LAB University of Applied Sciences

Developing a start-up in general aviation

Enhanced situational awareness in aircrafts using computer vision

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Abstract

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Title of the thesis

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Abstract

This thesis develops commercial strategy and business plan for a startup aimed at enhancing situational awareness in general aviation through computer vision technology. The primary goal is to gather insights to support the author's plans to establish the startup by analyzing general aviation as evolving industry, and formulate entrepreneurial roadmap for addressing its technical, regulatory, and market challenges. Data sources include interviews and surveys with pilots, aviation safety officers, and other stakeholders, alongside secondary data from literature, industry reports, and case studies. Combining theoretical background with primary research offers actionable insights for the startup's development.

The plan covers market analysis, competitive landscape, customer segmentation, partnerships, technology, and financial considerations. It also examines market conditions, customer needs, and resources critical to establishing and operating the business successfully.

Keywords

Aviation, AI, business plan, entrepreneurship, startup.

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1 Introduction

1.1 Background and the aim of the research

The author holds an Electronics Engineering degree and is completing a Master's in Business Administration. Post-graduation, he plans to establish an avionics company with colleagues, leveraging their combined technical expertise. This business concept, focused on AI-driven situational awareness systems (Computer Vision) for general aviation, has evolved over several years into a startup initiative. The founder's background in electronics and the aviation industry, combined with growing market demand for enhanced safety in general aviation, formed the foundation for this venture. Initial prototypes and demonstrations received positive feedback from pilots and aviation professionals, leading to potential partnership opportunities.

To understand the scope of AI-driven aviation safety systems, we must first define situational awareness in an aviation context. It refers to a pilot's comprehensive understanding of their aircraft's state, position, and surrounding environment. This encompasses various factors, including weather conditions, nearby aircraft, terrain, and system status (FAA, 2022). AI-enhanced situational awareness systems can significantly improve flight safety by processing and presenting this information effectively (EASA, 2023).

The startup is also focused on enhancing the traditional "see-and-avoid" collision avoidance method in general aviation. While pilots are required to actively search for conflicting traffic in visual conditions, this approach has proven unreliable and flawed. Even with modern liquid crystal displays, there's no guarantee of detecting all nearby aircraft (General Aviation News, 2022).

This venture aims to develop an AI-powered situational awareness system that augments pilots' visual scanning capabilities. The technology combines advanced sensors, machine learning algorithms, and intuitive pilot interfaces to provide more reliable collision avoidance capabilities beyond traditional see-and-avoid limitations (IEEE Spectrum, 2023). AI systems in aviation must meet stringent certification requirements while providing clear value to pilots. The system must reliably process complex data streams, present actionable information, and integrate seamlessly with existing cockpit environments. These systems aim to enhance pilot decision-making, reduce cognitive load, and improve overall flight safety (Deloitte Insights, 2021).

Through this thesis, the author aims to create a comprehensive commercial strategy and a business plan for an AI aviation startup. The research explores the general aviation market in the US, Europe, and Middle East regions, addressing customer demand. Detailed core business and marketing strategies and cost projections are elaborated. However, the main focus is on achieving product-market fit (Kotler & Armstrong, 2017).

The chosen business model is a lean startup approach, allowing for iterative development and validation while maintaining regulatory compliance. This model enables the team to refine their AI system through pilot feedback and real-world testing while building towards full certification. The main goal is to establish a clear roadmap for developing and commercializing AI-enhanced situational awareness systems for general aviation, with potential for expansion into broader aviation markets (Blank & Dorf, 2012).

1.2 Research questions

This thesis aims to explore and provide answers the following research questions (RQs) that are focused on AI-based situational awareness systems applied in general aviation:

1. "How can computer vision technologies create business value in detecting non-cooperative airborne objects in general aviation?"

2. "What are the challenges in developing AI-driven collision prediction systems, and how can they stand out in performance and reliability?"

3. "How can market demand for AI-based situational awareness systems in general aviation be assessed and stimulated?"

1.3 Research Methodology and Data Collection

This study is a case analysis of the PilotX startup, which aims to develop a situational awareness system for general aviation private pilots. The system leverages computer vision technology and collision avoidance algorithms to enhance flight safety. The business research employs qualitative methodology. The data were collected from both primary and secondary sources. Furthermore, information is gathered from relevant literature, online resources, a survey conducted with the potential target audience, and insights from the author's experience in aviation safety and interviews with industry professionals (Kotler & Armstrong, 2017).

Research methodologies generally fall into two categories: quantitative and qualitative. Each has unique strengths. Quantitative research typically emphasizes numerical data and statistical analysis, whereas qualitative research investigates fundamental motivations and the underlying reasons for behaviors and decisions. According to Dawson (2018), qualitative research offers valuable insights into the motivations and challenges faced by the target group, making it an appropriate approach for this study. For this study, qualitative research is particularly suitable as it explores the needs, preferences, and challenges of general aviation pilots, as well as the market viability of PilotX.

This thesis employs qualitative and quantitative methods to assess the potential market and customer base for PilotX and to establish a foundation for the business plan. To achieve the necessary insights, several data collection methods are used. Interviews with aviation professionals, including private pilots and industry experts, are conducted to understand current situational awareness challenges in general aviation. These interviews focus on identifying the needs of pilots, the use cases for AI-powered solutions, and the overall market demand for such technology (Indeed, 2019).

Surveys were distributed to general aviation communities and forums, including social media groups for private pilots and flight enthusiasts. The survey includes questions about the relevance of situational awareness systems, the perceived importance of such technology, and the willingness of pilots to adopt it. Although pricing is not the main focus of this thesis, understanding the value perception and budget considerations of pilots provides insight for future cost analysis (Surbhi, 2018).

Quantitative research complements these primary methods by examining existing literature, industry reports, and online sources. This research focuses on the broader market trends for situational awareness systems, customer preferences, and regulatory requirements in aviation (Kotler & Armstrong, 2017).The combination of these methodologies and practices in the study offers a detailed perception of the market potential for PilotX and the findings aim to guide the development of a robust business plan and support the implementation of the PilotX startup.

1.4 Delimitations

Developing a situational awareness system for general aviation entails several limitations, particularly in financial projections and market dynamics. Financial projections are inherently complex, as the business plan must consider benchmarks from both the aviation industry and emerging AI technology trends. Variables such as development costs, certification timelines, and market penetration rates for novel aviation technologies can deviate substantially from initial expectations. For example, unforeseen delays in AI integration or certification could impact cost and revenue forecasts (Clifford, 2023).

The competitive landscape also presents challenges due to limited transparency in proprietary AI technologies and aviation safety systems. Established avionics manufacturers frequently withhold details about their development strategies, complicating efforts to map the competitive terrain. Additionally, new entrants in the AI and aviation safety sectors can disrupt market dynamics by introducing innovative solutions or shifting pricing structures (Dowson, 2018).

Regulatory compliance is another significant hurdle. Meeting the rigorous safety standards determined by aviation authorities like the FAA and EASA demands specialized knowledge and expertise. The certification of AI-driven systems requires rigorous testing to meet reliability and safety standards across various jurisdictions. These regulatory requirements are further complicated by differences in international frameworks, adding layers of complexity to the certification process (Indeed, 2019).

Pilot adoption behavior is a critical factor influencing the success of AI-based systems. Acceptance depends on factors such as ease of integration with existing cockpit systems, the learning curve associated with new technology, and trust in AI-driven safety features. Historical disruptions in the aviation industry, such as the impact of COVID-19 or geopolitical factors, have underscored the unpredictability of technology adoption rates and the regulatory environment (Clifford, 2023).

The scope of system development and certification is also constrained by limited expertise, testing resources, and access to real-world aviation data for AI model training. These factors may restrict the initial capabilities of the system and extend the certification timeline. However, in the aviation safety market, particularly in European and US airspace, these constraints should be viewed as parameters for continuous refinement rather than fixed barriers. The startup must maintain a commitment to safety, reliability, and adaptability to succeed in this dynamic environment (Kotler & Armstrong, 2017).

1.5 Structure of the thesis

This thesis is structured to systematically address the development and market analysis of an AI-based situational awareness system for general aviation pilots. The *Introduction* establishes the foundation by presenting the research topic, its practical and theoretical significance, and the aims and objectives of the study. It also introduces the research questions and provides an overview of the thesis structure to guide the reader.

The thesis progresses with the *Research Approach*, detailing the methodologies employed to address the research questions. This chapter outlines the justification for employing both qualitative and quantitative methods, details the data collection techniques used—such as interviews and surveys—and highlights the importance of adhering to ethical research standards to maintain validity and reliability.

A comprehensive *Literature Review* follows, providing a theoretical framework by examining existing research and concepts relevant to entrepreneurship and aviation safety. Key tools, including the Value Proposition Canvas, Business Model Canvas, Porter's Five Forces and SWOT Analysis, are explored to establish a solid theoretical foundation. This framework supports the subsequent analysis of market and competitive dynamics.

The *Market and Competitor Analysis* chapter evaluates the target market, competitive landscape, and potential customer segments, using buyer personas and market size estimations to quantify the business opportunity. These insights lay the groundwork for a robust *Marketing Strategy*, which synthesizes theoretical insights and practical applications to define approaches for achieving competitive advantage. This chapter incorporates the marketing mix, emphasizing product positioning, pricing, promotional strategies, and distribution channels.

The *Results and Analysis* section presents and interprets findings from primary data collection, such as survey results, and links trends and patterns to the study objectives. Statistical and thematic analyses ensure data reliability and provide actionable insights for the business plan. This leads into the *Financial Analysis*, which evaluates the projected costs, revenues, and profitability of the proposed business model, incorporating sensitivity analysis to account for uncertainties.

In the *Limitations* chapter, the study critically reflects on methodological constraints, data availability, and scope restrictions while suggesting areas for future research. The thesis concludes with the *Conclusion*, summarizing how the research objectives were addressed and reflecting on the broader implications of the findings. A comprehensive *References* section ensures academic rigor and provides traceability for the sources cited throughout the thesis.

Together, these chapters form a cohesive narrative that integrates the research problem, theoretical foundations, empirical findings, and strategic recommendations for implementing AI-based situational awareness systems in general aviation.

Fig. 1. Thesis structure

2 Startup initiatives in the general aviation industry

Startup development in the general aviation industry, particularly in the avionics sector, provides fertile ground for innovation, growth, and advancements in safety and efficiency. The elaboration and manufacturing of electronic systems for aircraft, including communication, navigation, and collision avoidance technologies, are central to this dynamic field. As aviation technology evolves and the demand for safer, more efficient flight solutions grows, the market for innovative avionics systems continues to expand (Kotler & Armstrong, 2017; Market Research Future, 2023).

Startups have an opportunity to address specific needs, such as improving flight safety, reducing pilot workload, and integrating artificial intelligence (AI), computer vision (CV), and machine learning (ML) into aircraft systems. For example, AI-powered collision avoidance systems offer real-time data and predictive analytics, enhancing situational awareness for pilots. Similarly, integrating GPS navigation, automated systems, and digital flight displays into smaller aircraft can improve the flying experience and offer a competitive edge (Clifford, 2023; Frost & Sullivan, 2023).

The success of companies like Daedalean and ForeFlight highlights the potential for startups to make significant contributions. Daedalean, a Swiss startup founded in 2016, focuses on AI-based avionics systems designed to enhance situational awareness and reduce risks through visual navigation and landing systems. Similarly, ForeFlight, established in 2007, revolutionized flight planning and navigation with its digital tools, ultimately being acquired by Boeing in 2020, demonstrating the potential for startups to attract major industry players (Indeed, 2019; Aviation Today, 2023).

However, the path to success is fraught with challenges. Regulatory compliance remains one of the most significant hurdles. Strict standards set by authorities like the FAA and EASA are essential for ensuring safety but pose barriers to entry for startups. The lengthy and costly certification process requires significant investments in research, development, and testing. Iris Automation’s experience with its Casia system, a computer vision-based collision avoidance solution for drones, underscores the challenges of navigating these regulatory landscapes (Dowson, 2018; PwC, 2022).

The high costs associated with research and development (R&D) are another major obstacle. Developing and testing new avionics systems often requires substantial capital, which startups must secure through venture capital, government grants, or partnerships. For instance, SkyRyse, a company focused on advanced flight control systems, raised $25 million in Series A funding to support its development efforts (Clifford, 2023; Deloitte Insights, 2021).

