STIRLING DYNAMICS

SUPPORTING DISRUPTIVE AEROSPACE TECHNOLOGIES

TO GET THE RIGHT RESULTS, YOU NEED THE RIGHT PARTNER

STIRLING DYNAMICS
an expleo company

ABOUT STIRLING DYNAMICS

Stirling Dynamics is an advanced engineering company that provides high-end engineering and consultancy services to support programmes in the aerospace and marine industries – including those with demanding safety-critical requirements. Our strength is not only in providing world-leading technical expertise but also in our ability to work collaboratively with customers to build strong relationships with a focus on open communication and transparency. Trading since 1987, we have accumulated a wealth of knowledge on over 70 different aircraft types and 11 naval platforms around the globe, covering both civil and military programmes, ranging from conceptual design through to in-service support.

Exports make up over 80% of our business and our teams support clients in North America, Western Europe, and the Asia Pacific region, embedding with our customers or working remotely as required. We respect the differences in international cultures and recognise that every organisation has its own preferred way of working. Our flexible contracting models, coupled with cultural awareness, ensure that customer satisfaction is achieved throughout the project lifecycle. In 2018, Stirling Dynamics was acquired by Expleo and continues to operate under the Stirling Dynamics brand, focussing on the delivery and support of our core capabilities worldwide. Being part of the Expleo Group provides resilience and the ability to undertake large programmes for major clients, and enables access to a wide range of engineering skills and capacity.

Stirling Dynamics is approved to the global aerospace quality standard AS9100 and a member of the ITAR Approved Community.

80%
EXPORTS

30+
YEARS OF SERVICE

£10M+
TURNOVER

SUPPORTING NEW DEVELOPMENTS

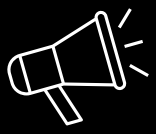
Stirling Dynamics helps ambitious aerospace companies develop new, disruptive aircraft and technologies by providing agile support and niche technical engineering services. We understand the challenges facing new aircraft development programmes and the need for a combination of experience and technical expertise at the different stages of the design process.

Stirling engineers have provided specialist engineering services to the aerospace industry for over 30 years and have the capability, flexibility and experience to support your programme regardless of size or complexity. Capabilities include in-depth knowledge of flight sciences, systems engineering and simulation. Our engineering team has particular expertise in loads and aeroelastics, landing gear systems, active pilot controls, all built around our core skills of modelling, simulation and control.

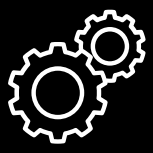
We take special care to fit into our customers' working culture and provide support in the way that best suits their programme and business model. Our experience has been gained in supporting many different types of customer, from start-ups to global OEMs. Projects supported range from small modifications to major new commercial aircraft programmes, with involvement at all stages of the development cycle, from concept through to certification and beyond. Working with Stirling Dynamics allows you to draw on that experience, so you can meet all your technical requirements and deliver your programme on time.

A combination of technical excellence and a flexible approach, makes us the ideal partner and supplier of engineering services for new aerospace programmes and the next generation of aerospace companies. This document provides some in-depth information on the services we can provide to support you.

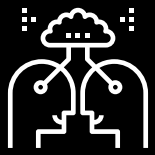
Benefits of working with Stirling Dynamics



Open communication and transparency



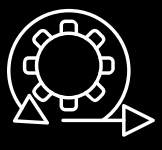
Highly experienced, collaborative engineers that easily integrate with your in-house teams



IP and knowledge sharing

100% impartial and independent

Competitive costs and flexible contracting models



Flexible and agile support when you need it most

ENGINEERING CAPABILITIES

Stirling Dynamics has delivered a broad range of engineering services to our clients for over 30 years across multiple domains. Our capabilities are backed by experienced engineering and project management staff, who are committed to delivering our customers' programmes. We pride ourselves in ensuring that best-of-class engineering delivery teams are selected for each programme or project activity, whether the engagement is consultancy or the delivery of fixed-price packages of work. The diversity of our capabilities is why so many clients see Stirling Dynamics as the solution to their project challenges, providing effective integrated working processes and a commitment to developing strong partnerships.

