Key Considerations in the Design of a New EASA CS-23 General Aviation Aircraft

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Abstract: *Designing a new General Aviation (GA) aircraft is a complex and demanding task, particularly when aiming to achieve competitiveness, reliability, safety, and cost-effectiveness. This article outlines the initial design considerations for a GA aircraft, focusing on configuration, regulatory compliance, key features, and intended operational missions. The discussion is framed within the context of an ongoing development project at INCAS Bucharest, targeting EASA CS-23 certification and market entry by the end of 2030. The initiative was driven by data from a preliminary market analysis conducted three years ago, which indicated a significant and growing demand for GA aircraft across both the EU and the USA. In addition to the technical aspects, the article addresses major challenges and highlights the importance of adopting a flexible design mindset to accommodate future upgrades, ensure environmental sustainability, and maintain overall feasibility. However, with the use of modern and appropriate tools and the commitment of a dedicated, highly engaged team, the project's objectives may be achieved ahead of schedule.*

Key Words: *General Aviation, EASA CS-23, aircraft design, flight safety, Product Lifecycle Management, aerospace standards, aircraft configuration, aerodynamics, aircraft systems, CATIA V5*

1. PRELIMINARY REMARKS

One of the aviation sectors is covered by General Aviation (GA) which encompasses all civil aviation operations other than scheduled commercial airline and military flights. This includes private flying, flight training, agricultural aviation, emergency medical services, aerial firefighting, and business aviation, making it the largest and most diverse sector of aviation worldwide. Due to its importance and coverage, a natural and anticipated direction of interest from aerospace companies is pointed towards developing new medium and small aircraft to better adapt technological advancements in systems, propulsion, safety, and operability, while also addressing market demands and consumer expectations.

The General Aviation market which addresses active GA aircraft [1] is steadily recovering from the pandemic downturn, with forecasts indicating sustained growth across both EU [2] and international scale [3] driven by rising demand for personalized air travel, training schools, business or recreational flights, advanced technologies, and evolving flexibility, efficiency, and safety. Proved by studies, the market is experiencing economic growth, as manufacturers respond to evolving customer needs with innovations in digital systems, sustainable propulsion, cabin comfort and more versatile aircraft platforms. Moreover, states across the globe are relying on GA services as they play a constant and crucial role in industry training and building and developing resilience in the sector to ensure its future sustainability [4].

Single-engine piston aircraft are the most common in GA due to a combination of economic, operational, and training-related advantages. Cost-effectiveness for both purchase and operating costs, simplicity regarding on-board systems, maintenance and pilot training, versatility, regulatory and licensing factors are the most proven key facts and advantages related to this aircraft category. In addition, they play a foundational role in shaping future airline pilots, serving as the primary training platforms where essential skills and flight experience are developed. Moreover, GA aircraft provide an ideal and flexible testbed for evaluating newly developed onboard systems, making them instrumental in advancing technology and supporting certification processes for broader aviation applications.

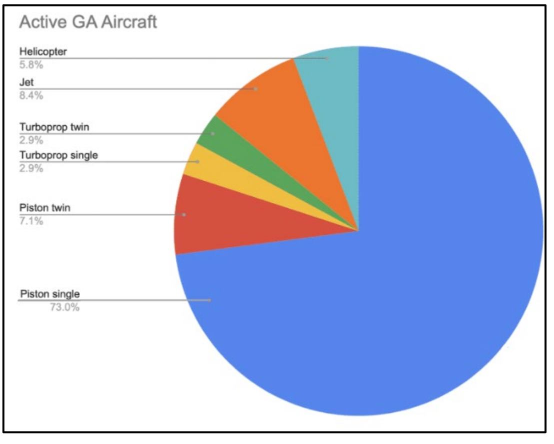

Figure 1. Active GA aircraft categories worldwide [1]

Figure 2. Europe General Aviation Market Forecast towards 2030 [2]

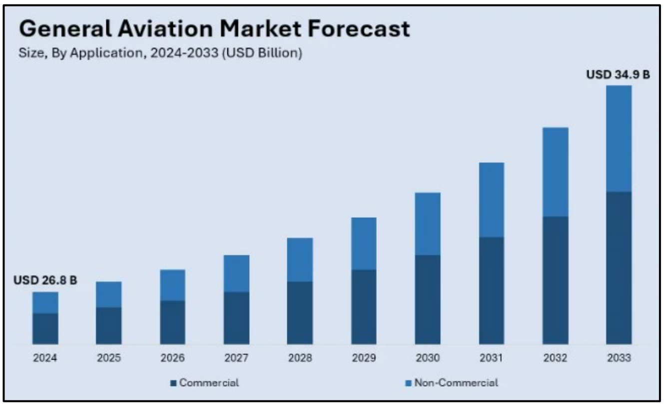

Figure 3. General Aviation Market Forecast on global scale [3]