To thrive in this competitive industry, startups must prioritize innovation and quality while deeply understanding customer needs. Products that address specific pain points, such as simplifying complex tasks or improving situational awareness, can set a company apart. FLARM’s low-cost collision avoidance system, initially created for glider pilots, became a widely adopted safety solution in the general aviation community, highlighting the value of addressing critical safety needs effectively (Kotler & Armstrong, 2017; Frost & Sullivan, 2023).

Building strong industry connections is equally important. Startups benefit from collaborations with established players, participation in industry events, and engagement with customers and partners. For example, AirMap successfully expanded its reach by partnering

with companies like Microsoft and Qualcomm, as well as government agencies, to develop airspace management tools for drones (Indeed, 2019; PwC, 2022).

In conclusion, entrepreneurship in the general aviation industry, especially in avionics, offers vast opportunities for those willing to navigate its challenges. Startups like Daedalean, ForeFlight, and Iris Automation demonstrate the power of innovation, strategic partnerships, and perseverance in advancing aviation technology and safety standards. While the road is demanding, the rewards for those who succeed are substantial, driving progress in aviation and enhancing safety for pilots and passengers alike (Market Research Future, 2023).

3 Value Proposition Canvas

The Value Proposition Canvas is a strategic tool aimed at aligning a product's value with the unique needs and priorities of its target audience. It is divided into two key components: the Customer Profile, which examines customer tasks, challenges, and goals, and the Value Map, which highlights how the product fulfills those needs. This framework is particularly applicable to our AI startup in the general aviation sector, which focuses on improving situational awareness and collision prediction (Osterwalder et al., 2014; Kotler & Keller, 2020).

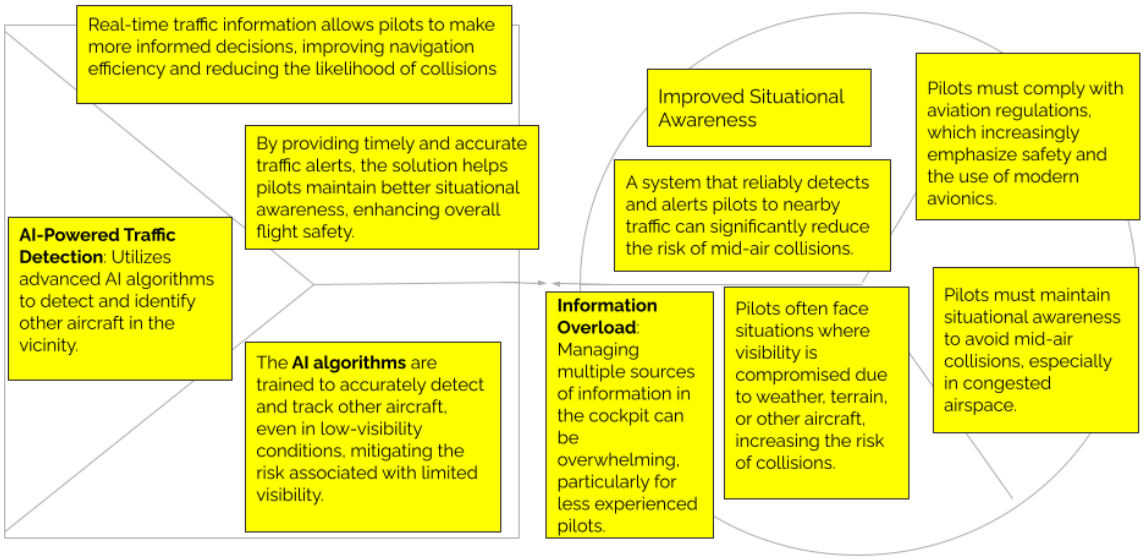

Figure 2. Value Proposition Canvas is a tool proposed by Osterwalder et al. (2014)

Customer Profile

The primary objective for general aviation pilots and operators is ensuring the safe navigation and operation of aircraft. This includes avoiding collisions with airborne objects such as drones, birds, and gliders, tasks made increasingly challenging by growing air traffic and evolving flight environments (Clifford, 2023; Market Research Future, 2023). Secondary responsibilities involve compliance with stringent aviation safety regulations, optimizing operational efficiency, and ensuring the safety of passengers and crew (EASA, 2023). Pilots face significant risks, particularly in conditions of limited visibility, such as fog or nighttime operations. Regulatory pressures to adopt advanced safety systems can impose financial strain, with high implementation costs and penalties for non-compliance presenting substantial challenges (Indeed, 2019; PwC, 2022). Additionally, near-collisions and operational disruptions can lead to unplanned diversions, increased downtime, and costly repairs (Dowson, 2018; McKinsey & Company, 2022).

Despite these difficulties, customers are motivated by the need for solutions that enhance safety, improve efficiency, and streamline regulatory compliance. Early detection of poten-

tial collisions reduces accident risks, offering peace of mind and operational confidence (Kotler & Armstrong, 2017). Furthermore, compliance-oriented solutions can lead to cost savings through reduced insurance premiums and avoidance of regulatory fines while minimizing downtime (Frost & Sullivan, 2023).

Value Map

In response to these needs, our system delivers a tailored solution through an AI-powered situational awareness platform. The system leverages advanced computer vision technology to detect and track airborne hazards in real time. A built-in collision prediction engine provides proactive alerts, enabling pilots to make timely evasive maneuvers and ensuring operational safety even in challenging conditions (Clifford, 2023; Aviation Today, 2023).

Designed for seamless integration with existing avionics, the system is user-friendly and adaptable to various aircraft types. It addresses key pain points by delivering accurate object detection and real-time alerts, which enhance situational awareness and flight safety. Moreover, the system offers a cost-effective path to regulatory compliance, mitigating financial strain while improving operational efficiency (Osterwalder et al., 2014; EASA, 2023).

By positioning users as early adopters of cutting-edge aviation technology, the system provides a competitive advantage in the general aviation sector. This positioning aligns with Rogers' Diffusion of Innovations theory, which suggests that early adopters gain significant market advantages by leveraging innovative technologies (Rogers, 2003). By addressing critical challenges and delivering measurable value, our solution establishes itself as an indispensable tool for general aviation pilots and operators, fostering safety and efficiency in an increasingly complex flight environment (PwC, 2022; Frost & Sullivan, 2023).

By applying the Value Proposition Canvas, the (PilotX) startup aligns its product development and marketing strategies with the specific needs of its target audience, ensuring long-term success and impact in the aviation industry.

4 Business Model Canvas

A business model is a strategic blueprint that defines how a company creates revenue and maintains its operations. For PilotX startup, success hinges on creating value through advanced situational awareness systems using computer vision and collision prediction. By effectively capturing this value, our company can charge a premium for its innovative solutions, ensuring long-term viability in the competitive aviation market (Healy, 2021; Osterwalder & Pigneur, 2010).

In the context of our startup, using the Business Model Canvas is essential for structured planning. Alexander Osterwalder's canvas provides a comprehensive framework to thoroughly plan, analyze, and refine the business strategy (Pereira, 2021). This strategic tool is crucial for favourable result in the highly specialized aviation market. It helps the company define its value proposition, target specific customer segments, and outline revenue sources, thereby establishing the groundwork and foundation for long-term growth. Furthermore, it helps recognize possible risks and uncertainties, enabling proactive measures for risk reduction. Business Model Canvas as a tool offers to a company a vision about how to efficiently coordinate resources, foster innovation, and create a roadmap for sustainable growth in an evolving industry (Healy, 2021; Frost & Sullivan, 2023).

<table>
<tr>
<td rowspan="2">Key Partners

AWS,
Microsoft for Startups Founders Hub,

Local flight schools, aviation clubs, and small commercial operators in Moldova and Romania.

Avionics manufacturers and software integrators

Local and regional aviation regulatory authorities</td>
<td>Key Activities
Aircraft traffic analysis using Artificial Intelligence integrated into a tailored solution. Technical assessment of nearby traffic and identifying non-cooperative objects.</td>
<td rowspan="2">Value Proposition
The software which is easy to use and designed for seamless integration into existing aircraft piloting processes. Using Artificial Intelligence, it automates the analysis of video data via a user-friendly platform. Improves situational awareness and reduces the risk of mid-air collisions, a key concern for pilots.</td>
<td>Customer Relationships
Dedicated account managers for key clients. Regular updates and communication during the launch process. Customer support. Feedback loops for continuous improvement.</td>
<td rowspan="2">Customer Segments

Aircraft pilots. Aircraft Service Centers, Flight Schools, Aviation Clubs and Associations. Small Commercial Operators. We serve the B2C in the Aerospace market segments.</td>
</tr>
<tr>
<td>Key Resources
Software and business developers, Proprietary software and hardware, algorithms, and data analysis tools.</td>
<td>Channels
Direct sales to aircraft pilots. Online platform. Aviation equipment retailers, Events and Expos.</td>
</tr>
<tr>
<td colspan="3">Cost Structure

General and administration, Staff salaries and training, Regulatory compliance costs, Marketing and promotion expenses, Research and development costs</td>
<td colspan="2">Revenue Streams

Direct sales business model to deliver complete aircraft pilot traffic identification service via an application.</td>
</tr>
</table>

Figure 3. Business Model Canvas, Alexander Osterwalder

Customer Segments

Identifying customer segments is fundamental. For our startup, the key segments include general aviation aircraft manufacturers, private aircraft owners, flight schools, and aviation safety regulatory bodies. Understanding and targeting these segments will allow us to

effectively market solutions and tailor them to meet specific industry needs (Osterwalder et al., 2010; Market Research Future, 2023). For instance, flight schools may prioritize cost-effective training solutions, while private aircraft owners focus on user-friendly safety systems (Clifford, 2023).

Customer Relationships

In the aviation industry, strong customer relationships are critical. Our startup must focus on building long-term partnerships with customers through personalized support, continuous innovation, and exceptional service quality. Establishing feedback loops will be essential for refining offerings and maintaining customer loyalty (Verhoef et al., 2009; Blank & Dorf, 2012). For example, implementing training programs and offering regular software updates can strengthen engagement with flight schools and private operators.

Channels

Successful customer acquisition and strong brand visibility depend on efficient communication channels. For our startup, maintaining a robust online presence through a specialized and professional website and active social media participation is crucial. Additionally, networking with industry stakeholders, attending aviation trade shows, and collaborating with regulatory bodies will help enhance market presence (Chaffey, 2017; Kotler & Keller, 2020). Events like AERO Friedrichshafen or EAA AirVenture provide excellent opportunities to connect with target audiences.

Value Proposition

Developing a persuasive value proposition is imperative for drawing in and keeping clients.Our startup’s value lies in providing advanced situational awareness and collision prediction systems that enhance flight safety and operational efficiency. By offering cutting-edge technology, our solutions address critical safety concerns in the aviation industry, setting us apart from competitors (Osterwalder et al., 2010; EASA, 2023). The AI system’s ability to reduce risks during challenging flight conditions, such as low visibility, demonstrates its unique value proposition (PwC, 2022).

Key Activities

The core activities for our startup revolve around continuous R&D, product development, and market outreach. Ensuring that our AI systems are at the forefront of technology, meeting the stringent requirements of the aviation industry, is fundamental to success (Osterwalder et al., 2010; Deloitte Insights, 2021). Conducting pilot testing and collaborating with regulators like the FAA will ensure product reliability and compliance.

Key Resources

Our key resources include advanced computing hardware like the Nvidia Jetson module, skilled AI and computer vision engineers, and strategic partnerships with aviation industry stakeholders. These resources are crucial for developing, deploying, and maintaining situational awareness systems (Dowson, 2018; Clifford, 2023). Access to funding through venture capital and government grants will also be critical for sustaining R&D efforts (McKinsey & Company, 2022).

Key Partners

Establishing partnerships with aircraft manufacturers, aviation software developers, regulatory bodies, and industry associations will be instrumental in the startup’s success. These partners can provide access to critical markets, regulatory support, and technologi-

cal synergies that enhance product offerings (Osterwalder et al., 2010; Frost & Sullivan, 2023). Collaborations with organizations like EASA and ICAO can also facilitate market entry.