01 CONTROL & SIMULATION

- Whole vehicle modelling
- Integrated performance models
- Algorithms and control laws

02 SYSTEMS & SAFETY

- Analysis of safety-critical systems
- System integration
- System design, development and certification

03 SOFTWARE DEVELOPMENT

- Safety-critical software development
- Aviation and submarine platforms
- In-house active control software

04 STRUCTURAL DYNAMICS

- Aircraft loads, flutter, vibration analysis
- Discrete structure through to whole vehicle
- Static and dynamic FEM analysis

05 FLUID DYNAMICS

- Computational fluid dynamics
- Aeroelastic, hydrodynamic and acoustic modelling

06 ELECTROMECHANICAL DESIGN & TEST

- Mechanical design
- Electrical and electronic design
- Metallurgy and material test
- In-house active control hardware design

07 PROCESS & KNOWLEDGE MANAGEMENT

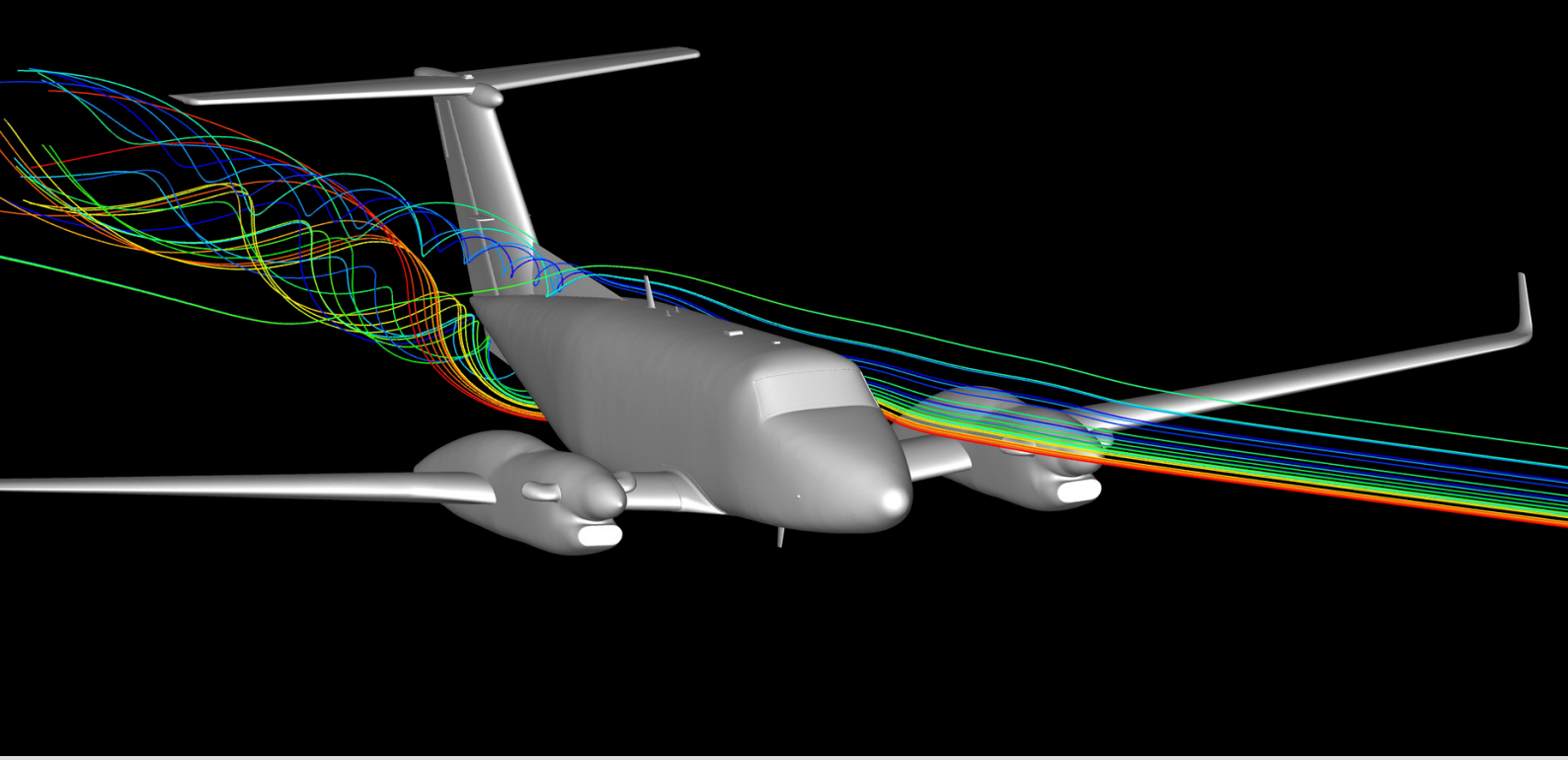
- Continual development of engineering and quality methods and processes
- Toolset development
- Process digitalisation