2. AIRCRAFT CONFIGURATION

Regulatory framework. One of the most fundamental and strategic steps in launching a new aircraft design project is conducting a comprehensive market survey, which serves as the foundation for defining product specifications. These specifications, shaped by user needs and market trends, ultimately guide the selection of an aircraft configuration that best supports the targeted mission profiles [5]. In this case, the range of operations includes flight training,

personal and recreational flying, business travel, and air taxi services, with the potential to expand into light logistics, research and experimental applications, humanitarian missions, and aerial work, all within the operational scope defined by *European Union Aviation Safety Agency (EASA)* via Certifications Specifications – 23 (CS-23) for Normal Category Aircraft [6]. To ensure the resulting platform is viable, safe, and fit for its intended use, a comprehensive assessment of technical, regulatory, and market-driven factors is essential.
A notable and highly versatile subcategory is represented by the *European Light Aircraft 1 (ELA-1)* [7] which is defined under EASA CS-23 regulatory framework and is intended to simplify regulatory requirements for certain light aircraft. The goal is to streamline maintenance, certification, and oversight, particularly for recreational and private aviation. To qualify under this subcategory, an airplane must meet with the following criteria:

1) A Maximum Take-Off Mass (MOTM) to not exceed 1200kg;
2) A classification as a non-complex, motor-powered aircraft (typically piston-engine driven);
3) A seating capacity limited to a maximum of four occupants.

This subcategory supports a more accessible and flexible path for aircraft operation and ownership, encouraging innovation and broader participation in light aviation.

Mission adaptability and safety. The aircraft design must be inherently adaptable to support a variety of mission profiles, with interior layouts and equipment configurations to be customized at later stages based on specific operational requirements. For pilot training, the emphasis is on stable flight characteristics and dual-control systems. In business and air taxi operations, passenger comfort and cruise performance are key to market success. Air mail and light cargo missions prioritize payload capacity and efficient use of cargo volume. Meanwhile, more complex roles such as atmospheric research, aerial photography or use as a testing platform demand provisions for dedicated power supply, flexible sensor integration, and modular avionics architecture. This mission-driven versatility is a core design objective, ensuring the aircraft remains relevant across diverse operational scenarios. A critical consideration is that as mission complexity increases, so do the associated operational costs drive by greater demands on systems capability, maintenance, crew training, and regulatory compliance.

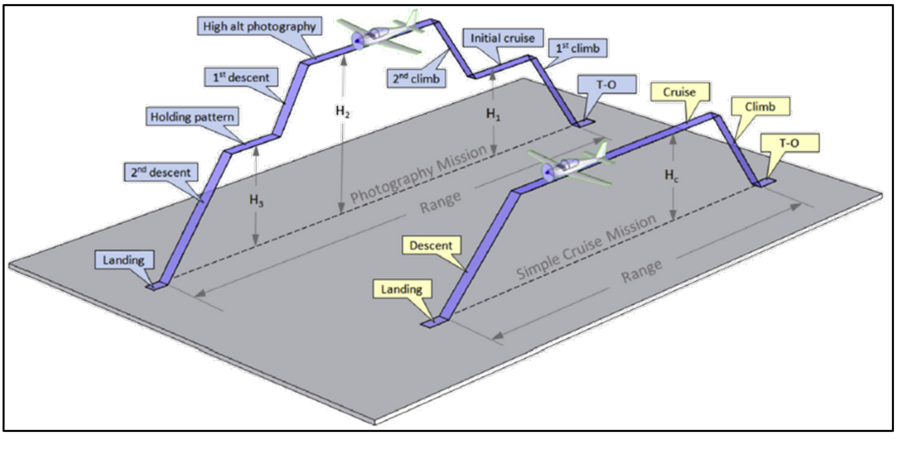

Figure 4. Comparison between two different mission scenarios for a GA aircraft [8]

Target performance envelope. Defining the aircraft's performance envelope is a foundational step in aligning the design with its intended operational roles. Key parameters to establish include cruise speed, range, service ceiling, rate of climb, stall speed, and takeoff/landing distances. Range could be expressed using Breguet Range Formula

$$R = \frac{\eta}{SFC} \frac{C_L}{C_D} \ln\left(\frac{W_{initial}}{W_{final}}\right),$$

where R is aircraft range, η is the propeller efficiency, *SFC* is the Specific Fuel Consumption, C_L is the lift coefficient, C_D is the drag coefficient and W is the aircraft weight in the initial and final stages of flight.

As demonstrated by the Breguet range equation, achieving greater aircraft range depends on the careful optimization of several interrelated factors:

1) Maximized Lift-to-Drag Ratio (*L/D*): Enhancing aerodynamic efficiency is key. It addresses clean airframe design, optimized wing geometry (e.g., high aspect ratio, low drag airfoils), the use of aerodynamic fairings, streamlined fuselages, and retractable landing gear to reduce parasitic drag**.**
2) Reduced Specific Fuel Consumption (*SFC*): Selecting more fuel-efficient propulsion systems such as modern piston engines or hybrid-electric powerplants can significantly lower fuel burn per unit of power, directly extending range.
3) Increased Propeller Efficiency (η): Adopting constant-speed propellers systems and advanced aerodynamic blade designs allows more effective conversion of engine power into thrust, reducing fuel waste and improving cruise efficiency.
4) Higher Fuel Fraction ($W_{initial}/W_{final}$): Maximizing the proportion of aircraft weight allocated to usable fuel by minimizing structural and systems weight defined as *Operational Empty Weight (OEW)* enables longer endurance without compromising payload or performance.

