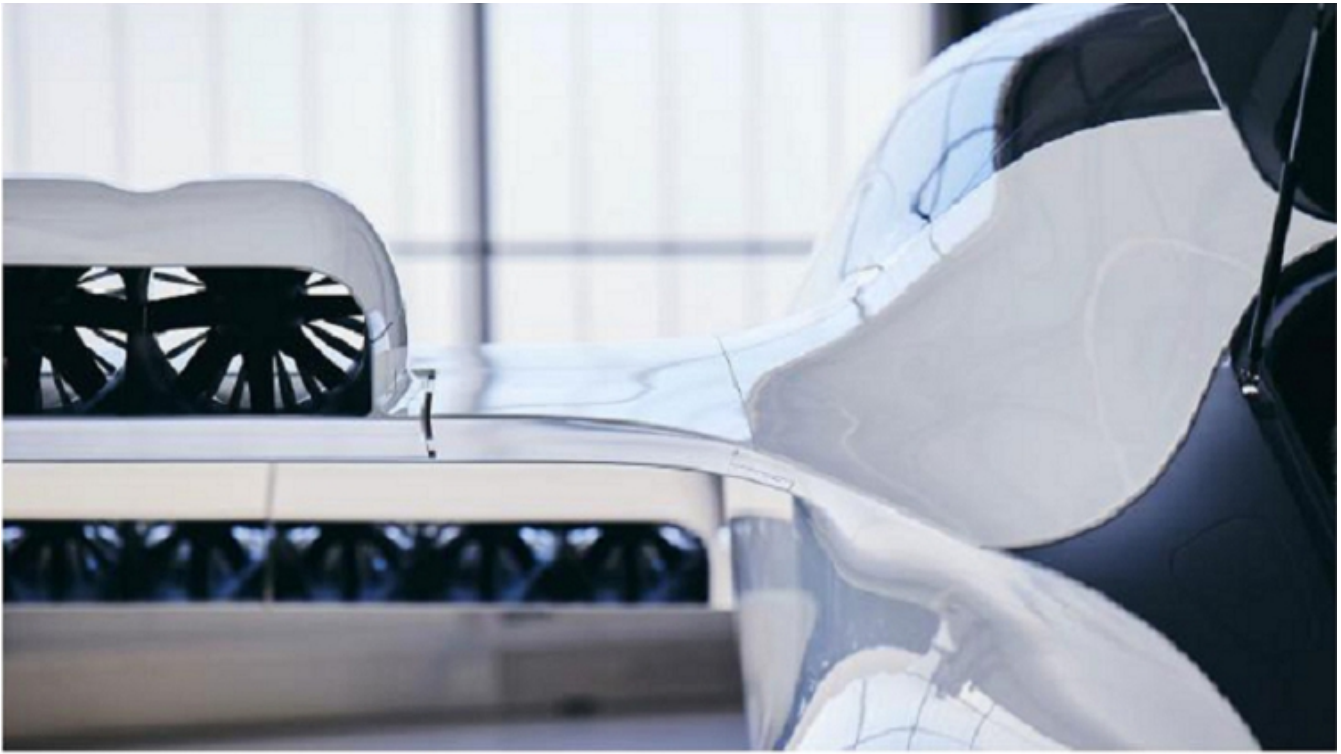


Fig. 4: The 7-Seater Lilium Jet will have 30 times fewer parts than a typical commercial airliner

Secondly, our team expertise and development program consistently follow a rigid, industry-standard and gated approach – what’s called a Validation and Verification (“V and V”) process. In this process, the requirements are first *validated* and cascaded down to the component level of the aircraft. Then, through the design, build and test phases, the final product is then *verified* with a program of analysis, ground and flight testing as agreed with our EASA and FAA regulators. This rigorous process is designed so that every single requirement can be demonstrated to the potential satisfaction of our regulators and allows us to leverage decades of well-established safety standards for aircraft development.