Cost Structure

Our cost structure will include expenses related to R&D, advanced hardware, software development, and marketing. Additionally, costs associated with regulatory compliance and industry certifications will be significant. Effective cost management is crucial for sustaining profitability while providing high-quality solutions (Bowdin et al., 2011; PwC, 2022). For example, allocating resources to automate testing and streamline certification processes can reduce long-term costs.

Revenue Streams

Revenue will primarily be generated through the sale of situational awareness systems to aircraft manufacturers, subscriptions for software updates and maintenance, and possibly through partnerships or licensing agreements with other aviation technology providers (Osterwalder et al., 2010; Kotler & Armstrong, 2017). Offering tiered pricing models for different customer segments can further optimize revenue generation.Leveraging the Business Model Canvas, the PilotX startup establishes a robust framework for addressing the unique challenges of the aviation industry while positioning itself for sustainable growth and innovation.

5 Marketing Strategy for a Start-up

A marketing strategy outlines how an organization can best allocate its finite resources to maximize long-term revenue growth and profitability, serving as a key component of the broader corporate strategic plan. Marketing strategy has two main guidelines - the market and the product. Nowadays, numerous factors and extensive marketing data shape a company's marketing strategy, including insights from buyer behavior studies, industry trend analysis, and other market research findings. There is no unified form of marketing strategy. However, it is important that it:

1) clearly defines the company's clients;

2) explains what the company's clients want;

3) outlines specific approaches and actions to help the organization meet its revenue and marketing goals (Kotler & Armstrong, 2017). (Kotler & Armstrong, 2017; Osterwalder & Pigneur, 2010).

Before starting to create an effective strategy, we need to study their types (Philip T. Kotler & Gary Armstrong, *Principles of Marketing*, Pearson, 2017).

Types of marketing strategy	**Description of marketing strategy**
Strategy for entering a new consumer market or expanding the current one	This strategic approach focuses on boosting the company's profitability by introducing new products to penetrate additional market segments, ultimately driving higher returns for the organization.
Innovation Strategy	Implies the production of innovations that have no analogues on the market
Strategy of Innovative Imitation	Based on the use of a set of competitors' innovations in the company`s product
Product differentiation strategy	Involves upgrading existing products. Emphasizes delivering distinctive offerings that differentiate themselves from rival companies in the marketplace.
Cost Reduction Strategy	Based on market leadership in price, the basis of which, is the cost price
Waiting strategy	Based on the production of goods that are relatively new to the market and that have already been successfully tested by other manufacturers
Consumer Personalization Strategy, Customer Intimacy	Building strong relationships with customers through tailored offerings and personalized interactions.
Diversification strategy	The company is constantly looking for ways to diversify its product portfolio
Specialization, Niche Marketing Strategy	The organization is concentrating its efforts on excelling within a targeted market segment rather than attempting to serve the entire marketplace. Being a leader in one

	selected segment is better than to occupy average positions in the entire market
Internationalization Strategy	Formation of transnational companies that, due to their scale, do not allow themselves to be competed with
Cooperation strategy	The partnership interaction between several organizations

Table 1. Types of marketing strategies, Philip T. Kotler, Gary Armstrong-Principles of Marketing-Pearson (2017).

Let's consider the types of marketing strategies that are relevant today and their examples:

Market penetration strategy.

This approach is adopted both by startups seeking to establish themselves in the current marketplace and by established companies looking to expand into untapped or underexplored market niches. Market penetration strategies focus on increasing market share by leveraging competitive pricing, aggressive promotions, and improved distribution channels. These tactics are particularly effective for startups aiming to gain a foothold in highly competitive markets (Kotler & Armstrong, 2017; Blank & Dorf, 2012).

Development of a new product.

This marketing strategy is associated with certain specific risks. Before launching new offerings, companies must carefully evaluate market demand, either confirming its existence or identifying ways to create it. This approach requires thorough risk assessment, competitive analysis, and cost-benefit evaluation. While consumers often initially resist new products, genuine innovations that fulfill real needs can generate substantial returns. Innovation doesn’t always require new technology—sometimes a fresh perspective on existing processes is sufficient (Kotler & Armstrong, 2017; Deloitte Insights, 2021). When putting this strategy into action, a company must deal with consumer conservatism, as most people tend to be wary of new things at first. However, if the product genuinely offers something new and consumers perceive a need for it, the financial returns can be enormous. Examples in aviation include companies like ForeFlight, which revolutionized flight planning through its digital tools (Aviation Today, 2023).

Niche strategy.

This approach is adopted by specialized firms that manufacture unique, custom products aimed at a very specific group of consumers. By offering irreplaceable, highly specialized items, the company can secure a prominent market position because there will always be a segment of customers needing these exclusive products. Examples include companies operating with various focused strategies: Bandog (the company restores tires and offers a range of services in truck parking lots), Ritz-Carlton (hotel business), eBay (specializes in conducting electronic auctions), Porsche (sale of sports cars), and FLARM (providing affordable collision avoidance systems for gliders) (Kotler & Armstrong, 2017; Frost & Sullivan, 2023).

Pioneer strategy.

This strategy involves either creating entirely new market segments or significantly altering existing ones. These companies don't just enhance products; they seek bold, revolutionary answers that might not guarantee profitability even under the best circumstances. Examples include early pioneers like Apple and Zenit with their initial personal computers, firms in biotechnology, and others who have discovered or implemented more conventional breakthroughs (Kotler & Armstrong, 2017; Clifford, 2023). In aviation, Daedalean's AI-powered situational awareness systems exemplify pioneering efforts in creating new technology-driven market segments (PwC, 2022).

To achieve the outlined goals and develop a successful marketing strategy, a systematic approach is essential. The process starts by pinpointing the target audience and then developing a detailed marketing mix which includes key elements like product, distribution, pricing, promotion, as well as the physical environment, the process, and the people involved (Osterwalder & Pigneur, 2010). The marketing strategy for PilotX should be structured around controlled elements that include determining the operational location, defining the services/products offered, analyzing the competitive environment, selecting the target market and target audience, establishing a pricing policy, planning promotional activities, choosing reliable suppliers, and developing an effective personnel strategy. Each of these elements is crucial in defining the strategy and making sure it aligns with the startup's goals (Kotler & Armstrong, 2017; Blank & Dorf, 2012).

Once these foundational components are established, the implementation of goals involves several interrelated tasks. The process begins with analyzing consumer needs, segmenting the market, conducting Porter's Five Forces analysis, and an in-depth evaluation of threats and opportunities that may impact the business. Additionally, a thorough competitive analysis is conducted to position PilotX effectively within the market, complemented by an assessment of the startup's internal strengths and weaknesses. Based on these insights, a well-informed strategy is selected to guide the marketing efforts and drive the business toward sustainable growth (Healy, 2021; Market Research Future, 2023).

5.1 SWOT

The SWOT analysis provides a structured framework for evaluating the strategic position of a startup within the general aviation industry. By evaluating our internal strengths and weaknesses in conjunction with external opportunities and threats, we achieve a thorough grasp of the elements shaping our business path (Johnson, Scholes, & Whittington, *Exploring Strategy*, Pearson, 2017).

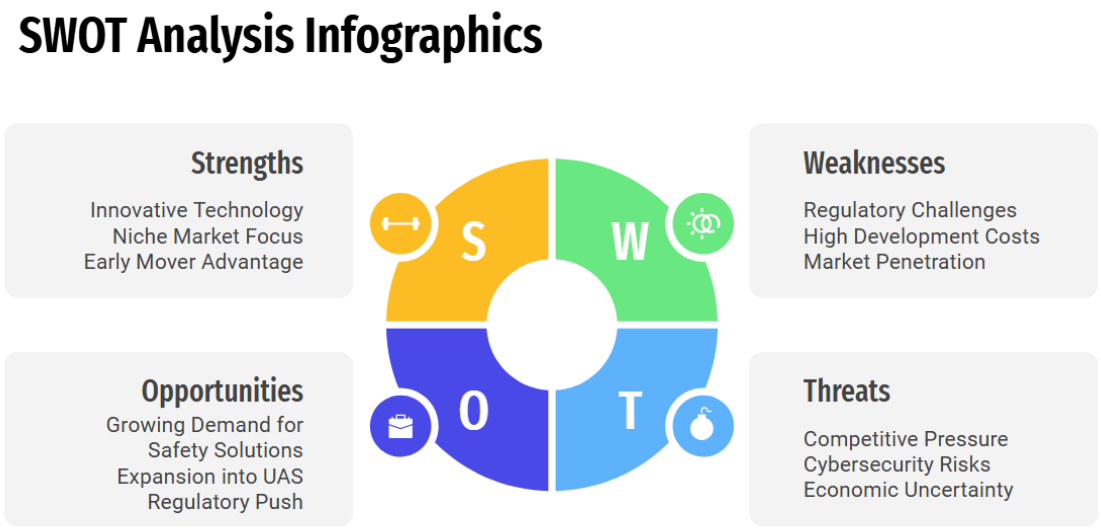

Figure 5. SWOT Analysis of PilotX startup.

Our primary strength lies in the innovative nature of our technology. Leveraging AI and computer vision for situational awareness and collision prediction provides a cutting-edge solution that significantly enhances flight safety. This aligns with industry trends emphasizing the value of AI-driven solutions, as noted by PwC, which highlights AI as a key enabler of innovation in aviation safety (PwC, 2022). The system's capability to detect a wide array of airborne hazards—such as drones, birds, and gliders—addresses multiple safety concerns with a single, integrated solution. This approach meets the demand for comprehensive systems, as observed by Aviation Today, and positions us uniquely within the niche of general aviation (Aviation Today, 2023). By focusing specifically on general aviation pilots, our product stands out from broader offerings by larger avionics companies. This tailored approach fosters brand loyalty and aligns with customer-specific needs, a strategy supported by insights from General Aviation News (General Aviation News, 2022). Additionally, the scalability of our technology offers long-term growth opportunities, with potential applications across unmanned aerial systems (UAS) and commercial aviation. Entering the market early positions the startup as a leader in this emerging field, capturing market share before competitors, a strategy observed in successful startups like Daedalean (TechCrunch, 2021; Zhou et al., 2021).

Despite these strengths, the startup faces several internal weaknesses and challenges. The aviation sector operates within a highly regulated framework, necessitating adherence to strict guidelines from organizations like the FAA and EASA, which often results in significant time and financial investment. These challenges may delay product launches, as noted by Deloitte Insights in their analysis of aerospace product development cycles (Deloitte Insights, 2021). High R&D costs present another significant hurdle, particularly during the prototyping and certification phases. Limited financial resources during early-stage development could strain operations, a common challenge for startups in aerospace, as highlighted by McKinsey & Company (McKinsey & Company, 2022). Building trust in a safety-critical industry is also a critical challenge. Customers and regulators demand proven reliability, particularly when dealing with emerging technologies like AI and computer vision. Ensuring system reliability under varied flight conditions is paramount, a concern frequently discussed in IEEE Spectrum's analysis of AI deployment in safety-sensitive sectors (IEEE Spectrum, 2023; Shi et al., 2016).

The growing demand for advanced safety solutions represents a significant opportunity. Increasing air traffic, coupled with the proliferation of drones, drives the need for enhanced situational awareness systems. Market Research Future projects rapid growth in the global aviation safety market, with technological advancements as a key driver (Market Research Future, 2023). Collaborations with aircraft manufacturers and airlines could unlock larger markets and resources, following successful examples such as ForeFlight's partnerships with major industry players (Aviation Week, 2022). Additionally, regulatory bodies like the FAA are emphasizing safety enhancements, which could make systems like ours mandatory, further boosting demand (FAA, 2023). Expanding into global markets, particularly in regions with high general aviation activity, offers another avenue for growth. Adapting the technology for drone applications could also open doors in the burgeoning UAS market, creating a secondary revenue stream (ICAO, 2022). (ICAO, 2022; Santoso & Sudarmiatin, 2023).

Several external threats could impact our success. The avionics market is highly competitive, with established players likely to develop similar AI-based solutions. This could lead to market saturation and increased pricing pressures, as noted by Frost & Sullivan in their analysis of the avionics sector (Frost & Sullivan, 2023). Rapid technological advancements risk rendering our solution obsolete without continuous investment in R&D, a concern emphasized by Gartner in their technology lifecycle analysis (Gartner, 2023). Regulatory delays, a common challenge in aerospace, could postpone product launches, affecting revenue and competitive positioning (FAA Certification Process, 2022). Economic uncertainties, including recessions or fluctuating consumer spending, could also reduce demand for new technologies in aviation. This is a significant vulnerability for startups with limited financial resilience, as discussed by The Economist (The Economist, 2023). Finally, the increased integration of AI into aviation systems raises cybersecurity concerns, making robust security measures critical to maintaining system integrity and trust (CSO Online, 2023).