Naturally, these well proven factors are closely correlated with the multidisciplinary fields of aerospace studies related to aerodynamics, performance and stability, structural layout and systems integration linked with aircraft weight and balance considerations that together combined seek to identify the design point of the aircraft. In the context of mission envelope definition, this design point often represents a strategic trade-off: prioritizing one performance factor such as range, payload, or speed may require compromises in others, underscoring the importance of a balanced and mission-driven design approach.

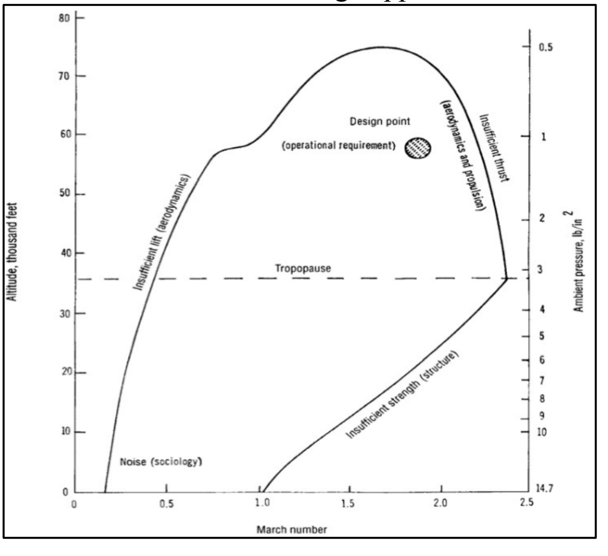

Figure 5. Example of envelope defined by lift, thrust, structural strength and environmental noise pollution curves used for identifying the design point of an aircraft [9]

In terms of aerodynamic approach, considered in low-subsonic flight speeds, the drag coefficient C_D is often represented as a function of lift coefficient C_L known as aircraft drag polar. For low subsonic Mach numbers these polars are approximated by the parabolic function.

$$C_D = C_{D_0} + C_{D_i} = C_{D_0} + \frac{1}{\pi\, AR\, e} C_L^2,$$

where C_{D0} is the zero-lift drag coefficient, C_{Di} is the induced drag coefficient, AR is the wing aspect ratio (defined as the ratio of the square of the wingspan to wing surface area), and e represents the Oswald efficiency factor representing a key aerodynamic parameter used in estimating induced drag for subsonic aircraft. It quantifies how closely a real wing approaches the performance of an ideal elliptical lift distribution, which produces the minimum possible induced drag. For ideal elliptical wing $e = 1$, while for efficient GA aircraft it goes down to 0.8 or less for low-efficiency configurations.[5] The extreme values of the lift coefficient, denoted as C_{Lmax} and C_{Lmin}, represent the maximum positive and negative lift generation capabilities of the airfoil, respectively. These values are critical in selecting and shaping the wing airfoil, as they directly influence key performance parameters such as stall speed, maneuverability, spin behavior and overall aerodynamic efficiency.

Stall is generally defined as the aerodynamic condition that occurs beyond the peak of the lift curve corresponding to C_{Lmax} (or C_{Lmin} in negative lift scenarios) where airflow begins to separate significantly from the wing surface, resulting in a sharp decrease in lift and a loss of stable flight. The lift curve slope, denoted as $C_{L\alpha}$ describes how sensitively lift responds to changes in angle of attack. According to linear thin airfoil theory for incompressible flow, the theoretical maximum slope is 2π (approximately 6.283 per radian), and most well-designed airfoils closely approach this value under ideal subsonic conditions.

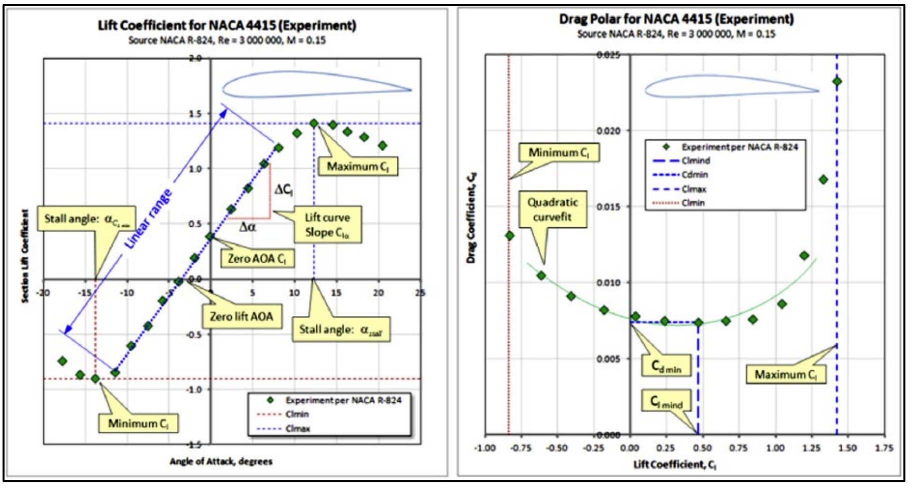

Figure 6. A typical two-dimensions lift curve and drag polar for an airfoil (NACA 4415 in this example) [8]