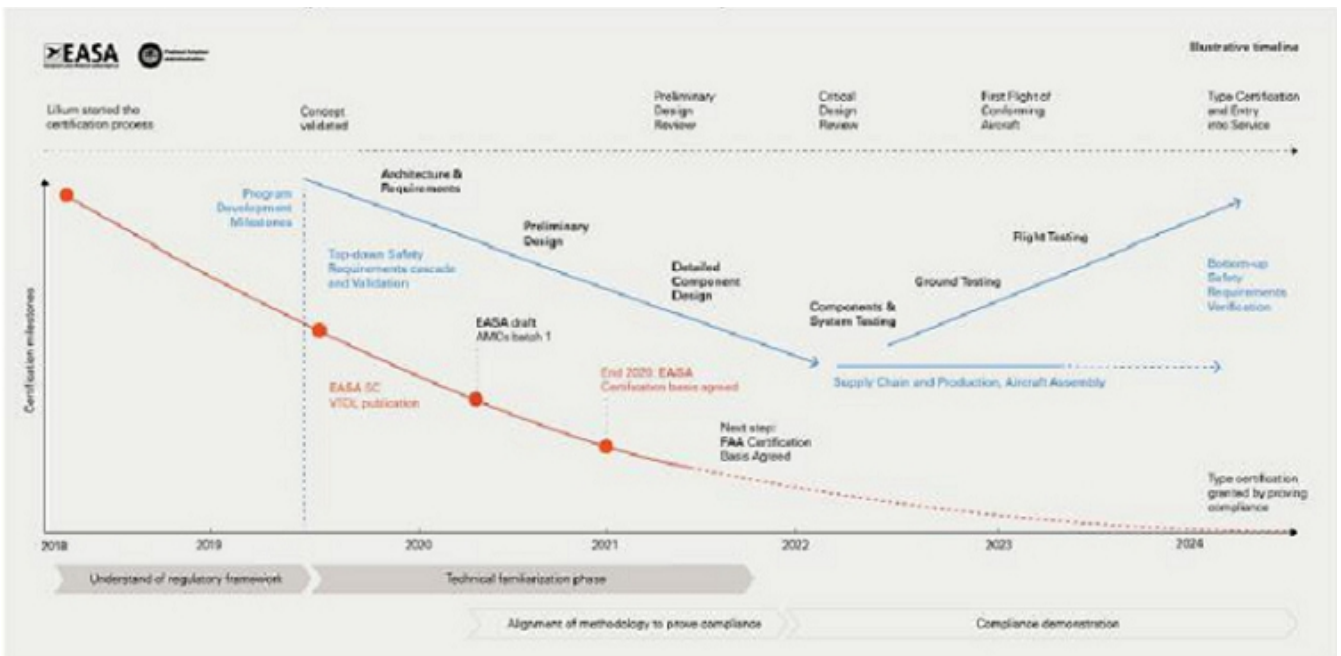


Fig. 5: An illustration of Lilium's Validation and Verification process closely aligned with publications on the development of complex aircraft and systems to satisfy EASA and the FAA means of compliance.

Working within an emerging set of regulations

The emergence of a new class of eVTOL aircraft, complemented by innovations in battery technology and aircraft design, is forcing regulators to re-evaluate existing regulatory frameworks as we enter a new age in aviation; however we are not working within a regulatory vacuum. While the certification basis will vary, the *process* for achieving certification (and thereafter being granted a Type-Certificate by the airworthiness authority) *is the same for Lilium as for any other commercial aircraft manufacturer.*

In principle, the program and Type-Certification process involves the following steps:

- 1) Definition and agreement of working methods used for development and certification of the aircraft
- 2) Technical familiarization of the aircraft and establishment of the initial certification basis
- 3) Agreement of the certification programme and level of involvement from the regulators
- 4) Detailed design
- 5) Production and assembly
- 6) Testing and Compliance Demonstration
- 7) Technical closure and issue of a Type-Certificate

The sequencing of these steps is critical, not only because the authorities require it, but because there is no alternative sequence that can successfully bring an aircraft to market.