08 PRODUCTION

- Assembly and test of active controls
- In-house procurement function
- Through-life support, spares and repairs

Knowledge Transfer

As new, disruptive entrants to the aerospace sector, you aim to revolutionise the industry and bring your new technology to the market place rapidly. However, the experience and expertise required to deliver these ambitions cannot be gained overnight. **To get the right results, you need the right partner**. Stirling Dynamics has supported many programmes where our experienced engineers work collaboratively with customers transferring knowledge throughout the project and allowing the customer to retain intellectual property rights.



AERODYNAMICS

Stirling Dynamics' aerodynamic expertise is utilised to support design and certification for a diverse range of aerospace projects, from large commercial jets to novel, urban air mobility solutions spanning new designs and aircraft modifications. We have provided aerodynamic services to organisations such as TAI, KAI, Leonardo, Airbus, Raytheon and Cobham, across a number of fixed and rotary wing, civil and military platforms.

Our capabilities range from the use of empirical methods to estimate the effect on aircraft performance of design changes and modifications, right through to more advanced computational physics approaches to support analysis of transonic and supersonic effects. In addition to our modelling capabilities, Stirling Dynamics can support the planning and analysis of wind tunnel and flights tests.

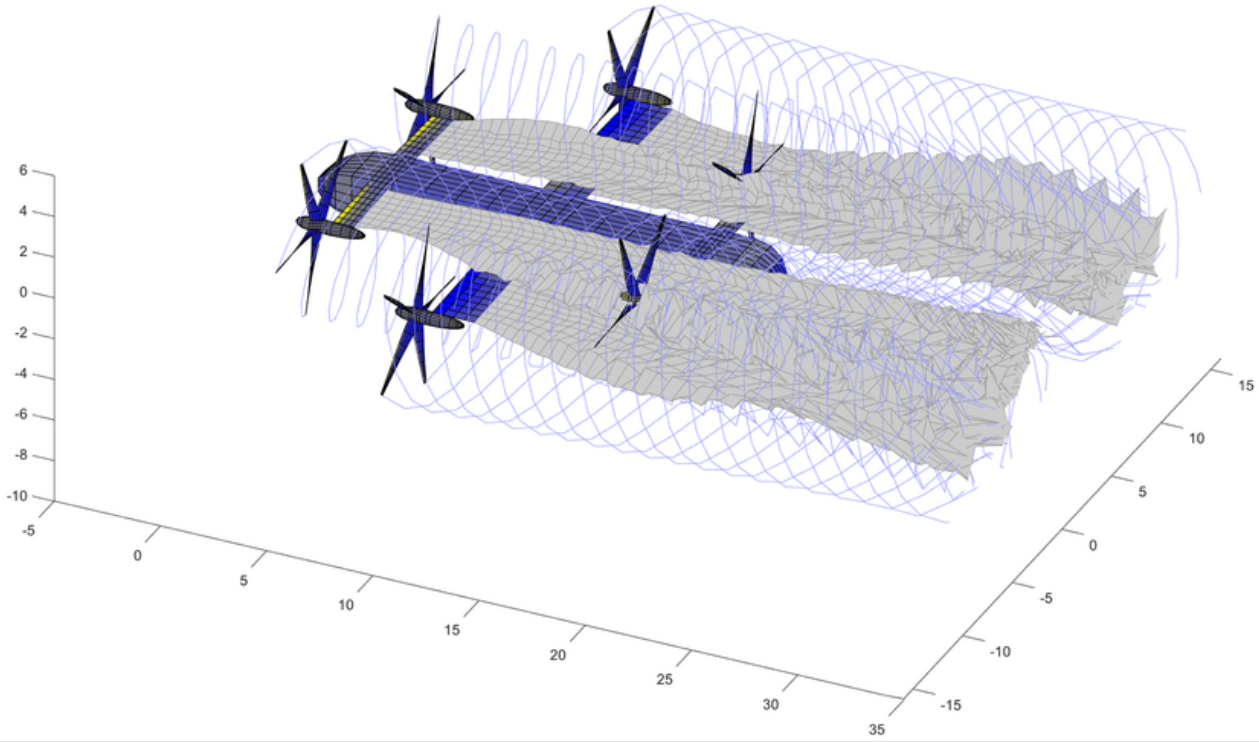
Our expertise in aerodynamics, structural dynamics and aircraft loads allows us to build fully coupled aerodynamic and structural aeroelastic models for static and dynamic analysis, supporting optimised overall design projects.