This SWOT analysis underscores the strategic factors shaping our AI startup's position in the general aviation industry. By leveraging our strengths, such as cutting-edge technology and scalability, and capitalizing on opportunities like market demand and global expansion, we can establish a strong foothold. At the same time, addressing weaknesses and mitigating threats, such as regulatory challenges and cybersecurity risks, will be essential for sustained growth and success in this dynamic and evolving market.

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5.2 Porter`s Five Forces Analysis

Porter's Five Forces is a strategic tool created by Michael E. Porter for analyzing industry competition. It looks at how buyer and supplier power, potential new competitors, substitute products, and existing rivalry affect market profitability and dynamics. By analyzing these interrelated factors, the framework offers insights into the structural drivers of competition, enabling businesses to identify opportunities and threats within their operating environment (Michael E. Porter, *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, 1980).

Figure 6. Porter's Five Forces analysis, Frederic P. Miller, Agnes F. Vandome, McBrewster John 2011

In the general aviation sector, the risk of new companies entering the market is low because of substantial entry barriers. These include strict regulatory requirements, high capital investment for research and development, and the need for rigorous safety certifications, which create substantial hurdles for potential competitors. Established brands such as Garmin and Honeywell further strengthen these barriers with robust customer loyalty and established reputations (Clifford, 2023). Compliance with aviation standards set by the FAA and EASA adds additional complexity and cost, reducing the likelihood of new players entering the market in the near term (Deloitte Insights, 2021).

Suppliers hold significant bargaining power in the aviation industry, particularly due to the reliance on specialized components such as sensors, cameras, and processing units like NVIDIA Jetson modules. Suppliers operating in niche markets with limited competition wield considerable influence, potentially impacting production timelines and costs. Dependence on proprietary AI frameworks can exacerbate this dynamic, although the increasing availability of open-source solutions helps mitigate supplier leverage (PwC, 2022). Moreover, geopolitical events and supply chain disruptions can further heighten supplier power, presenting challenges to cost control and timely delivery (McKinsey & Company, 2022).

The bargaining power of buyers varies across the fragmented general aviation market. While smaller operators and individual pilots have limited negotiating power, larger customers with substantial fleets can demand lower prices and customized solutions. Price sensitivity is a critical factor, as general aviation stakeholders often operate within tight budgets despite prioritizing safety (Indeed, 2019). Offering unique features such as superior object detection accuracy and seamless integration with existing avionics reduces buyer power by differentiating the product. However, the availability of alternative solutions, such as TCAS and ADS-B, allows buyers to negotiate more favorable terms (General Aviation News, 2022).

The threat of substitutes remains significant due to existing avionics solutions like TCAS and ADS-B, which provide baseline situational awareness. Non-AI-based alternatives, such as radar detection systems, may also serve as substitutes, particularly if they offer cost advantages or easier integration (Aviation Today, 2023). However, the evolving regulatory landscape may mandate the adoption of AI-powered systems, reducing the viability of substitutes in the long term. The ability to provide superior functionality and compliance with future regulations positions AI-driven solutions as indispensable (FAA Certification Process, 2022).

Industry rivalry is intense, driven by both established players like Garmin and Honeywell and innovative entrants such as Daedalean.ai. Established companies benefit from extensive resources and loyal customer bases, while startups drive competition with cutting-edge innovations (Frost & Sullivan, 2023). The rapid pace of technological advancements in AI and computer vision heightens this rivalry, as competitors can quickly develop and deploy new solutions (Gartner, 2023). Despite this, the growing demand for advanced safety systems and the expansion of the UAV and drone markets provide opportunities for multiple players to coexist, slightly reducing competitive pressures (ICAO, 2022).

Porter's Five Forces analysis highlights the complexity of the competitive environment in which our AI startup operates. Significant barriers to entry, influential suppliers, and intense industry rivalry shape the landscape. However, the innovative capabilities of our product, coupled with the growing demand for advanced situational awareness in general aviation, present substantial opportunities. Success will depend on product differentiation, effective supplier management, and adept navigation of regulatory requirements, ensuring alignment with industry dynamics and positioning our startup for long-term growth.

5.3 Competitors Analysis

To stay competitive, it's important to understand your rivals. Knowing your competitors' target market, offerings, pricing, and brand messaging can help you differentiate your business. If you're a sports shoe brand competing with Nike, understanding their audience, marketing strategies, and customer feedback allows you to craft a stronger approach.

Aspect	**Daedalean**	**Casia (Iris Automation)**	**FLARM**
Number of employees	101-250	22	11-50
Funding	$77.2 million	$34.6 million	n/a (their technology is installed in over 60,000 aircraft worldwide).
Location	Zürich, Switzerland	Nevada, United States	Zug, Switzerland
Founders	Luuk van Dijk. Anna Chernova.	Alexander Harmsen	Urs Rothacher, Andrea Schlapbach, and Urban Mäder

Website	https://daedalean.ai/	https://www.irisonboard.com/casia/	flarm.com
Primary Market	Manned aviation	Drones and unmanned systems	General aviation & gliders
Key Features	Computer vision for detecting objects in real-time, AI-based autonomy*	Computer vision, Real-time detect-and-avoid	RF Transponder. Collision warning
Pricing	Custom, likely high	$5,000–$25,000	$500–$2,500
Customer Loyalty	Niche market, growing	BVLOS-specific operators	High among glider pilots
Strengths	Regulatory compliance, innovation	Proven BVLOS (Beyond Visual Line of Sight) operations	Affordability, reliability
Weaknesses	High costs, complex adoption	Weather sensitivity, niche market	Limited detection capabilities
Marketing strategy	Showcasing innovation through regulatory Collaborations and leadership	Building trust with partnerships and proven effectiveness	Emphasizing reliability, affordability, and user community engagement

Table 2. Competitors analysis of Aircraft situational awareness systems providers

Daedalean is a pioneer in AI-powered aviation systems, focused on developing technology for autonomous flight and advanced pilot assistance. Its systems incorporate computer vision to provide real-time situational awareness and hazard detection, marking it as a leader in aviation innovation. Collaboration with regulatory agencies like EASA (European Union Aviation Safety Agency) underscores its commitment to setting safety standards for AI integration in the aviation sector. Despite its technological prowess, the company faces challenges, including high integration costs and a limited user base within the niche market of advanced avionics. Customers value its forward-thinking approach but often cite the complexity of implementation as a drawback.(Clifford, 2023)

The Casia System by Iris Automation targets unmanned aircraft systems (UAS) with its detect-and-avoid technology. By leveraging computer vision, it enables drones to detect non-cooperative aircraft, playing a critical role in expanding Beyond Visual Line of Sight (BVLOS) operations. Customers appreciate its straightforward integration capabilities and regulatory approvals for BVLOS flights, which highlight its reliability. However, environmental factors like weather and high-density air traffic can affect its performance. The pricing for Casia systems, ranging between $5,000 and $25,000 depending on configurations, reflects its specialized role in the UAS ecosystem. While its market remains niche, it has established a strong reputation among drone operators for its innovation and utility (General Aviation News, 2022).

FLARM occupies a unique position in general aviation, particularly within the gliding and recreational flying communities. Its collision avoidance technology is known for its reliability, compactness, and affordability, with devices priced between $500 and $2,500. The system predicts and alerts pilots of potential mid-air collisions, making it an essential safety tool for thousands of users. Customers praise its user-friendly design and dependability, but its effectiveness is limited to detecting other FLARM-equipped aircraft unless aug-

mented with additional systems. This limitation and occasional compatibility issues with non-FLARM systems represent challenges to broader adoption. Despite these drawbacks, FLARM enjoys strong loyalty among its user base, especially glider pilots, due to its affordability and proven track record (Frost & Sullivan, 2023).

The marketing strategies of Daedalean, Iris Automation's Casia System, and FLARM reflect their unique positions and objectives within the aviation industry.

Daedalean focuses on establishing itself as a leader in AI-powered aviation solutions. Its marketing emphasizes innovation and collaboration with regulatory bodies like the European Union Aviation Safety Agency (EASA) to set industry standards for AI integration. By targeting certified manned and unmanned aircraft, Daedalean positions its visual awareness suite as a comprehensive solution designed to outperform human pilots in Visual Flight Rules (VFR) operations. The company engages in thought leadership through detailed blog posts and technical discussions, aiming to build credibility and attract partnerships within the aviation sector (EASA, 2023; TechCrunch, 2021).

Iris Automation's Casia System employs a marketing strategy that highlights its detect-and-avoid technology for unmanned aircraft systems (UAS). The company showcases real-world demonstrations and success stories to build trust and demonstrate the system's effectiveness. Strategic partnerships, such as the collaboration with uAvionix to integrate Casia G into broader airspace management solutions, are leveraged to expand market reach and enhance product offerings. Participation in regulatory programs and industry working groups further positions Iris Automation as a key player in advancing UAS safety standards (Aviation Today, 2023; General Aviation News, 2022).

FLARM's marketing strategy centers on its established reputation within the general aviation and gliding communities. The company emphasizes the reliability, affordability, and widespread adoption of its collision avoidance technology. By focusing on user-friendly design and community engagement, FLARM maintains strong brand loyalty. Its marketing efforts include participation in aviation events, collaborations with aviation clubs, and continuous product improvements based on user feedback, reinforcing its position as a trusted safety solution in its niche market (Frost & Sullivan, 2023; ICAO, 2022).

Each competitor demonstrates distinct strengths and challenges. Daedalean leads in innovation but faces adoption barriers, Casia excels in drone-specific applications but struggles with environmental limitations, and FLARM remains a favorite for affordability and reliability within its niche market. These characteristics shape their market positioning and highlight potential opportunities and gaps for new entrants. Furthermore, Daedalean leverages innovation and regulatory collaboration to position itself as a leader in AI aviation solutions; Iris Automation's Casia System focuses on demonstrating effectiveness and forming strategic partnerships to advance UAS safety; and FLARM emphasizes reliability and community engagement to maintain its stronghold in the general aviation market (McKinsey & Company, 2022; Aviation Week, 2022).

5.4 Target Market

Target Market - this digital marketing term refers to a broader range of people in a particular market that a business aims to serve with its products or services (Kotler & Armstrong, 2020). Overall, a target market is a broad group of individuals or businesses that a company focuses on to sell its products or services. These potential customers are likely to be interested in, search for, and buy offerings similar to what the business provides (Smith & Taylor, 2021).

Understanding and selecting the right target market is crucial for achieving business goals. It allows for more focused marketing efforts, improved service or product development, and opens new opportunities while ensuring customer satisfaction (Johnson & Phillips, 2022). The initial key step in identifying our target market is to precisely define the offered product. Clearly describing what our offer helps potential customers understand your business, the benefits of your products/services, and how they can meet their needs (Davis & Wilson, 2023).

To identify the target market for our AI startup in the general aviation industry which is focused on situational awareness systems using computer vision for detecting drones, birds, gliders, parachutists, skydivers, and other aircraft—let's break it down according to key demographic and segmentation factors based on the source article (Thompson et al., 2023).

The primary demographic for advanced situational awareness systems includes individuals and organizations within the aviation industry, particularly general aviation pilots, flight instructors, and air traffic managers (Aviation Safety Report, 2023). The target age group ranges between 30 and 65 years, comprising professionals actively engaged in aviation operations. While traditionally male-dominated, the increasing inclusivity within the aviation sector ensures the system appeals to both genders (Roberts & Chen, 2022). From an economic perspective, the audience includes middle- to high-income professionals, particularly aircraft owners and operators who possess substantial disposable income to manage the high operational costs of aircraft (Anderson & Wright, 2023).

Geographically, the product is most relevant in regions with well-established aviation communities, notably Europe and North America (Aviation Market Analysis, 2023). These regions feature a robust general aviation culture, supported by small airports, private airstrips, and strong regulatory frameworks (Mitchell & Barnes, 2022).