Within these frameworks, our role in the development of the 7-Seater Jet is to collaborate with regulators to champion the design and demonstrate a robust process for the verification of applicable requirements. Lilium first applied for a Type-Certificate in 2017 through EASA and requested FAA validation as early as 2018 – and we've been working hand in hand with both authorities ever since.

Certification Basis – and what it is

The **Certification Basis** is the set of requirements comprising Airworthiness, Environmental Protection and Operational Suitability Data requirements as established by the authorities, that we must comply with when developing and certifying our aircraft. In addition to general principles and industry frameworks such as ARP4754 for the development of aircraft and systems, EASA published a new set of airworthiness requirements for small eVTOL aircraft in 2019 by release of a Special Condition for small-category VTOL aircraft, SC-VTOL.

These requirements draw from existing regulations used for the certification of airplanes and rotorcraft. They have been developed in consultation with the industry over many years to provide clarity on the standards that – for example – our Lilium 7-Seater Jet must comply with. Additionally, EASA has also published Means of Compliance (MOC) with the Special Condition VTOL, MOC SC-VTOL, updated in May 2021, which provide acceptable means for complying with these airworthiness requirements.

Lilium has been involved with the development of the EASA MOC's through active participation with rulemaking bodies like the European Organisation for Civil Aviation Equipment (EUROCAE), to substantiate how our novel aircraft design can comprehensively fulfil the requirements of the certification basis.



Fig. 6: Front covers of Lilium's ARP4754A, SC-VTOL & CRI-A01

Lilium's certification basis milestone - and why it is important

Although EASA is our primary airworthiness authority, we are pursuing the concurrent certification of our 7-Seater Jet, through validation of the aircraft by the FAA under the provisions of the EU/US BASA. Whilst EASA have defined a new set of requirements for (e)VTOL, we believe that the FAA intends to use Special Conditions in addition to the existing airworthiness code for small airplanes, also known as Part 23, to define their certification basis.

EASA has provided their initial certification basis in the format of a Certification Review Item (CRI), and we are continuing to actively work with both authorities to finalize the FAA certification basis for the Lilium Jet, which will be formalized under an FAA Issue Paper (IP) G-1. We are aligning our development efforts on our aircraft to meet the stringent sets of requirements adopted by both authorities, with the goal of achieving the highest level of safety.

CRI-A01, which defines our EASA certification basis, was issued by EASA in 2020, and marked a major milestone in laying out the various certification requirements applicable to our 7-Seater Jet. In setting out various requirements, CRI-A01 provides the foundation for all of our activity around certification – including aircraft propulsion systems, noise requirements, airframe and minimum equipment, as well as standards for flight crew training and maintenance staff.

For example, for equipment, systems and their installations, there is a requirement under SC-VTOL.2510, wherein the design and installation of equipment and systems must be considered separately and in relation to other systems in order to evaluate failure conditions.

Commercial airliner-grade safety standards

EASA's safety standards for (e)VTOL aircraft are comparable to that of large commercial jet aircraft, which means we have integrated redundancy throughout our architecture. Safety of such aircraft is measured in terms of probabilities of catastrophic failure – which in the case of both commercial airliners and Lilium's 7-Seater Jet is extremely improbable, at less than or equal to 1 in billion flight hours (or 10^{-9} in industry parlance). Designing to these requirements makes the Lilium 7-Seater Jet approximately 1,500 times safer on a passenger-kilometer basis than road transportation.

Designing to this safety standard shows our commitment to an extremely low likelihood of any potential failures. These are also the safety standards that consumers have come to expect, as a recent EASA study on societal acceptance and adoption of Urban/Advanced Air Mobility has shown.