Core Capabilities

- Phase analysis including cavitation effects
- Aerodynamic design and analysis
- CFD modelling of fixed and rotary-wing
- Novel and modified aircraft designs (UAMs, experimental, role fit etc.)
- Performance, stability and control assessments
- Loads and aeroelastics
- Wind tunnel test, planning and analysis
- CVE signatory

Recent Projects

- Highspeed buffet analysis
- Towed decoy aerodynamic redesign
- Icing analysis for flight clearance
- Aircraft performance analysis
- Bird strike analysis
- Aerodynamic design evaluation and analysis of a twin-turboprop aircraft upgrade



ROTARY AEROMECHANICS

Stirling Dynamics provides blade design, analysis, certification support and software development to aircraft and propeller/rotor manufacturers in the UK and overseas. Our advanced aerodynamic design capability ensures that the blade is high performance and has low noise whilst minimising vibratory loads through the use of aeroelastic tailoring and blade structural design.

Stirling engineers have provided optimised blade design to enhance rotor efficiency and extend the flight envelope of legacy platforms. We have also established rotor system design principles for the future exploitation of actuation technologies integrated into the blade structural design.

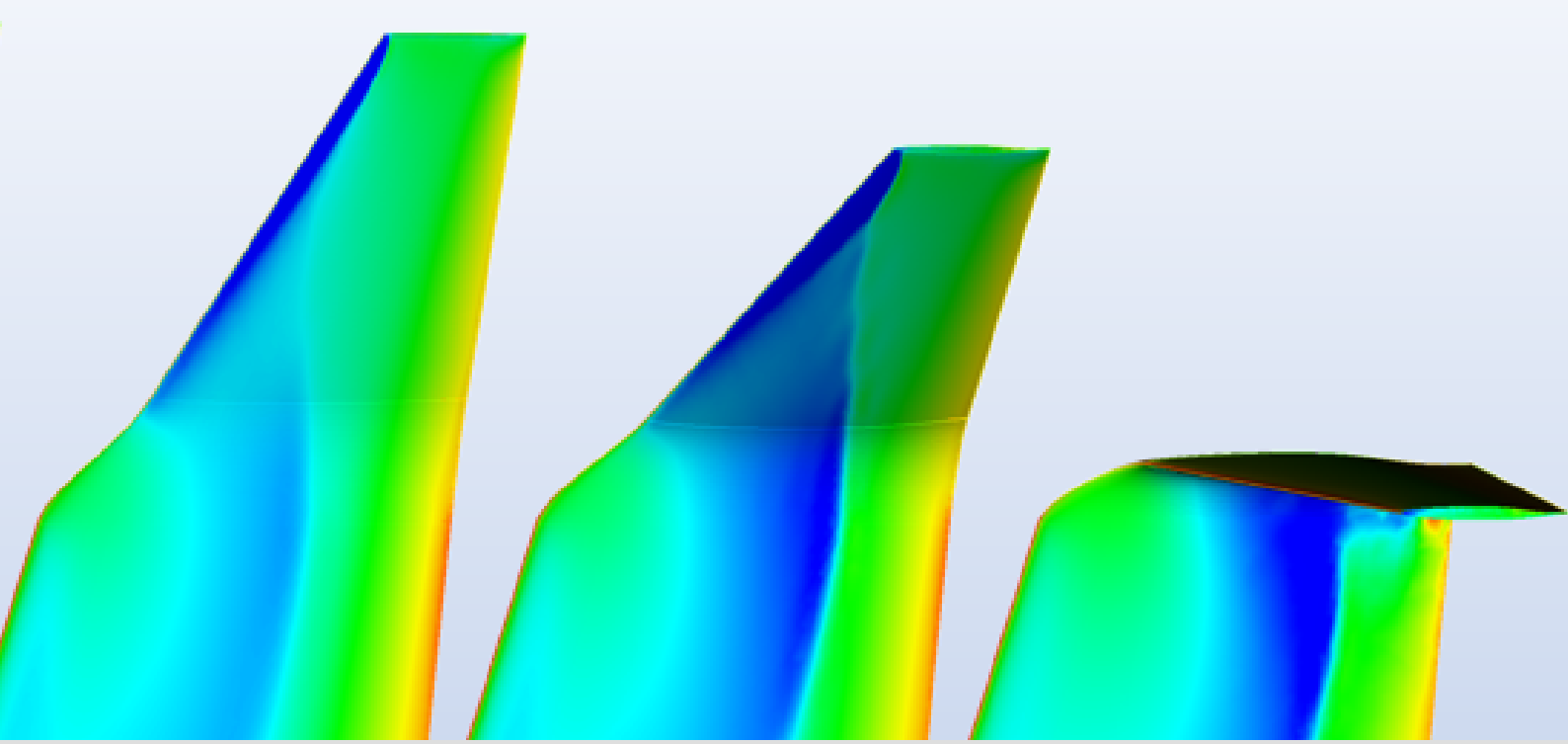
Our analysis experience has been acquired using commercially available and in-house software packages, including transforming customer in-house legacy software into an advanced, adaptable and user-friendly simulation environment. In addition, previous projects have involved providing certification advice on flight envelope specification and loads documentation.

Core Capabilities

- Aerodynamic design
- Aeroelastic and structural design
- Analytical method development
- Commercial code support
- Limit loads calculation
- Wind tunnel test programme support
- Certification support
- Flight test support
- Technical mentoring

Recent Projects

- Highspeed buffet analysis
- Research into future helicopter rotor concepts
- Consultancy on retrofit helicopter blade design
- Bespoke propeller stall flutter analysis software