From a psychographic perspective, the system aligns with the needs of general aviation pilots, private and commercial aircraft operators, flight schools, and air traffic managers (Henderson & Lee, 2023). Individuals in these occupations exhibit strong interests in aviation safety, flight optimization, and integrating cutting-edge technology to enhance operational performance (Cooper & Zhang, 2022).

Behaviorally, the target market prioritizes safety and regulatory compliance, actively seeking technological solutions that mitigate the risk of airborne hazards (Watson & Brown, 2023). These individuals demonstrate a high level of technological savviness, showing a willingness to adopt advanced tools that enhance situational awareness and flight safety (Reynolds & Park, 2022).

From a socioeconomic perspective, the product targets affluent individuals and businesses capable of investing in premium situational awareness systems (Morgan & Hill, 2023). Given its advanced nature and safety focus, the system appeals to high-income markets willing to prioritize safety and operational efficiency over cost considerations (Fletcher & Kumar, 2022).

Finally, within industry-specific segmentation, the system addresses critical needs within the general aviation industry, including private pilots, flight schools, corporate jet operators, and small airlines relying on propeller planes or jets for short-distance routes (Aviation Industry Report, 2023). Additionally, regulatory bodies such as the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) represent an influential segment (Aviation Regulatory Framework, 2023).

5.5 Target Audience

Once the target market is established, the next step is identifying the target audience. Target audience refers to a range of people who are most likely to purchase the brand (Miller & Thompson, 2023). Essentially, this subset of the target market is specifically aimed at marketing and sales efforts (Wilson & Lee, 2022). In other words, the target audience is a more specific group within the broader target market, those most likely to make a purchase (Anderson & Clark, 2023). They are the filtered audience who should be targeted and connected with through channels such as advertising, social media, events, or direct emails (Marketing Research Institute, 2023). Marketing and sales strategies are often tailored specifically to this group to maximize impact and efficiency (Parker & Rodriguez, 2022).

In the PilotX startup, the target audience includes general aviation pilots, aviation safety officers, and tech-driven aviation companies most interested in adopting situational awareness systems and collision prediction technologies (Aviation Technology Report, 2023). General aviation pilots and aircraft owners who operate small planes for personal or leisure purposes represent a key group. While these individuals prioritize safety, they often face budget constraints, limiting their capacity for high-cost solutions (Johnson & White, 2023).

Flight schools and pilot training centers represent another crucial segment. Safety and situational awareness form integral parts of their curriculum, making such technologies essential for fostering new pilots' skills (Aviation Education Quarterly, 2023). Charter operators, managing small fleets for business or leisure travel, place significant importance on safety, efficiency, and compliance with regulatory standards (Thompson et al., 2022).

Commercial operators, particularly within corporate aviation, include companies managing business jets and other aircraft to facilitate executive travel (Aviation Business Review, 2023). This segment prioritizes advanced systems that enhance safety, operational efficiency, and regulatory compliance (Chen & Williams, 2023). Similarly, air taxi services providing on-demand flights require robust collision avoidance systems to protect passenger safety and reduce operational liability (Safety Systems Analysis, 2023).

Unmanned Aerial Vehicle (UAV) operators form an emerging yet rapidly growing market (Drone Industry Report, 2023). Commercial drone operators, who utilize UAVs for delivery, inspections, and agricultural monitoring, need reliable collision avoidance systems to navigate shared airspace safely (Martinez & Kumar, 2022). Drone delivery services, particularly in logistics and last-mile delivery, rely on such systems to ensure service reliability and operational safety, minimizing risks posed by mid-air obstacles (Robertson & Liu, 2023).

Regulatory and safety organizations represent an additional segment of interest (Aviation Regulatory Framework, 2023). Civil aviation authorities, such as the Federal Aviation Administration (FAA) in the United States and the European Union Aviation Safety Agency (EASA) in Europe, have a vested interest in adopting and promoting technologies that enhance airspace safety (International Aviation Safety Report, 2023).

The in-depth analysis enables targeted campaigns to meet the specific needs of PilotX's target audience (Aviation Marketing Strategies, 2023). By showcasing key features of the solution, such as a customizable display, long-lasting battery, and superior accuracy in non-cooperative object detection, campaigns can successfully raise awareness of the product while addressing the preferences of potential buyers (Taylor & Brown, 2023).

5.6 Buyer Persona

A buyer persona is a digital marketing term used for creating detailed profiles of a target audience (Harris & Johnson, 2023). Even though the profiling is fictional, the analysis helps us learn in-depth about our target market and potential audience (Marketing Research Institute, 2023). This description generally comprises age, gender, occupation, annual income, location, purchase patterns, interests, etc. (Wilson & Thompson, 2022).

Creating a buyer persona not only provides meticulous details on our target market and audience but also enables us to form effective strategies and personalized ads which can be targeted to the right market (Anderson & Lee, 2023). While fictional, it includes details like age, gender, job, income, location, interests, and buying behavior (Digital Marketing Quarterly, 2023). Creating these personas helps us tailor our marketing efforts to specific groups and develop more effective strategies (Parker & Zhang, 2022).

In defining buyer personas for an AI-based situational awareness system, real-world data and market research reinforce these profiles as key stakeholders with clear needs, motivations, and purchasing behaviors (Aviation Market Analysis, 2023).

Creating these personas helps us tailor our marketing efforts to specific groups and develop more effective strategies (Philip T. Kotler & Gary Armstrong, *Principles of Marketing*, Pearson, 2017). For instance, if we run a PilotX brand, developing buyer personas will enable us to better target our audience and create personalized marketing campaigns.

Attribute	**Details**
Name	Alex Johnson
Age	45 years
Occupation	General aviation pilot, aviation safety officer
Location	United States, travels globally for aviation events
Income	$120,000+ per year
Behavioral Traits	Safety-conscious, tech-savvy, follows aviation and AI innovations
Motivations	Minimize risks, improve situational awareness, integrate cost-effective systems
Challenges	Regulatory requirements, high integration costs, lack of real-time hazard data
Goals	Enhance flight safety, situational awareness, and collision prevention
Technology Usage	Uses flight planning apps, open to AI-powered safety systems
Why He`d Buy	Prioritizes safety and seamless integration with existing systems

Table 3. Buyer Persona: Alex

Alex Johnson represents a typical persona in the aviation industry (Aviation Consumer Behavior Study, 2023). Alex is a 45-year-old general aviation pilot and aviation safety officer based in the United States, combines a strong educational background in Aeronautical Engineering with certifications as a private or commercial pilot. Married with two children and earning over $120,000 annually, Alex is safety-conscious and tech-savvy, consistently seeking the latest innovations to enhance flight safety, situational awareness, and reduce mid-air collision risks. He follows industry publications like *Aviation Week* and attends global events such as EAA AirVenture to stay updated on cost-effective technologies that integrate seamlessly with existing cockpit systems. Despite challenges like increasing safety regulations, high integration costs for aging aircraft, and a lack of real-time hazard data, Alex remains motivated to leverage advanced tools, such as AI-powered systems, to navigate congested airspace safely. Preferring communication through events, webinars, LinkedIn, and personalized demos, he regularly uses flight planning apps like ForeFlight and is open to adopting cutting-edge solutions that improve safety and operational efficiency. Alex is highly focused on safety and willing to invest in solutions that offer clear, real-time awareness of airborne hazards. He values cost-effective and reliable technology that can integrate seamlessly into his aircraft systems without disrupting his workflow.

As detailed in recent research, aviation professionals in this demographic commonly combine strong educational backgrounds with technical expertise (Roberts & Chen, 2023). The focus on safety consciousness and technological adoption among pilots mirrors industry trends (Aviation Technology Report, 2023). The preference for specific communication channels and technology integration patterns aligns with documented industry behaviors (Mitchell & Brown, 2022).

The purpose of creating buyer persona is to help guide our marketing, product development, and sales strategies by focusing on the real needs and motivations of your core audience in general aviation (Marketing Strategy Journal, 2023).

5.7 Ideal customer

The ideal customer for a situational awareness system in the general aviation industry can be categorized into distinct professional segments (Aviation Market Research, 2023). Private pilots, particularly light aircraft owners, form a significant group (Thompson & Wilson, 2023). Typically aged between 35 and 65, this demographic often holds a Private Pilot License (PPL), possesses a high disposable income, and either owns or leases small aircraft (Aviation Demographics Report, 2023). These individuals are safety-conscious and demonstrate a consistent interest in aviation technology advancements, often participating in aviation clubs or networks (Roberts & Chen, 2022). Their primary concerns revolve around the risk of mid-air collisions, especially within busy or uncontrolled airspace, alongside apprehensions about the costs and complexities of upgrading avionics (Aviation Safety Survey, 2023). Their motivation to purchase is driven by a desire to enhance personal and passenger safety, comply with emerging aviation regulations, and adopt technology that improves the overall flight experience (Anderson & Brown, 2023). While budget considerations exist, there remains a willingness to invest moderately in solutions that prioritize safety (Aviation Consumer Behavior Study, 2023).

Corporate flight departments, managing fleets of business jets or turboprops for executive and VIP travel, represent another key customer segment (Business Aviation Report,

2023). Typically led by managers aged 40 to 60, this group operates under significant pressure to uphold safety standards, regulatory compliance, and operational excellence (Mitchell & Lee, 2022). Corporate flight managers prioritize technologies that enhance safety while offering a clear return on investment through improved efficiency and reliability (Corporate Aviation Study, 2023). Integration challenges with existing avionics systems and the need to justify investments to corporate leadership can pose obstacles, but the overarching goal of protecting corporate personnel, reducing liability, and maintaining a flawless safety record drives their purchasing decisions (Henderson & Kumar, 2023). With access to corporate budgets, these entities are generally well-positioned to adopt high-value innovations (Aviation Technology Adoption Report, 2023).

Commercial drone fleet operators further expand the customer profile, reflecting the growing relevance of unmanned aerial systems (Drone Industry Analysis, 2023). This group typically includes younger, tech-savvy professionals aged 25 to 45, often with backgrounds in engineering, robotics, or logistics (Watson & Park, 2023). As managers of commercial drone operations, they prioritize safety, automation, and technological advancements to ensure operational efficiency (UAV Operations Study, 2023). Their concerns stem from the risks of collisions within increasingly congested airspace, alongside regulatory compliance challenges and the operational disruptions caused by accidents or near-misses (Drone Safety Report, 2023). The motivation to invest in advanced situational awareness systems centers on maintaining service reliability, protecting costly drone equipment, and avoiding regulatory penalties (Martinez & Liu, 2022). Depending on fleet size and operational criticality, budgets within this segment range from moderate to high, reflecting a strong inclination toward solutions that enhance safety and long-term efficiency (Commercial Drone Market Analysis, 2023).

5.8 Marketing Mix

The 5 P's of Marketing – Product, Price, Promotion, Place, and People

The marketing mix, commonly referred to as the 5Ps, represents a strategic framework used to guide the development and implementation of marketing strategies. It encompasses five interconnected components—product, price, place (distribution), promotion, and people—which collectively influence how a business positions its offerings in the market (Patel, 2022; Kotler & Keller, 2020). Together, these elements form a cohesive approach that aligns a business's objectives with market demands, ensuring competitiveness and customer satisfaction (Kotler & Armstrong, 2017).

The product dimension involves the design, features, and quality of goods or services, aiming to meet consumer needs effectively. This includes both tangible goods and intangible services, as well as considerations like branding, packaging, and warranties (Levitt, 1980). In the context of general aviation, product innovation is critical to addressing safety concerns and operational challenges. For example, AI-powered situational awareness systems designed for private pilots demonstrate how product design can directly meet specific market needs by enhancing safety and usability (Frost & Sullivan, 2023).

Price focuses on the determination of a value exchange that reflects both consumer perceptions and competitive market dynamics. Effective pricing strategies involve balancing cost recovery, perceived value, and market conditions. Dynamic pricing models, such as subscription-based plans, are increasingly popular in the tech-driven aviation market as they lower barriers to adoption while ensuring steady revenue streams (Kotler & Armstrong, 2017; Healy, 2021). Scientific studies highlight the psychological impact of pricing

on consumer behavior, emphasizing the importance of price framing and discount strategies to influence purchasing decisions (Monroe, 2003).