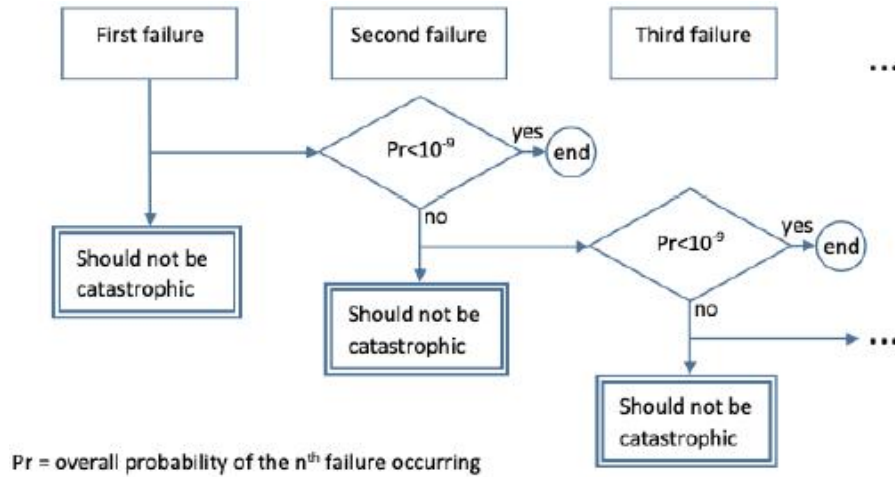


Figure 2: Methodology for the cascading failure evaluation for Category Enhanced

Fig. 7: - EASA, MOC SC VTOL, May 2020

Example: Methodology for the cascading failure evaluation for Category enhanced.

In order to meet these safety objectives, Lilium is following the development assurance process of ARP4754. This effort is further strengthened by the involvement of EASA's "subject matter experts" to ensure that we adhere to this rigorous process throughout the development lifecycle.

EASA has been at the forefront of creating new 'rules of the road' that meet the high consumer demand for new types of urban and regional air mobility, all while maintaining extremely rigorous safety standards.

The road to a Type-Certificate for the 7-Seater Lilium Jet

In the coming months, and after almost two years of ongoing program development, we are heading towards the following key milestones:

- Preliminary Design Review (PDR)
- Detailed design of all components
- Critical Design Review (CDR)
- Component and systems build and test phase
- Aircraft assembly of our 'Conforming Aircraft'
- Ground testing of the aircraft with a level of involvement from EASA and the FAA
- Flight test campaign

Importance of Conforming Aircraft and Test Phase

While we continue the flight testing of our technology demonstrators, the first flight of our 'Conforming Aircraft' will mark a key milestone for Lilium. The entire flight test campaign for the purposes of certification requires the use of a conforming aircraft, where Lilium will conform the test aircraft configuration against applicable design data and requirements and collaborate with EASA for approval of flight conditions.

Although a demonstrator and a conforming aircraft may look similar, for the sake of flight testing and certification, they are totally distinct. The only tests, including measures such as 'flight hours', that are valid in the context of certification are those conducted using a conforming aircraft.

Lilium's conforming aircraft will be manufactured by our EASA Production Organization (POA) under its quality management system and use conforming materials and design data approved for the purpose of manufacturing a conforming prototype. The approved flight conditions and associated data will then be used by the aviation authority of the nation where flight testing will be conducted, to issue a Permit to Fly. For Lilium, and in the case of Germany, the competent authority is the Luftfahrt-Bundesamt (LBA).

We expect that our flight test campaign will rely on six or more prototype aircraft for testing to ensure our ability to efficiently test different configurations of the aircraft, and perform numerous flight tests in parallel. This campaign for compliance demonstration will continue until the Type-Certification of our 7-Seater Lilium Jet, which is expected in 2024. EASA and the FAA issue Type-Certificates for aircraft against their applicable certification basis.