- Bespoke propeller performance and loads analysis software



LOADS AND AEROELASTICS

Stirling Dynamics delivers loads and aeroelastic design support for new and modified aircraft in both the civil and military sectors. From concept evaluation through to certification, we help our customers keep their programmes on schedule by providing experienced, agile and technically competent engineering services.

With established in-house processes and tools we can support all aspects of flight and ground loads development. Our methods replicate the aircraft in both normal and damaged or failed states to deliver static, dynamic and fatigue loads for the full operational flight envelope. These methods can use customer/OEM furnished information, or, where this is unavailable, we can utilise our own methods to reverse engineer this data from carefully devised test campaigns.

The ability to reverse engineer data, combined with an in-house suite of tools means we can provide independent, impartial analysis for our customers. Stirling can support projects of all sizes and stages of maturity, from small scale problem solving to whole aircraft loads calculations for highly complex aircraft.

Core Capabilities

- Aeroservoelastic modelling
- Static and dynamic loads
- Fatigue and damage tolerance
- Aerodynamic, control and structural non-linearity
- Reverse engineering
- Certification support
- In-service incident support
- Flight test management
- Ground Vibration Testing

Recent Projects

- Independent loads assessment for a new business jet programme
- Loads calculation for passenger-to-freighter conversion
- Review of jet trainer loads methodology
- Flutter clearance
- Hard landing incident support
- Wing aerodynamic loading
- Landing gear door aerodynamics loads
- Research into morphing wingtips

LANDING GEAR DESIGN

Stirling Dynamics provides independent and impartial advice on landing gear design, analysis and modification. We understand the challenges surrounding modern landing gear and have extensive knowledge of all the latest EASA, FAA and military requirements and standards, which are applied in conjunction with a range of proven in-house analysis and modelling tools.