In the context of an aircraft design project, analytical aerodynamic studies are closely integrated with advanced numerical simulations to ensure accurate performance predictions. One of the primary tools employed in this phase is *Computational Fluid Dynamics (CFD)*, which allows detailed flow analysis around complex geometries under various flight conditions. These simulations are typically carried out using high-performance computing resources and specialized software suites such as DAR Corporation's *Advanced Aircraft Analysis (AAA)* or similar platforms, enabling an accurate examination of lift, drag, pressure distribution, and flow separation. To reinforce the validity of these numerical results, physical testing is conducted using scale models of the aircraft in wind tunnel facilities. These models are meticulously built to reflect the exact aerodynamic shape and scaled appropriately to preserve key similarity parameters such as Reynolds and Mach numbers while also accommodating the interface requirements of the wind tunnel setup. The combination of analytical methods, CFD, and wind tunnel testing provides a robust, multi-fidelity approach to validating and refining the aerodynamic characteristics of the aircraft before advancing to the prototype phase.

Figure 7. GA aircraft wind tunnel model during testing campaign at INCAS' Subsonic Wind Tunnel

Another critical safety and design tool that shapes the airworthiness, operations utility, and structural robustness of the GA aircraft (but not limited to) is the *V-n envelope*, also known as the *flight envelope* or *maneuvering diagram*. This graphical representation defines the structural and aerodynamic limits of an aircraft in terms of airspeed (*V*) and load factor (*n*). As its title says, the key parameters in a V-n Envelope are described below [6].

1. Airspeed (*V*):
- V_A **-** Maneuvering speed: Maximum speed at which full, abrupt control inputs can be applied without structural damage;
- V_C - Design cruise speed: Normal maximum structural cruise speed;
- V_D - Design dive speed: Maximum speed considered for structural integrity during extreme conditions;
- *VNE* - Never-exceed speed (operational limit): The absolute maximum speed the aircraft can safely reach.

2. Load Factor (*n*)
- Expressed in terms of g-forces (1g = normal gravity);
- Positive and negative load factors are considered:
    - o Typical GA aircraft: +3.8g (positive) to -1.52g (negative) for Normal Category;

- o Acrobatic or Utility Category have higher tolerances;

3. Critical points on the envelope:
   - Stall boundaries (low-speed limits): Curved portions representing maximum lift capability;
   - Structural limits (positive and negative): Straight lines showing where structural failure could occur if exceeded.
   - Gust load lines: Represent how atmospheric turbulence affects load factors at various speeds (important for certification under CS-23).

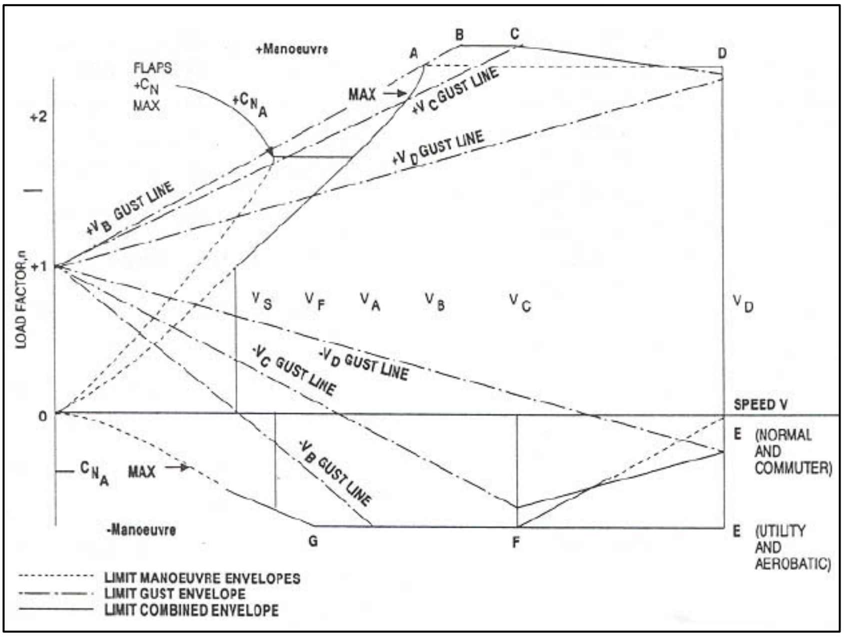

Figure 8. A generic V-n diagram presented in CS 23.333 [6]

As a conclusion, the V-n diagram ensures the aircraft can withstand expected load factors during maneuvers and turbulence without structural failure, which is critical for both safety and regulatory compliance. This envelope directly influences design choices for the airframe, control surfaces, and systems, ensuring structural integrity across various flight conditions. Additionally, the shape of the envelope can be tailored to suit different mission profiles such as high maneuverability for training or enhanced gust tolerance for air taxi operations. It also informs pilot limitations through the aircraft's flight manual and supports virtual testing by providing boundary conditions for CFD and flight simulations.