Following Type-Certification and Entry Into Service (EIS)

In order to welcome our first passengers on board for EIS, operations of the Lilium aircraft will need to comply with continuing airworthiness and operational requirements such as flight operations and crew training. It will therefore be operated by a fully-fledged airline (defined as the holder of an Air Operator Certificate, (AOC) or similar aviation operating authority). Regulators will review the end-to-end passenger experience and safety of the aircraft before an AOC is granted for use of the Lilium Jet. This is in line with current practices for commercial airline operators. Given the similarity of operations of the Lilium aircraft to existing services, a close-to-comprehensive set of operating rules already exists.

Bonus Content: applying the lessons of four generations of demonstrator aircraft

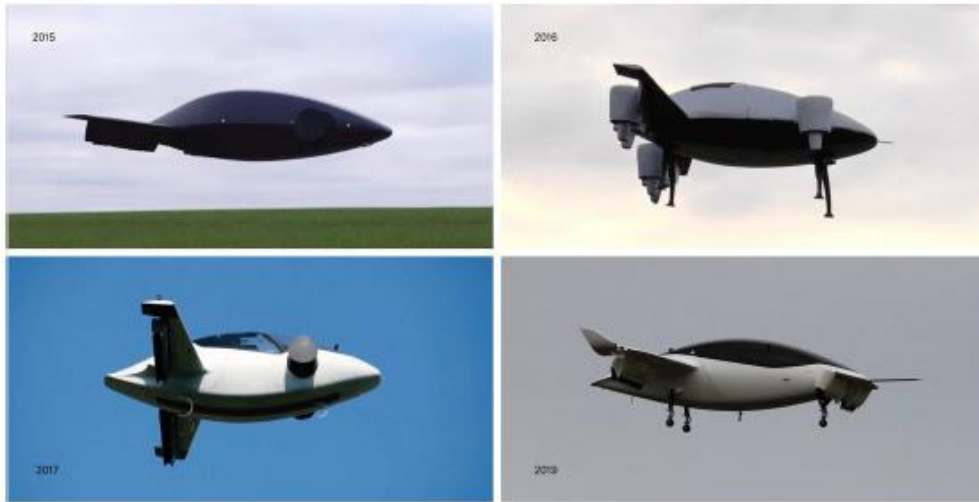


Fig. 8: Four generations of Lilium technology demonstrator aircraft in flight.

One of Lilium's competitive advantages in designing for certification of the 7-Seater Jet is our ability to apply the lessons from four successive generations of demonstrator aircraft design.

A technology demonstrator is an aircraft design with the sole purpose of validating and refining technologies and performance. Aircraft demonstrators (including Lilium's) are not used for the purposes of certification.

Crucially, we are approaching the Preliminary Design Review (PDR) stage for the 7-Seater Jet with technologies matured through our technology demonstrator aircraft, which have effectively served as proof-of-concept for Lilium's development of the propulsion system and aircraft architecture. Lilium's engineers were already demonstrating core components of the technology before EASA's rules for (e)VTOL aircraft were formalized in 2019, and our findings about flight physics and aircraft performance helped us design for certification of the 7-Seater Jet.

Bonus Content: Standing on the shoulders of industry leaders



Fig. 9: Some of our aerospace-grade suppliers to help ensure we receive certifiable parts on time. Pictured (left to right): Aciturri, Honeywell and Lufthansa Aviation Training

The most successful commercial aircraft programs from leading Original Equipment Manufacturers (OEMs) will always rely on world-class suppliers. Lilium's program is no different.

Throughout the program development for the 7-Seater Jet, we have worked with very well-established Tier 1 aerospace manufacturers and suppliers. These suppliers will form part of the supply chain that helps Lilium deliver the final certified aircraft.