Our specialist landing gear team works with aircraft manufacturers, system providers, modification companies and aircraft operators globally on a variety of fixed and rotary wing aircraft, from the Airbus A350 to the T625 Light Utility Helicopter.

We have capabilities that encompass definition of the landing gear architecture, including sizing, kinematic studies, shimmy analysis and extend to the wider landing gear systems such as extension and retraction, steering, braking, door systems and monitoring system functionality; covering all aspects of ATA 32 subsystems.

Core Capabilities

- Requirements capture and definition
- Concept design and architectural studies
- System and component design and integration
- System simulation and modelling
- Loads analysis
- Verification and validation
- Certification support
- Continuous product development
- In-service issues and incident support

Recent Projects

- Nose wheel steering control system for a military fast jet
- Preliminary design of helicopter landing gear
- Extension/retraction performance assessment
- System performance modelling
- Tyre burst and bird strike analysis
- Wheel design
- Landing gear structure redesign
- Electric actuation design
- Brake control system algorithm development
- Shimmy analysis
- Electric nose wheel taxi system
- Drop test support

SIMULATION AND CONTROL

Stirling Dynamics' engineers use simulation-based engineering to assist our customers and partners in the development of their products and systems, to solve problems and improve performance at all stages of development. By taking a model-based systems engineering approach, modelling can be deployed at all phases of the "V" cycle, from requirements validation through to design realisation to hardware in the loop, virtual testing and product verification.

Complex multi-system interactions can be simulated to provide a better understanding of the design, highlighting potential issues and possible solutions. Adopting a model-based design framework can lead to models and control systems developed in a virtual environment being autocoded to hardware test platforms and embedded software targets, reducing development costs and lead time.

Experience gained by our engineers working with customers around the world, along with our core skill set, allows us to model, simulate and control the most complex systems. We have helped our customers integrate their systems into wider platforms and understand how other systems fit into their platform.

Core Capabilities

- Whole vehicle modelling
- Expertise in structure, mechanics, fluids and control
- Requirements capture and definition including Model-Based Systems Engineering (MBSE)
- Model specification
- Control law and algorithm development
- System architectures solutions and early trade-off and performance
- Detailed dynamic analysis
- Multi-physical modelling
- Integrated, multi-system performance models
- Full verification and validation
- Auto-code generation

Recent Projects

- Integrated system model for new aircraft
- Airship flight control system design
- Nose wheel steering system
- Landing gear extension-retraction modelling
- Bird strike modelling

SYSTEMS AND SAFETY

Stirling Dynamics has been providing innovative systems design and integration services to the world's biggest aircraft manufacturers and equipment suppliers. We work closely with our customers to deliver their complex aerospace systems from requirements definition all the way through to certification and our engineers have significant experience in the definition, integration and safety assessment of new and updated aircraft systems.

Following recognised industry processes such as ARP4754 and ARP4761, Stirling Dynamics is fully equipped to support activities across the full product life-cycle including certification planning and compliance, product assurance, safety assessment and ARM, platform integration and supplier management.

Our systems safety capability covers the full development process from FHA (Functional Hazard Assessment) through CCA (Common Cause Analysis) to SSA (System Safety Assessment) including FTA (Fault Tree Analysis), PRA (Particular Risk Assessment) and FMEA/FMES (Failure Modes Effects Analysis/Summary).

Having worked successfully on projects involving fixed and rotary-wing aircraft, our engineering team is familiar with the scope of CS23, 25, 27 and 29 across systems and equipment such as landing gear, extension & retraction and braking & steering.