Powerplant. Selecting the appropriate piston engine for a new GA aircraft is a critical decision that must align with the aircraft's intended mission, performance targets, and regulatory requirements. Whether the aircraft is designed for pilot training, business travel, or utility operations, the powerplant must deliver sufficient horsepower to meet takeoff, climb, and cruise performance while remaining efficient and reliable. Engine configuration such as turbocharging for altitude performance or a horizontally opposed layout for balance affects both aerodynamics and weight distribution. Fuel type and consumption directly influence range and operational costs, while cooling requirements and propeller selection impact thermal efficiency and overall performance.

Beyond raw power, successful integration of the engine into the airframe requires careful attention to structural compatibility, vibration isolation, and proper center-of-gravity management. Environmental regulations push for quieter, cleaner engines, motivating the consideration of modern or alternative-fuel powerplants. Reliability, ease of maintenance, and global parts availability are equally important, particularly for commercial or fleet use. The newest generations of engine keen to support electrical and avionics demands, with high-end designs of engines integrating systems like *Full Authority Digital Engine Control (FADEC)* or de-icing. Ultimately, defining the powerplant is a multidisciplinary task, where mission-driven performance is harmonized with safety, regulatory compliance, lifecycle costs, and future sustainability goals.

Original Equipment Manufacturer (OEM) supplied power charts for type-certificated engines serve as the primary reference for determining engine output under controlled conditions, but they come with important limitations that must be understood to avoid misinterpreting actual performance.

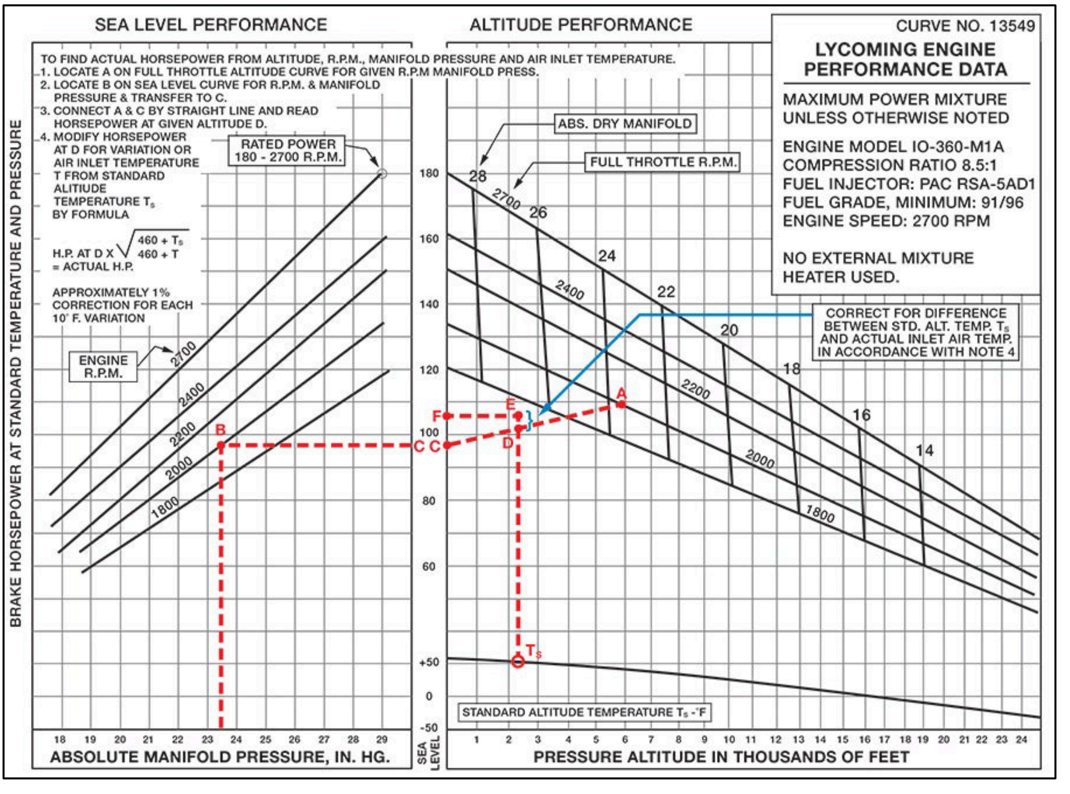

Figure 9. A model of OEM supplied power chart (simplified for illustrative purposes).[10]

These charts assume that the fuel mixture is set for best power, not for economy or other modes of operation. They rely on *International Standard Atmosphere (ISA)* under ISO 2533 standard for standard atmospheric conditions (*typically 15°C at sea level and 1013.25 hPa*) and any deviations in temperature require appropriate corrections using the data provided. The charts also presume dry air, meaning that high humidity will reduce air density and therefore engine power. Additionally, they apply only to engines that exactly match the listed configuration, including compression ratio, ignition system, and fuel delivery components. Most importantly, they assume the engine is in excellent mechanical condition, wear, low compression, leaky valves, or weak ignition will prevent the engine from achieving the listed power values. Carefully considering these factors ensures more accurate performance assessments and supports safer and more reliable aircraft operation.