As announced, we are working with Honeywell, an industry leader with around a century of experience within aerospace applications, to develop the 7-Seater Lilium Jet's avionics and flight control systems. Additionally, Aciturri, an aerostructures specialist who holds EASA production and maintenance approvals, will supply the composite structures for our 7-Seater Jet with the required level of quality and conformity. We are also working with Lufthansa Aviation Training, one of the foremost global authorities on certification and crew training, to build the training programs in alignment with our flight crew data for operations.

Attempting to build the whole aircraft by ourselves would imply needing to design and certify every subsystem (and its production) as well. By working with established aerospace suppliers we are taking full advantage of their capabilities for the development program, which will facilitate our rapid transition into serial production of the 7-Seater Lilium Jet. Collaborating with established aerospace leaders is a deliberate choice - they typically have their own regulatory approvals and quality management systems already in place that satisfy aerospace quality requirements - such qualifications bolster our strategy of timely certification of the 7-Seater Jet.

We will provide a more detailed overview of our supply chain and manufacturing approach on this blog in the coming weeks.

Next steps

We are working in a unique chapter of aviation history, comparable to the development of standards for large commercial aircraft in the 1960s. Industry and regulators are now once again laying down the foundations for an entirely new category of commercial aircraft.

As mentioned earlier, FAA is our validation authority for a Type-Certificate in the United States. Our choice to concurrently certify our aircraft with both EASA and the FAA demonstrates our commitment that Lilium's service meets the most rigorous safety standards and is acceptable globally in markets that follow these certification standards. Our next steps are to work towards securing a certification basis with FAA, with the issuance of the G-1 issue paper, the FAA's Certification Basis for our 7-Seater Jet.

We are invested in an active and ongoing cooperation with both authorities: this collaborative approach includes detailed technology deep-dives with various members of our team to review design approaches, components, and systems, as well ongoing communication with the authorities to support the build out of Lilium's own compliance and airworthiness teams.

Key Takeaways

- In certifying the 7-Seater Lilium Jet, we have taken our cues from industry best practices and built an entire organization that prizes program development with a certification mindset and the highest safety standards.
 - Our program philosophy has been tuned to ensure that we face and proactively solve areas of risk up front and minimize potential program delays during the test phase.
 - We have recruited an aerospace leadership team well-versed in the certification of a broad array of aircraft types and made the requirements for the certification of the 7-Seater Jet a core component of the onboarding process for every new member of the Lilium engineering team.
 - After working closely with the regulators over several years, we have received the CRI-A01 certification basis from EASA, which puts us on a firm trajectory towards achieving Type-Certification.
 - We are in ongoing and concurrent engagement with both EASA and FAA to understand the airworthiness requirements and agree on means of compliance for our aircraft as we develop them. These efforts help to guide our program development team.
 - We are on track for the first flight of a certified aircraft and welcoming you on board in 2024.
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Fig. 10: Lilium engineers at work