Core Capabilities

- New and modified systems development & integration (ARP4754)
- Full verification and validation (V&V)
- Requirements definition, development and management
- Systems safety assessment (ARP4761)
- Particular risk – Bird-strike, Wheel & Tyre Failure
- ARM (Availability Reliability Maintainability)
- Certification, planning and support
- Supply chain management

Recent Projects

- MRJ/Space-Jet landing gear and flight controls
  - Equipment and system development
  - Safety assessment
  - Flight test and certification support
- Leonardo safety assessments and hazard logs
- Airbus landing gear systems support
- In-wheel taxi system integration and certification
- Oil dispersant system integration
- In-bay tyre burst analysis
- Fuel system safety analysis

ACTIVE CONTROLS

Stirling Dynamics is a world leader in simulator active controls and has been at the forefront of this technology for over 25 years. We supply a range of standard and custom solutions for test, training and simulation applications and have a longstanding track record of delivering equipment into major defence and R&D programmes. To date, we have provided support to the UK MoD, global defence OEMs such as Lockheed Martin, BAE Systems and Leonardo and also research organisations such as NASA and DLR.

Our family of active controls are feature-rich, highly reconfigurable and suitable for single or dual (linked) cockpit configurations. Stirling's range of active products includes side sticks, throttles, collectives, cyclics and pedals. These controls are extremely compact, fully active and benefit from low acquistion and product life-cycle costs.

Stirling's active controls have been used extensively in both fixed and rotary wing configurations and are equally applicable for UAMs, UAVs, ground vehicles and marine applications. Today, we supply the active stick and throttles for the F-35 pilot training simulators and continue to break new ground in cockpit control technology.

Benefits of Active Controls

- Small space claim
- Real-time configurable feel
- Force feedback and tactile cueing
- Electronically linkable
- Easily integrated
- Replicates any aircraft

Recent Projects

- F-35 stick and throttle cockpit sets
- Supply of active flight controls and an actuated seat system for a fast jet simulator
- Development of CH-53K cockpit controls
- Design and manufacture of CH-47 Thrust control lever
- UH-60 cockpit controls

CASE STUDY: SUPPORTING A NOVEL INVENTION

The future operation of aircraft will need to meet ever-demanding emission and efficiency targets and therefore, innovative solutions are required to support both new and in-service aircraft fleets. WheelTug is a company that has developed a pioneering concept to meet these challenges. They are developing a taxiing system, which consists of a nose wheel mounted motor and drive, powered by the aircraft's Auxiliary Power Unit. The ultimate goal of the system is to save time, engine life and fuel use, resulting in reduced emissions and significant cost savings.

WheelTug approached Stirling to assess the system feasibility due to our unique landing gear systems capability. An added challenge for Stirling on this project is the lack of OEM information, which necessitates a reverse engineering approach to develop representative aircraft and landing gear to support the design process. As this is such a novel system, we have had to assess the FAA certification requirements to determine what is applicable and to provide a suitable means of compliance.Stirling developed a process to achieve the FAA-certified STC for the system.

After successfully completing the system feasibility work, our team were also asked to conduct a preliminary loads analysis and generate the certification plan for submission to the FAA. In early 2017, the Federal Aviation Administration (FAA) approved the Project Specific Certification Plans (PSCP) for the installation of the WheelTug® electric drive system for the Boeing 737NG aircraft. This approval was a key milestone for WheelTug and a major step forward in achieving certification for the system.

This news was especially meaningful to Stirling as the landing gear and airframe PSCP was issued by Stirling's engineering team. This PSCP describes the activities required to achieve certification of the Boeing 737NG for use with the WheelTug system.

At the end of 2017, Stirling was awarded a new contract with WheelTug to design and achieve certification for a brand-new landing gear nose wheel, where our engineering team were required to draw on the company's core capabilities in reverse engineering, wheel analysis, landing gear analysis, safety analysis and structural stress analysis to deliver on this exciting project. In 2019, Stirling's wheel design specification was issued, development wheels were manufactured in accordance with Stirling's design and production forgings were manufactured, which have been qualified in accordance with Stirling defined requirements. Work is currently progressing on the Technical Standard Order (TSO) test plan and qualification test plans and procedures.

In early 2020, the nose landing gear rig test and aircraft flight test plans were issued. As a result, both the flight test and landing rig test programmes started in August 2020. Stirling's test planning has been vital in defining the aircraft and landing gear testing required to acquire capture the data necessary for the to validate the Boeing 737NG models. These models will support certification and the installation of the WheelTug system. Safety documentation for the first design baseline has also been completed by the Stirling Dynamics team.

For further information or if you have any other questions,
please email us at enquiries@stirling-dynamics.com