In most of piston-power GA aircraft, engines are typically mounted at the front of the fuselage using a robust (typically welded) engine mount structure attached to the firewall. This mount connects to the engine via vibration-damping isolators and a circular engine ring. Cooling is achieved through air inlets on the cowling, directing airflow over the cylinder fins to dissipate heat and maintain safe operating temperatures.

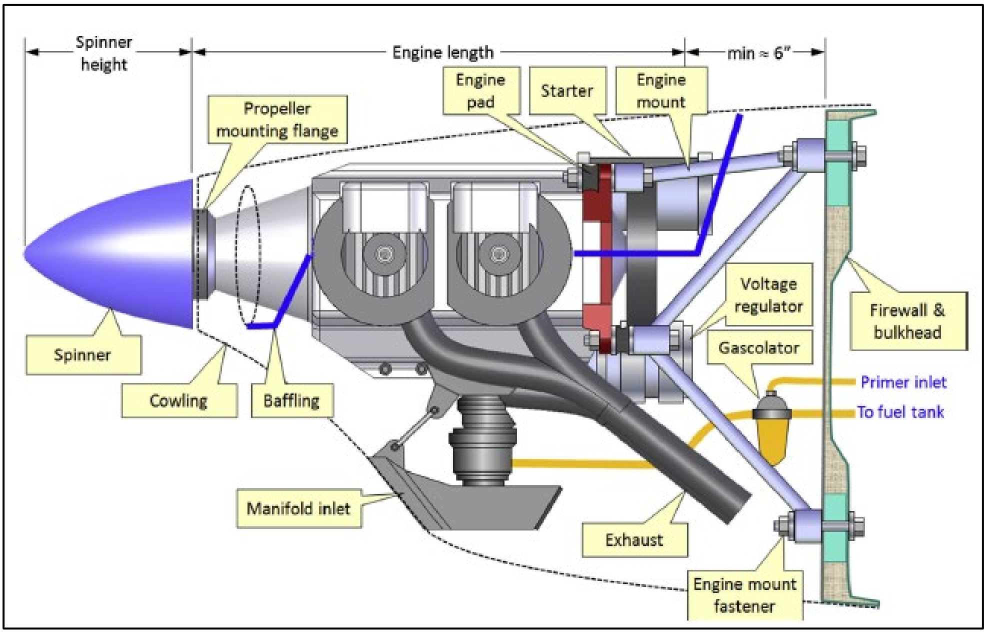

Figure 10. Typical piston-engine installation in front of the firewall [8]

Avionics. Proper selection and integration of avionics and onboard systems for a CS-23 Normal Category GA aircraft involves balancing functionality, weight, cost, and regulatory compliance. The selection process must consider mission needs such as *Visual Flight Rules (VFR)* or *Instrumental Flight Rules (IFR)* capabilities, autopilot integration, and future scalability. Compliance with EASA CS-23 requirements ensures systems meet airworthiness, environmental, and safety standards. System redundancy, power requirements, and ease of maintenance are also critical factors when defining the avionics suite and associated electrical architecture.

Communication and data exchange between avionics units rely on standardized protocols like ARINC 429, RS-232/422, and increasingly, CAN or Ethernet-based architectures in modern GA aircraft. These protocols ensure reliable, deterministic communication between flight displays, GPS, transponders, engine monitoring systems, and other key components.

CS-23 emphasizes system integrity, fault tolerance, and the ability to safely detect and manage failures. Proper integration supports modular upgrades, simplifies certification efforts, and enhances operational reliability and situational awareness for pilots. One of the most influential and innovative players in the field of GA avionics is GARMIN$_{TM}$, offering a wide range of integrated systems tailored to CS-23 aircraft. Their flagship digital cockpit suite, the Garmin G1000, exemplifies cutting-edge avionics integration by combining *Primary Flight Display (PFD)*, *Multi-Function Display (MFD)*, GPS, communications, engine monitoring, and navigation in a fully digital, glass-cockpit layout. The G1000 enhances situational awareness, reduces pilot workload, and supports advanced features like synthetic vision, traffic and terrain awareness, and autopilot coupling. This evolution significantly consolidates information into intuitive displays, reducing cockpit clutter and switch density.

Figure 11. GARMIN G1000 NXi flight deck installed in a small GA aircraft [11]

Cabin configuration. Cabin ergonomics, seat design, and installation are essential aspects in the development of a new GA aircraft, particularly under the guidelines of EASA CS-23 for Normal Category aircraft. According to CS-23, seating systems must meet standards for occupant safety, crashworthiness, restraint system compatibility, and accessibility during all phases of flight. Human-centered design plays a crucial role in shaping the cabin layout, focusing on pilot and passenger comfort, reachability of controls, visibility, and ease of ingress and egress. Seats must provide adequate lumbar and lateral support, and their installation must ensure structural integrity under load conditions defined in *CS 23.562 (Emergency Landing Dynamic Conditions)*. Adjustability for different body sizes and proper alignment with flight controls further enhance pilot effectiveness and reduce fatigue. Integrating ergonomic principles with regulatory compliance allows designers to deliver a functional, safe, and comfortable cabin environment tailored to diverse mission profiles and user needs.