Forward-Looking Statements

This document contains certain forward-looking statements within the meaning of the federal securities laws, including, but not limited to, statements regarding the Lilium's, Qell's and Lilium N.V.'s proposed business and business model, the markets and industry in which the Lilium, Qell and Lilium N.V. (collectively, the "Lilium Group") intend to operate, the anticipated timing of the commercialization and launch of the Lilium Group's business and the Company's officers and directors. These forward-looking statements generally are identified by the words "believe," "project," "expect," "anticipate," "estimate," "intend," "strategy," "future," "opportunity," "plan," "may," "should," "will," "would," "will be," "will continue," "will likely result," and similar expressions. Such statements are based on management's belief or interpretation of information currently available. Forward-looking statements are predictions, projections and other statements about future events that are based on management's current expectations with respect to future events and are based on assumptions and subject to risk and uncertainties and subject to change at any time. The Lilium Group operates in a rapidly changing emerging industry. New risks emerge every day. Given these risks and uncertainties, you should not rely on or place undue reliance on these forward-looking statements. Actual events or results may differ materially from those contained in the projections or forward-looking statements. Many factors could cause actual future events to differ materially from the forward-looking statements in this document, including, but not limited to, the following risks: (i) the business combination with Qell Acquisition Corp. ("Qell") may not be completed in a timely manner or at all; (ii) the business combination may not be completed by Qell's business combination deadline and the potential failure to obtain an extension of the business combination deadline if sought by Qell; (iii) the parties' failure to satisfy the conditions to the consummation of the business combination, such as Qell's shareholders or Lilium's shareholders failing to adopt the business combination agreement, failing to satisfy the minimum trust account amount following redemptions by Qell's public shareholders or an inability to secure necessary governmental and regulatory approvals; (iv) the impact of COVID-19 on Lilium's business or the business combination; (v) the Lilium Group's ability to implement business plans, operating models, forecasts and other expectations and identify and realize additional business opportunities; (vi) the failure of the Lilium Group and its current and future business partners to successfully develop and commercialize the Lilium Group's business or significant delays in its ability to do so; (vii) the Lilium Group's inability to secure or protect its intellectual property; (viii) the effect of the announcement or pendency of the business combination on Lilium Group's business relationships, performance and operations generally; and (ix) the outcome of any legal proceedings that may be instituted against Qell or the Lilium Group related to the business combination. The foregoing list of factors is not exhaustive. Forward-looking statements speak only as of the date they are made. You are cautioned not to put undue reliance on forward-looking statements, and the Lilium Group assumes no obligation and does not intend to update or revise these forward-looking statements, whether as a result of new information, future events or otherwise. A further list and description of risks, uncertainties and other matters can be found in the Registration Statement (as defined below), including those risks outlined in "Risk Factors," and in subsequent U.S. Securities and Exchange Commission filings, all of which are available at www.sec.gov. All forward-looking statements attributable to Lilium or any person acting on its behalf are expressly qualified in their entirety by this cautionary statement.

Important Information About the Business Combination and Where to Find It

A full description of the terms of the business combination is provided in the registration statement filed with the SEC by Liliium B.V. (“Registration Statement”), which will later be converted into a Netherlands public limited liability company (naamloze vennootschap) (“Liliium N.V.”) that includes a prospectus with respect to Liliium N.V.’s securities to be issued in connection with the business combination and a proxy statement with respect to the shareholder meeting of Qell to vote on the business combination. Qell urges its investors, shareholders and other interested persons to read, when available, the preliminary proxy statement/prospectus filed with the SEC and documents incorporated by reference therein because these documents will contain important information about Qell, Liliium and the business combination. After the Registration Statement is declared effective, the definitive proxy statement/prospectus to be included in the Registration Statement will be mailed to shareholders of Qell as of a record date to be established for voting on the business combination. Shareholders are able to obtain a copy of the Registration Statement, including the proxy statement/prospectus, and other documents filed with the SEC without charge by directing a request to: Qell, info@qellspac.com. These documents will also be made available on Qell’s website. The preliminary and definitive proxy statement/prospectus to be included in the Registration Statement may also be obtained, without charge, on the SEC’s website (www.sec.gov).

Participants in the Solicitation Process

Qell, Liliium, Liliium N.V. and their respective directors and executive officers may be deemed participants in the solicitation of proxies from Qell’s stockholders with respect to the business combination. A list of the names of those directors and executive officers and a description of their interests in Qell has been filed in the Registration Statement, which includes the proxy statement/prospectus, for the business combination and is available, without charge, at www.sec.gov.

No Offer or Solicitation

This document shall not constitute a solicitation of a proxy, consent or authorization with respect to any securities or in respect of the business combination. This document shall also not constitute an offer to sell or the solicitation of an offer to buy any securities, nor shall there be any sale of securities in any states or jurisdictions in which such offer, solicitation or sale would be unlawful prior to registration or qualification under the securities laws of any such jurisdiction. No offering of securities shall be made except by means of a prospectus meeting the requirements of Section 10 of the Securities Act of 1933, as amended.