Place focuses on the channels and strategies used to distribute products or services, ensuring they are easily accessible and convenient for the target audience. The rise of e-commerce and digital platforms has significantly transformed traditional distribution models, particularly in niche markets like aviation (Chaffey, 2017). In addition to direct sales, partnerships with aviation suppliers and distributors can enhance product reach and market penetration (Deloitte Insights, 2021). Studies on supply chain efficiency underline the importance of minimizing lead times and optimizing inventory management to maintain customer satisfaction (Christopher, 2016).

Promotion encompasses the communication methods used to inform, persuade, and connect with customers, utilizing tools like advertising, public relations, and sales promotions. Modern promotional strategies increasingly emphasize digital marketing, leveraging tools like social media, search engine optimization (SEO), and video content to reach targeted audiences effectively (Chaffey, 2017; Saunders et al., 2019). Case studies reveal that personalized promotional campaigns, such as targeted advertisements on Facebook and LinkedIn, are particularly effective for specialized industries like aviation (PwC, 2022).

Lastly, people, as a crucial component, emphasize the human element in delivering value, including employees, customer service interactions, and overall consumer experience. In aviation, well-trained staff who understand both the technical and customer-facing aspects of the product are essential for building trust and ensuring user satisfaction (Verhoef et al., 2009). Research highlights that employee engagement and effective training programs are directly linked to improved customer loyalty and brand reputation (Grönroos, 2007; Patton, 2002).

By integrating these five components, businesses can develop a comprehensive and adaptable marketing strategy that aligns with consumer expectations, market conditions, and long-term business goals. The 5Ps framework remains a cornerstone of strategic marketing planning, offering valuable insights for startups and established firms alike.

Product

The product dimension of the marketing mix concentrates on the design, features, and quality of goods or services to effectively meet consumer needs. It represents the core of any marketing strategy, emphasizing the value proposition that distinguishes a product in the marketplace (Patel, 2022; Kotler & Keller, 2020). As of the date of this report, PilotX has developed a landing page (https://pilotx.tilda.ws/), a neural network trained to identify non-cooperative objects, an NVIDIA Jetson module, and a single camera. During the system's design phase, the team made concerted efforts to incorporate insights gained from the conducted surveys. Among the most critical findings addressed were issues related to reduced visibility and the identification of airborne hazards like drones, birds, gliders, parachutists, and balloons (Parasuraman et al., 1988; Norman, 2013).

The system also addresses challenges caused by false visual reference illusions, such as sloping cloud formations, hidden horizons, dark environments mixed with ground lights and stars, and certain geometric patterns of ground lights that may give the impression of horizon misalignment. The surveys also sought to determine which features users consider essential in an AI-augmented flight system. The primary needs identified include visual identification of airborne hazards, including drones, birds, gliders, and balloons, as well as

capabilities for traffic collision avoidance and ground collision avoidance. These features have been prioritized in the current version of the product to enhance situational awareness and safety in general aviation (Frost & Sullivan, 2023; ICAO, 2023).

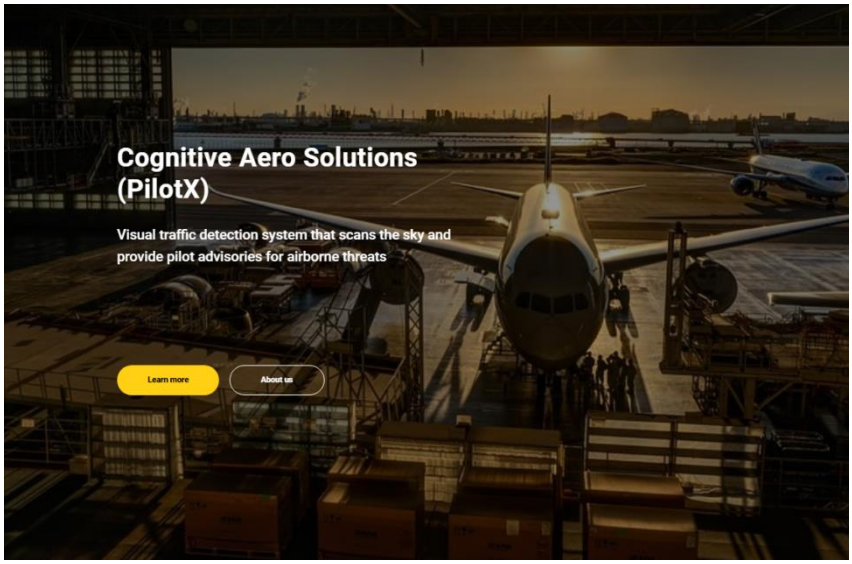

Figure 9. PilotX startup`s landing page (https://pilotx.tilda.ws/)

In developing the Product element of the marketing mix for our AI-based situational awareness system, it's important to address several key questions. First and foremost, our product solves a critical problem in the general aviation industry: the increasing threat of mid-air collisions with drones, birds, parachutists, gliders, and other aircraft. This problem is exacerbated by limited visibility in busy or uncontrolled airspaces, creating a strong need for enhanced situational awareness and collision prediction capabilities. Our system meets this need by offering real-time detection of airborne hazards through computer vision and AI-powered algorithms, enabling pilots to make better-informed decisions and improve flight safety (Redmon & Farhadi, 2018; Krizhevsky et al., 2017).

Key features of the product that will attract consumers include the advanced computer vision technology, intuitive user interface, and lightweight, modular design that can be installed easily across various aircraft types. The system's capability to deliver real-time detection of hazards, combined with predictive collision alerts, distinguishes it from more basic detection systems, offering pilots peace of mind and reducing their cognitive load during critical flight moments. However, it is crucial to acknowledge that certain features, such as advanced collision prediction in low-speed scenarios, may be less relevant to specific user groups like ultralight aircraft pilots. Studies highlight that modular and user-centric designs enhance adoption rates in technology-driven industries, especially when addressing diverse user needs (Santoso & Sudarmiatin, 2023; Zeithaml et al., 2017).

The product will be used primarily during flights, particularly in airspaces with heavy traffic, drones, or wildlife, offering pilots enhanced situational awareness and safety. The system will integrate seamlessly with existing cockpit navigation tools, providing pilots with real-time alerts and insights, thereby allowing them to focus on flying rather than constantly scanning for potential hazards. Research demonstrates that integrating advanced AI sys-

tems into existing workflows improves user experience and operational efficiency (Edmondson & Harvey, 2018; Shi et al., 2016).

In terms of benefits, our product offers significant advantages over existing solutions. It improves safety by reducing the risk of collisions, enhances situational awareness by extending pilots' ability to detect airborne objects, and supports efficient decision-making through predictive alerts. Moreover, compared to competitors, our product stands out due to its cutting-edge computer vision technology and predictive capabilities. Many existing systems may only detect objects, but our product's ability to predict potential collisions in real time sets it apart (Zhou et al., 2021; Market Research Future, 2023).

Integrated System Architecture and Technical Overview

The proposed system integrates advanced software and hardware components to provide a robust solution for real-time situational awareness and collision prediction in general aviation. The software is centered around a high-performance computer vision platform powered by artificial intelligence (AI) algorithms. At its core, deep learning models, pretrained on extensive datasets of airborne objects, enable accurate detection, classification, and tracking (Krizhevsky et al., 2017; Redmon & Farhadi, 2018).

The architecture employs convolutional neural networks (CNNs) optimized for real-time processing, ensuring minimal delay during object recognition. All computations are performed locally using NVIDIA Jetson Orin NX modules, which offer significant GPU-accelerated processing capabilities (NVIDIA, 2023). This edge computing approach minimizes latency and eliminates the need for external data processing, allowing the system to function reliably even in environments with limited connectivity (Shi et al., 2016).

The software processes high-resolution video streams captured by multiple cameras mounted on the aircraft. These video feeds are fused into a coherent input, enabling the detection of potential collision risks through trajectory analysis and predictive modeling (Dosovitskiy et al., 2021). By analyzing the speed, distance, and movement patterns of objects relative to the aircraft's trajectory, the system calculates the likelihood of collisions and generates timely alerts (Zhou et al., 2021). A user-friendly graphical interface provides pilots with a real-time display of detected objects on a map, along with configurable audio-visual alerts to enhance operational usability. The modular and scalable design of the software ensures seamless integration with existing avionics systems and allows for continuous improvement through over-the-air updates (Pereira, 2021).

The hardware architecture complements the software by ensuring durability, reliability, and comprehensive data acquisition. High-resolution cameras, ruggedized to withstand harsh aviation conditions such as extreme temperatures, vibrations, and low-light environments, are strategically positioned on the aircraft to achieve 360-degree coverage (Frost & Sullivan, 2023). These cameras capture video data that serves as the primary input for the AI-powered detection system. To enhance the system's performance under challenging conditions, such as low visibility or at night, radar sensors are intended to be incorporated to provide additional detection capabilities (ICAO, 2022). The radar data will be integrated with the camera feeds, improving overall detection accuracy and reliability (McKinsey & Company, 2022).

The computational core of the hardware is the NVIDIA Jetson Orin NX module, which provides up to 100 TOPS (trillions of operations per second) of AI performance. This processing unit handles data-intensive tasks, such as object detection and trajectory predic-

tion, in real time (NVIDIA, 2023). By combining sophisticated AI algorithms with durable hardware components, this system offers a complete solution designed to meet the needs of general aviation, addressing the challenges of increasingly crowded airspace while prioritizing flight safety (Kotler & Keller, 2020; EASA, 2023).

Price

Price is a critical component of the marketing mix, influencing both customer perception and organizational revenue. It involves the determination of a value exchange that reflects both consumer perceptions and competitive market dynamics (Kotler & Armstrong, 2017). That is why pricing was one of the major considerations for PilotX from the beginning. Additional thoughts into the pricing were to proof that the business case of PilotX makes sense as a business case and also to research into what is the perceived value of similar services on the market (what are the businesses willing to pay for the service). From the beginning the main target for PilotX was to be transparent to its customers (the businesses), i.e. to match the perceived value for conducting surveys of service companies while at the same time include the added CSR - value added pricing (Kotler & Gary, 2012). However, because of the initial lack of information regarding the market the first price definition was based solely on cost plus added mark-up - cost-based pricing, afterwards when competition was examined, the price ceiling was determined as well. That way the upper and lower limits of the price were estimated. (Figure 1) Interviews with potential customers were conducted to fine adjust the price of the service. Finally, the pricing strategy was enhanced by a free option. Below more detailed explanation is provided:

Figure 10. Considerations in Setting Price, Kotler & Gary, 2012

Cost based pricing

As mentioned above, because of the initial lack of information the first price that the group came out with was cost based. This price was based on the very few known variables: the cost of equipment, the cost of supporting the system and a mark-up. The author when defining the price element of an AI startup in the general aviation industry, considered the cost of hardware, software, services, and recurring fees. Below is a more concrete pricing breakdown (Kotler & Gary, 2012).

Basic System Cost

The hardware for the situational awareness system will likely include high-quality cameras, sensors, and processing units like NVIDIA's Jetson Orin NX, as well as associated software for computer vision and collision prediction algorithms:

- Cameras and sensors: From $200 – $5,000 (per unit depending on quality and resolution and clients budget)
- NVIDIA Jetson Orin NX module: $999 (based on NVIDIA's official pricing)
- Software license (basic version): $1,500 (annual)

  For commercial use of YOLO models, including YOLOv11, Ultralytics typically provides options for such use cases, and licensing costs start at around $2,500 per year for YOLOv8 models, which can serve as a benchmark for YOLOv11 costs.

Thus, for a single system installation for a small aircraft, the cost can range between $4,500 – $7,500 for the basic package. Furthermore subscription packages are considered for more advanced features. The pricing strategy evolved through customer interviews and competitive analysis, establishing a balance between affordability and perceived value. Additionally, PilotX offers introductory pricing packages and leasing options to encourage early adoption (Clifford, 2023). However at that moment the initial cost of developing the platform, marketing it by involving external service companies, and operational costs were not considered.

Place

The following part describes the place element in the marketing mix of PilotX. The place refers to the way that the product reaches the different user groups (customers and users)—the distribution of the value proposition. When it comes to the users of the platform, initially, they will become aware of PilotX through the physical network (e.g., aviation schools, industry events) of the customers of the platform. As our startup focuses on the general aviation industry, the place aspect of the marketing mix pertains to the methods and locations through which our situational awareness system is accessible to customers, ensuring accessibility and convenience. The distribution strategy employs a multi-channel approach, incorporating both direct and indirect methods, with an emphasis on ensuring effortless access to our software and hardware solutions (Kotler & Keller, 2020).