According to EASA CS 23.562, aircraft seats must meet dynamic crashworthiness standards to ensure occupant safety in emergency landing conditions. Specifically, the seat and restraint system must withstand a forward horizontal deceleration of 26g and a vertical downward force of 19g, simulating realistic crash loads. These tests ensure that the seat structure, mounts, and occupant restraints remain intact and effective, protecting the occupants by limiting head movement, preventing ejection, and absorbing impact energy.

For more comprehensive and up-to-date guidance, it is highly recommended to refer to modern aerospace standards that complement CS-23 regulations. Examples include DIN EN 4730, which provides guidelines on the anthropometric dimensioning of aircraft seats to improve ergonomics and occupant fit, and DIN EN 4888, focused on reliability testing for commercial aircraft passenger seats. Additionally, the well-established SAE AS8049 standard defines robust performance and crashworthiness criteria for seats in civil rotorcraft, transport, and General Aviation aircraft. These standards support the development of cabin seating systems that meet regulatory, safety, comfort, and durability requirements for modern aircraft applications.

Extended safety features. Modern GA aircraft are increasingly adopting advanced safety technologies that significantly enhance survivability and situational response during emergency events. Among the most impactful innovations is the *emergency ballistic parachute system*, designed to deploy an aircraft-wide parachute in the event of catastrophic failure or loss of control. These systems provide an additional layer of protection beyond pilot skill, allowing for controlled descent and impact reduction. Their integration into the airframe is relatively straightforward for new designs and can even be retrofitted in some legacy platforms. Ballistic parachutes have proven their reliability in numerous real-world scenarios, preventing fatalities that showed no escape solutions. Their importance lies not only in the increased odds of survival but also in the psychological assurance provided to pilots and passengers alike, contributing to greater confidence and broader appeal of GA flying.

A further innovation enhancing occupant protection is the use of *seatbelt-integrated airbags*. These systems deploy instantly in the event of a crash, cushioning the head, neck, and torso of the occupant and reducing the likelihood of fatal injuries. Installed directly within the shoulder strap of the seatbelt, they require minimal structural changes and maintain the cabin's ergonomic layout. Airbag-equipped restraint systems have proven effective in reducing trauma from forward impact, especially during emergency landings or runway excursions. They offer a lightweight and highly reliable solution that complements traditional restraints, supporting the broader shift in GA aircraft toward more advanced and holistic crashworthiness.

Another vital safety feature is the *Emergency Locator Transmitter (ELT)*. Required on most registered aircraft, ELTs automatically transmit distress signals following a crash, guiding search and rescue teams to the aircraft's location. Modern ELTs, particularly 406 MHz models with GPS integration, offer highly accurate positioning and faster response times. These devices activate automatically upon significant impact and are designed to be compact, durable, and maintenance-friendly. In remote or adverse environments, an ELT can mean the difference between life and death by ensuring that rescue operations are initiated promptly and accurately.

a) b) c)

Figure 12. Extended safety features for modern GA aircraft: Emergency Ballistic Parachute, a) [12]; Integrated airbag system within restraint systems, b) [13]; ELT kit, c) [14].

3. DESIGN FRAMEWORK AND MANAGEMENT

Aircraft modelling by means of PLM framework. When designing complex products within large, multidisciplinary teams, the use of robust *Product Lifecycle Management (PLM)* tools becomes essential for ensuring consistency, traceability, and efficiency across all development stages. One of the most widely adopted and highly reliable solutions for this purpose is

Dassault Systèmes CATIA V5. Known for its advanced parametric modeling capabilities and seamless integration with PLM platforms like ENOVIA, CATIA V5 is ideally suited for aerospace projects where precision, data integrity, and collaboration are paramount. The software supports the management and handling of massive datasets, from the conceptual phase through to manufacturing and documentation, ensuring that each component meets strict design and compliance requirements.

When working in large design teams, especially in aircraft development programs, a collaborative digital environment is required—one that allows real-time updates, version control, and standardized modeling protocols. CATIA V5 facilitates this through tools such as Power Copies, publications, and contextual design. A central concept in such environments is the creation of a *Master Geometry model*, which acts as the reference framework for all downstream parts and assemblies. This Master Geometry contains published elements—such as theoretical points, reference lines, intersection curves, datum planes, and critical aerodynamic or structural surfaces—which serve as standardized interfaces for all team members. These features are geometrically linked and ensure that all dependent parts automatically update with any changes to the master reference. Adhering to project-specific file management rules and naming conventions, CATIA V5 ensures modularity, traceability, and configuration control, which are vital for the success of a certified aerospace product. Proper use of these tools reduces errors, improves productivity, and supports cross-functional collaboration throughout the aircraft's development lifecycle.