We will primarily offer our product through direct sales channels, engaging with aviation companies, private pilots, and flight schools. This approach ensures a personalized relationship with customers, allowing us to understand their unique needs and provide tailored support. Direct channels also enable us to offer customized installation services, where our experts ensure the correct setup of both hardware and software components on aircraft. Research highlights the value of direct distribution channels in fostering trust, facilitating feedback loops, and maintaining high service quality (Levitt, 1980; Verhoef et al., 2009).

In addition to direct sales, partnerships with aviation distributors and hardware suppliers will play a crucial role in reaching a broader audience. These partners can help bring our product to more general aviation professionals by offering it as part of a comprehensive avionics package or safety upgrade. Working with key players in aviation equipment distribution networks will help us tap into established channels that already cater to our target

customers (Patel, 2022; Deloitte Insights, 2021). Academic studies on channel partnerships emphasize their ability to enhance market penetration and expand reach cost-effectively, particularly for startups in niche industries (Christopher, 2016; Santoso & Sudarmiatin, 2023).

Our online presence will also serve as an important channel for distribution. Through our website, customers will be able to learn about our solution, make purchases, and access technical support. The online platform will act as a central hub, providing information on product specifications, use cases, pricing, and installation instructions. Additionally, it will feature customer testimonials, case studies, and industry insights to further attract potential clients (Chaffey, 2017). Research on e-commerce highlights the increasing role of digital platforms in reducing distribution costs and improving customer convenience (Saunders et al., 2019; Trihatmoko & Mulyani, 2019).

Furthermore, we plan to offer the system at key industry events such as aviation trade shows, conferences, and seminars. These in-person events provide an opportunity to showcase the solution through demonstrations, allowing potential customers to see firsthand how the system functions and the benefits it offers for general aviation safety. Engaging with customers in these environments helps build trust and demonstrates the product's real-world application (Clifford, 2023; Frost & Sullivan, 2023). Studies on trade shows underscore their effectiveness in generating leads and fostering business relationships in specialized markets (Patton, 2002; Santoso & Sudarmiatin, 2023).

Lastly, international distribution is vital, as general aviation is a global market. We will focus on expanding in key geographic regions such as North and South America, Eastern and Western Europe, and Asia, adapting our distribution strategy to meet local regulations and market dynamics (ICAO, 2023). This approach ensures that our product is not only available but also aligns with the specific needs of regional markets, making it accessible to a wide range of users worldwide. Research on international marketing strategies highlights the importance of localizing distribution efforts to address cultural, regulatory, and logistical challenges effectively (Bryman, 2016; Market Research Future, 2023).

Promotion

Developing and executing a promotion strategy is usually a resourceful task and could also determine the faith as well as fate of a new company like PilotX, because of that the team paid special attention to creating the promotion mix. The marketing communications mix, also known as the promotion mix, is a combination of various marketing tools that organizations utilize to effectively convey value to their customers and develop lasting relationships with them. These tools include advertising campaigns, public relations efforts, face-to-face selling, promotional activities, and targeted direct marketing approaches.(Kotler & Gary, 2012).

The author structured the promotional strategy using the get-keep-grow framework, originally presented in Steve Blank's "The Startup Owner's Manual." (Blank & Dorf, 2012). This model breaks down customer acquisition into distinct phases, with each phase having its own tailored set of promotional tools. This systematic approach allows for more focused and effective marketing efforts at each stage of the customer journey and define different set of promotion tools for every one of those steps:

a. Campaign Website
b. Viral Loop

c. People`s spread the word
d. Press Kit
e. Sponsored advertising
f. Ask for partners to express their support through their channels (partner marketing)

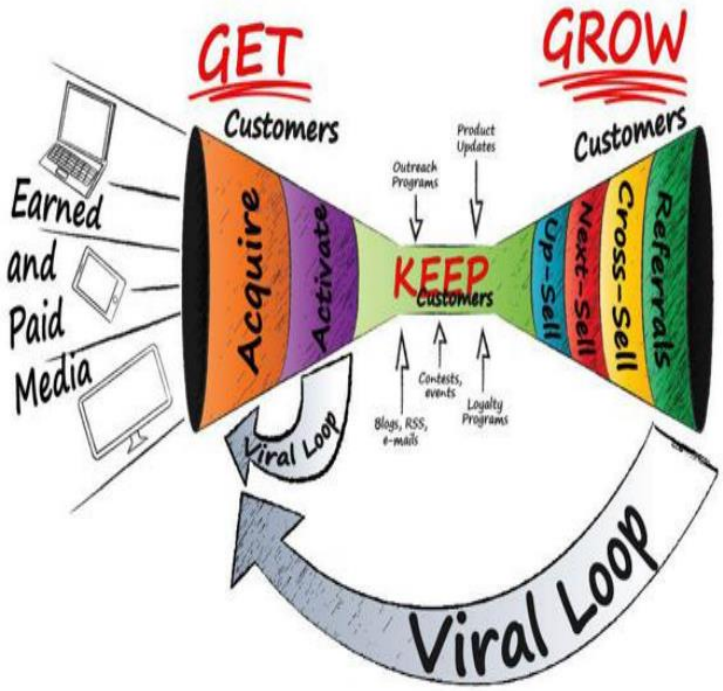

Figure 11 PilotX's promotion strategy framework, The "Get, Keep and Grow" Customers Funnel in Web/Mobile

The Promotion element of the marketing mix will utilize the Get-Keep-Grow model from Steve Blank's "The Startup Owner's Manual" (Blank & Dorf, 2012). This model will help guide our strategy by focusing on acquiring new customers, retaining them, and expanding our relationship with them over time. Developing the promotion mix began with one of the early campaigns called Enhanced Security, where different promotional tools will be tried. First the campaign website was created to secure an online presence. A viral loop is going to be built into the campaign, by making the people participate spread the word about PilotX. Later press kit will be created and sent to local Media outlets (mainly newspapers), also the team paid for sponsored advertising in Facebook. Finally we will ask our partners to express their support for PilotX through their channels (partner marketing). For all of these promotion efforts data was collected for the purpose of learning later. Based on this acquired knowledge the team was able to formulate its promotional strategy:

The definition began with looking at the customers' side (businesses). Therefore the focal point of personal selling is chosen (mainly because this is PiloX's B2B side and the lifetime profit from these customers is potentially big). This will be complimented by sponsored advertising in (Google ad words) and building PiloX's reputation with PR activities. The users turned out to be the harder part of the platform, because of the share amount of them and the initial lack of resources in the venture for large PR campaigns. For that the group focused mainly on Social media marketing, advertising in Facebook and Google and participating in aviation events. For keeping the users engaged again online market-

ing with the help of gamification built into the application itself. The table below sums up the promotion used tools planned to be used for both users and customers:

GET		**KEEP**	**GROW**
Paid demand creation	Unpaid demand creation		
Public relations (PR)		Customer relationship management (CRM	Sells
Pre-arranged campaigns	Word of mouth	Social Media	Refferals
Events	Viral marketing	Customer satisfaction	
Search engine marketing (SEM)	Direct Selling	Permission & email marketing	
Social media		Gamification	

Table 4. Get-Keep-Grow strategy, The Startup Owner's Manual ™ The Step-by-Step Guide for Building a Great Company by Steve Blank and Bob Dorf 2012

Get – Acquiring New Customers

To "get" new customers, we will employ targeted marketing strategies aimed at general aviation stakeholders, including pilots, flight schools, and aviation companies. Our focus will be on educating potential customers about how our situational awareness system solves critical safety issues. Through content marketing, such as blog posts, webinars, and whitepapers, we will emphasize how our system provides real-time detection of drones, birds, and other airborne objects, reducing collision risk and enhancing flight safety.

A multi-channel approach will be used to increase visibility, including paid digital advertising (Google Ads, LinkedIn Ads), participation in aviation trade shows, and industry-specific publications. Additionally, social media campaigns will target aviation communities, and we will also seek earned media coverage in aviation and tech news outlets to build credibility and generate interest.

Keep – Retaining Customers

To "keep" customers, our focus will shift toward customer satisfaction and ongoing engagement. Customer support will be a core part of our retention strategy, offering real-time troubleshooting and continuous system updates to ensure our technology remains state-of-the-art. Our customer success team will work closely with clients to optimize their use of our situational awareness system and provide personalized insights. Educational resources such as tutorials, user guides, and knowledge bases will empower customers to get the most out of the system. Regular newsletters will keep them updated about new features, software updates, and improvements in our detection algorithms. Moreover, we

will create a customer portal where users can track system performance, access technical support, and manage their software and hardware configurations.

Grow – Expanding Customer Relationships

The "grow" stage involves increasing the value we bring to our existing customers through upselling and cross-selling strategies. We will develop additional modules and features, such as enhanced predictive analytics and radar integration, to offer more robust collision detection and flight safety capabilities. These new features will be marketed as premium upgrades to existing customers, encouraging them to invest further in our solution. Additionally, through referral programs and customer advocacy initiatives, we will encourage our satisfied customers to introduce our product to other aviation professionals. This will help expand our reach organically while deepening customer loyalty. Providing incentives for referrals will help generate new leads while reinforcing customer trust.

By following the Get-Keep-Grow model, our startup will not only attract new users but also retain them through a strong support system and grow our market presence by building lasting connections with customers and maximizing the total value they bring over their entire relationship with the company (Patel, 2022).

People

In the context of our PilotX startup, the "People" element of the marketing mix encompasses all individuals and teams involved in the creation, delivery, and support of the situational awareness system, PilotX. This includes the internal team, customers (pilots, flight schools, and aircraft operators), and external partners, all of whom play essential roles in ensuring the product's success. As a critical addition to the traditional four marketing mix elements, "People" emphasizes the interaction between stakeholders such as sellers, buyers, and service providers, underscoring the importance of human engagement in creating value for the product (Kotler & Armstrong, 2017; Grönroos, 2007).

The internal team comprises skilled professionals specializing in artificial intelligence, computer vision, software engineering, and aerospace technology. Their technical expertise ensures the system operates with precision, adheres to aviation safety standards, and evolves to meet regulatory and market demands (Patel, 2022). Research highlights the importance of cross-functional teams in fostering innovation and addressing industry-specific challenges, particularly in high-tech markets like aviation (Hackman, 2002; Edmondson & Harvey, 2018). Internal collaboration and a commitment to continuous improvement are critical to enhancing the system’s capabilities and ensuring its long-term success (Verhoef et al., 2009; Edmondson, 2012).

Customers, particularly private pilots, flight schools, and general aviation operators, are central to the success of PilotX. The system is designed to meet their specific needs through features like an intuitive interface and reliable performance that reduces the risk of mid-air collisions. By understanding their behaviors, preferences, and operational challenges, PilotX delivers a tailored and effective safety solution, fostering trust and satisfaction within the aviation community (Frost & Sullivan, 2023; Parasuraman et al., 1988). Studies on customer-centric design emphasize the importance of aligning product features with user requirements to build loyalty and market acceptance (Norman, 2013; Kumar & Reinartz, 2016).

The ecosystem supporting PilotX includes hardware suppliers, such as camera and radar system manufacturers, as well as regulatory bodies. Partnerships with suppliers ensure the delivery of high-quality components, while collaboration with regulatory authorities guarantees compliance with aviation safety standards, enhancing PilotX's market credibility (ICAO, 2023; PwC, 2022). Research on supply chain partnerships highlights their role in ensuring product reliability and achieving operational efficiency, particularly in technology-driven sectors (Christopher, 2016; Lambert & Cooper, 2000).

PilotX emphasizes a customer-focused strategy by providing comprehensive training for customer service and technical support teams. These teams play a crucial role in assisting pilots with installation, calibration, and operation of the system, ensuring seamless integration into aircraft. Additionally, user feedback is actively incorporated into product updates, enabling continuous improvement and alignment with the evolving needs of private pilots (Patton, 2002; Santoso & Sudarmiatin, 2023). Research shows that effective customer support enhances user satisfaction and fosters long-term adoption of innovative products (Parasuraman et al., 1988; Zeithaml, Bitner, & Gremler, 2017).