Materials, Fasteners and Semi-finished products standards database. In aerospace engineering, maintaining a comprehensive and meticulously organized database of standards for materials, fasteners, and semi-finished products is of great importance to ensure the integrity, reliability, and efficiency of the entire design and manufacturing process. The aerospace industry is heavily regulated, relying on standardized elements that conform to strict performance, safety, and quality criteria. These standards include internationally recognized specifications such as *DIN (Deutsches Institut für Normung), SAE (Society of Automotive Engineers)*, *MS (Military Standard)*, *AN (Army-Navy)*, *NASM (National Aerospace Standard, Metric)*, and *NAS (National Aerospace Standard)*, which govern everything from material compositions and mechanical properties to dimensional tolerances and surface finishes. By integrating these standardized elements into a centralized, easily accessible database, aerospace engineers can ensure that every material and component used meets the exacting requirements mandated by certification authorities like EASA and FAA, reducing risks of non-compliance and improving overall safety. The availability of such a database greatly facilitates the selection and specification of parts throughout the product lifecycle. Designers can rapidly access verified properties of alloys, composites, fasteners, and raw materials such as sheets, rods, or extrusions, each traceable to its relevant standard. This traceability is critical in aerospace projects, where every component must be documented for audit and certification purposes. For instance, fasteners such as bolts, rivets, and washers are often specified per MS or NAS standards, ensuring consistency in mechanical strength, corrosion resistance, and compatibility with other aircraft structures. Similarly, semi-finished products like aluminum plates or titanium bars conforming to DIN or SAE standards provide reliable baseline mechanical properties essential for structural design and finite element analysis.

Modern CAD environments, notably CATIA V5, greatly enhance the utility of such databases through their capability to hyperlink detailed technical documentation directly to the components and materials within the model. This integration allows engineers to instantly retrieve specification sheets, test certificates, and compliance reports without leaving the design interface, dramatically improving accuracy and efficiency. When properties such as density, Young's modulus, yield strength, and thermal conductivity are embedded directly into the CATIA material library, designers can trust that simulations and performance calculations reflect real-world behavior. Moreover, the parametric nature of CATIA allows for automatic updates when standards or supplier data change, ensuring that models always use the most current and validated information.

Project Management corelated with ATA 100 Specification. The ATA 100 Specification [15] is a crucial standard in the aviation industry that provides a comprehensive and systematic method for organizing technical information related to aircraft systems and components. Originally developed by the Air Transport Association (ATA), this numbering system categorizes aircraft maintenance documentation into specific chapters, each addressing a particular system or functional area, ranging from engines and landing gear to electrical systems and flight controls. The ATA 100 chapters serve as a universal language that facilitates clear communication, efficient maintenance, and streamlined documentation across manufacturers, operators, and regulatory authorities.

In a GA aircraft design, the implementation of ATA 100 chapters is integral to organizing technical data in manuals such as the *Aircraft Maintenance Manual (AMM)*, *Structural Repair Manual (SRM)*, *Illustrated Parts Catalog (IPC)* and *Component Maintenance Manual (CMM).* These manuals, required for certification and ongoing airworthiness, rely on ATA numbering to categorize instructions, troubleshooting guides, repair procedures, and parts identification. By standardizing documentation formats and chapter references, ATA 100 enables maintenance personnel and engineers to quickly locate relevant information, reducing errors and downtime during inspections or repairs.

Compared to commercial and military aircraft, the ATA 100 Specification structure for GA is typically more streamlined and less complex, reflecting the simpler systems and fewer subsystems involved. GA aircraft often do not require extensive chapters dedicated to specialized equipment such as onboard oxygen systems, weapons, lavatories, or elaborate environmental control systems, which are standard in larger commercial airliners and military platforms. As a result, the ATA documentation for GA aircraft focuses primarily on essential systems like propulsion, flight controls, electrical systems, landing gear, and basic avionics.

4. CONCLUSIONS AND REMARKS

This paper has outlined the essential steps involved in the development of a new GA aircraft, beginning with a foundation built on evidence-based insights derived from an initial market analysis. These insights are critical in defining a product vision that aligns with both current user demands and future market trends. The paper describes the qualitative and technical aspects that influence the aircraft's configuration, examined through the lens of regulatory frameworks such as EASA CS-23. These regulations provide the foundation upon which mission adaptability, safety, and performance goals must be balanced. Key configuration elements were discussed, including the aircraft's mission-specific adaptability, target performance envelope by aerodynamic assessments, and essential safety factors, alongside critical components like powerplant selection, avionics architecture, cabin layout, and integration of extended safety systems such as ballistic parachutes, ELTs, and airbag-equipped restraints.

In addition to the technical parameters, this paper emphasized the importance of a robust and organized design framework. The use of advanced PLM tools (specifically CATIA V5) was discussed as a cornerstone for effective aircraft modeling, enabling efficient design iteration, real-time collaboration, and precise integration of design data. The importance of maintaining a standardized and hyperlinked database of aerospace-grade materials, fasteners, and semi-finished products, referencing international norms like SAE, DIN, MS, AN, and NAS standards, was also described, ensuring consistent quality and traceability across the project. Furthermore, the ATA 100 specification was identified as an essential project management and documentation tool, structuring technical content and directed towards supporting post-certification operations such as maintenance and parts cataloging.

Together, these considerations form a coherent roadmap for advancing a GA aircraft project from initial concept through to prototype development and eventual certification. By closely aligning engineering practice with regulatory compliance and standardized processes, the likelihood of achieving a safe, efficient, and certifiable aircraft is greatly improved paving a structured path from conceptual design to operational reality.

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