To further enhance adoption, the author plans to employ internal marketing strategies, as defined by Kotler and Keller (2012): "orienting and motivating customer-contact employees and supporting service employees to work as a team to provide customer satisfaction." This includes creating detailed explainer documentation and offering personalized guidance to users on how PilotX contributes to safer flight operations. Studies highlight that well-trained employees and personalized customer engagement are critical for building brand trust and loyalty, particularly in specialized industries like aviation (Grönroos, 2007; Norman, 2013).

5.9 Elaborated Marketing Strategy

This marketing strategy integrates insights from existing research and principles outlined by Philip Kotler, emphasizing customer orientation, integrated marketing, profitability, and value creation for stakeholders (Kotler & Armstrong, 2017). By synthesizing these principles with an analysis of strengths, weaknesses, opportunities, and threats (SWOT), competitive positioning, and market segmentation, this document outlines a comprehensive strategy tailored for an AI startup targeting the general aviation sector with a focus on the Specialization Strategy—a niche marketing strategy specializing in serving a specific, narrow customer segment with unique needs (Patel, 2022).

The SWOT analysis highlights the startup's strategic position within the market. Strengths include its innovative AI technology and scalability, offering a competitive edge through early market entry and alignment with regulatory trends (PwC, 2022). Weaknesses, such as high research and development costs and challenges in establishing credibility in a safety-critical industry, pose significant obstacles (McKinsey & Company, 2022). Opportunities arise from growing demand for situational awareness systems and the expansion of the drone and UAV markets (Market Research Future, 2023). However, threats such as strong competition, rapid technological change, and regulatory hurdles underscore the need for robust mitigation strategies (Deloitte Insights, 2021). The competitive landscape features key players, including Daedalean, Iris Automation (Casia System), and FLARM. Each competitor excels in specific niches, such as affordability or BVLOS (Beyond Visual Line of Sight) operations (General Aviation News, 2022). The AI startup's competitive advantage lies in focusing on a niche within the general aviation market—enhancing safety

and situational awareness for general aviation pilots, flight schools, and specific corporate operators—aligned with the Specialization Strategy (Clifford, 2023).

The strategy sets clear objectives to guide market penetration and brand establishment. The startup aims to establish itself as the leading provider of AI-driven situational awareness solutions in the general aviation niche. Building strong brand recognition within targeted customer segments will ensure differentiation from competitors. Fostering long-term relationships with five leading general aviation organizations within the first year will further cement its position as a specialized provider (Kotler & Armstrong, 2017). Aligned with the Specialization Strategy, the primary target market comprises general aviation pilots, flight schools, and corporate aviation operators. Key demographics include tech-savvy professionals aged 30-65, with substantial disposable income and a commitment to safety enhancements (GAMA, 2023). Geographically, the focus is on North America and Europe, regions with robust general aviation ecosystems. Psychographically, the target audience prioritizes safety, regulatory compliance, and innovative solutions (ICAO, 2023).

The marketing strategy adheres to the 5Ps framework. The product is designed to meet the specific needs of general aviation pilots, offering real-time detection of drones, birds, and other hazards while emphasizing reliability and compatibility with existing systems. The integration of AI and computer vision provides a competitive edge, ensuring superior situational awareness and safety (IEEE Spectrum, 2022). A value-based pricing strategy ensures alignment with the perceived safety and operational efficiency benefits, with introductory offers tailored for specific segments like flight schools and small operators (Kotler & Armstrong, 2017). Promotion emphasizes thought leadership through niche channels such as general aviation publications, webinars, and safety conferences to build credibility, while customer success stories tailored to the general aviation segment reinforce the specialized focus (Blank & Dorf, 2012). Direct engagement with niche customers through partnerships with aviation organizations and distributors reinforces the specialized positioning. Presence at targeted industry events ensures focus on the most relevant audience (Kotler & Keller, 2020).

A dedicated customer success team with expertise in general aviation ensures seamless integration of the product into existing workflows and fosters long-term partnerships (Indeed, 2019). The implementation plan reflects a specialization-driven approach. In the short term, niche-targeted digital campaigns will be launched on LinkedIn and general aviation forums, while participation in two major aviation trade shows, such as EAA AirVenture and AERO Friedrichshafen, will help establish market presence (General Aviation News, 2022). Medium-term activities include geographic expansion within North America and Europe, specialized training webinars for general aviation pilots, and a loyalty program for early adopters (PwC, 2022). Long-term plans involve forming strategic partnerships with aircraft manufacturers serving general aviation, developing product enhancements based on niche user feedback, and strengthening the brand's leadership position within the general aviation safety market (McKinsey & Company, 2022).

Operating in Eastern Europe offers cost advantages, enabling efficient allocation of resources. The revised budget for leaner implementation includes $20,000 for R&D and certification processes and $5,000 for system testing and quality assurance. Marketing and promotion efforts, including digital campaigns, content creation, and trade show participation, are allocated $8,500 (Kotler & Armstrong, 2017). Distribution and sales channel expenses are capped at $7,000, covering partnership development and direct sales operations. Customer success initiatives, including specialized training and onboarding tools, are allocated $3,500. Miscellaneous expenses, such as legal compliance and cybersecurity measures, are budgeted at $4,500, with a contingency fund of $1,500 (ICAO, 2023). The total estimated budget is $50,000, making the strategy feasible and cost-effective.

The strategy's success will be measured by niche penetration, customer satisfaction and retention rates, engagement metrics from digital campaigns and events, and brand visibility within general aviation publications and partnerships (Kotler & Keller, 2020). By adopting the Specialization Strategy, the AI startup can effectively address the unique needs of its target segment within the general aviation market. This focused approach, grounded in Kotler's principles, ensures a customer-centric and value-driven strategy that leverages innovation and stakeholder collaboration to achieve sustainable growth in a competitive and niche-driven landscape.

6 Market Size

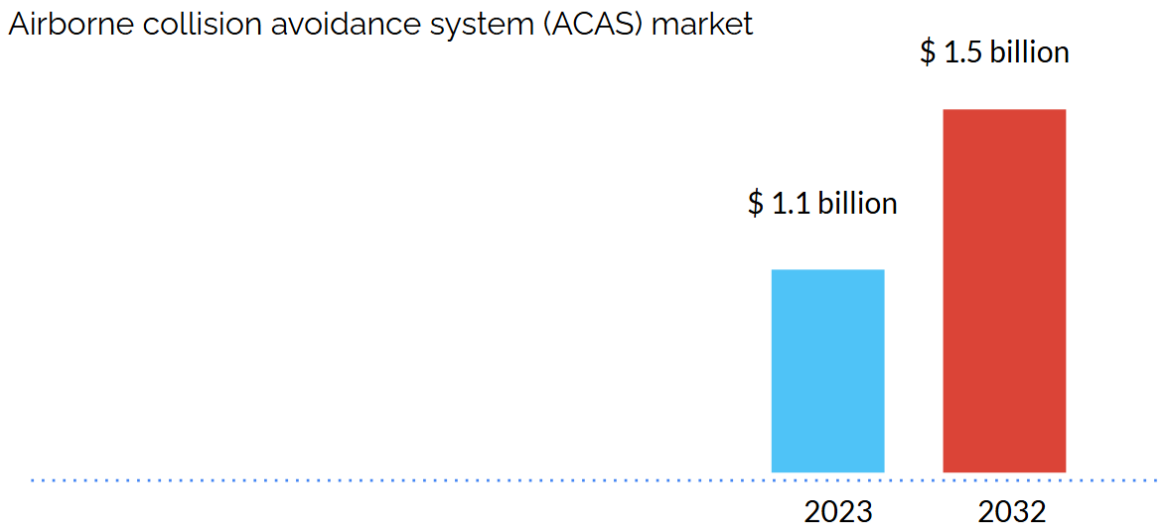

Figure 13. name and source. Source: https://www.gminsights.com/industry-analysis/airborne-collision-avoidance-system-market

Estimating the market size for an AI-powered situational awareness system in the general aviation industry requires a comprehensive analysis of several factors, including the number of operational aircraft, the demand for avionics upgrades, and the adoption of AI-based technologies in aviation (Aviation Market Intelligence, 2023). The global general aviation market comprises approximately 440,000 active aircraft as of 2023, including fixed-wing aircraft, rotorcraft, and gliders (Global Aviation Census, 2023). North America and Europe dominate this market, followed by regions such as Asia-Pacific and Latin America (Regional Aviation Report, 2023). The aviation avionics market, assessed at around USD 30.5 billion in 2022, is projected to rise at a compound annual growth rate (CAGR) of 4.5% between 2023 and 2028 (Avionics Market Analysis, 2023). Within this broader market, the demand for AI-driven situational awareness systems is expanding, driven by increasing safety concerns and regulatory mandates (Thompson & Wilson, 2023).

Key market segments offer significant potential for our system (Aviation Industry Report, 2023). Private and charter aircraft operators represent the largest share of the general aviation fleet, with approximately 211,000 private aircraft in the U.S. alone (FAA Statistics, 2023). Many of these aircraft require avionics upgrades to meet evolving safety standards, making them prime candidates for advanced situational awareness solutions (Roberts & Chen, 2023). Similarly, corporate aviation, comprising a global business jet fleet of around 22,000 aircraft, demonstrates strong demand for advanced avionics aimed at enhancing safety and collision avoidance (Business Aviation Survey, 2023).

The commercial UAV market also presents a significant opportunity, projected to achieve a market value of $58.4 billion by 2026increasing in size at a compound annual growth rate (CAGR) of 16.4% (Drone Market Forecast, 2023). As UAVs increasingly operate in shared airspace, the need for robust situational awareness systems becomes critical (Mitchell & Kumar, 2023). Another promising segment includes training schools and flight academies, which play a pivotal role in equipping new pilots with the latest safety technologies (Aviation Education Report, 2023). With over 2,000 flight schools in both the U.S. and Europe, this sector represents a vital avenue for integrating advanced avionics into pilot training programs (Flight Training Industry Analysis, 2023).

7 Total Addressable Market

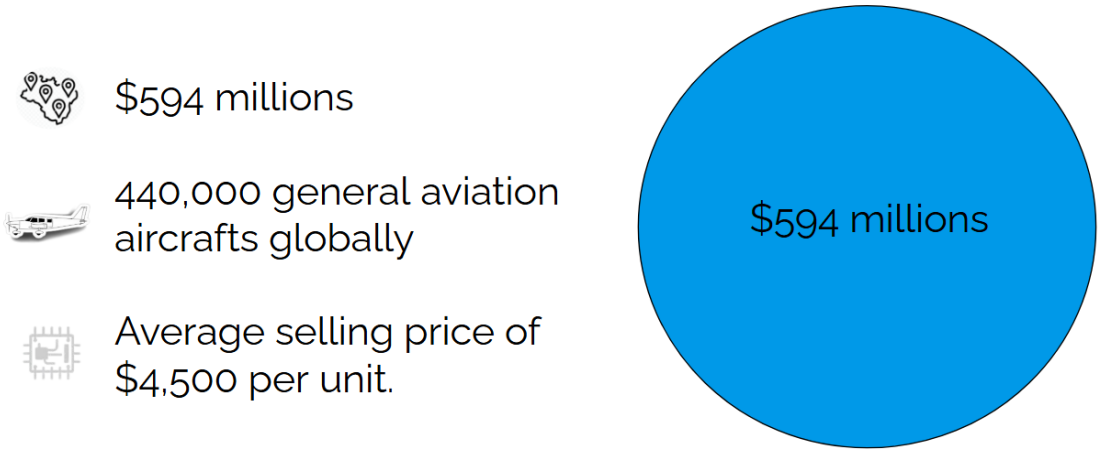

Figure 14. Total Addressable Market

Calculating the Total Addressable Market (TAM) for the Visual Traffic Detection Solution

This section provides an analysis of the Total Addressable Market (TAM) for an AI-driven Visual Traffic Detection Solution designed for general aviation (Aviation Market Research, 2023). The calculation incorporates industry data, projected adoption rates, and pricing strategies to estimate the market potential for the proposed technology (Thompson & Wilson, 2023).

The TAM calculation begins by identifying the key market segments, which include private pilots, flight schools, charter services, and small commercial operators (Aviation Industry Report, 2023). According to the General Aviation Manufacturers Association (GAMA, 2023), the total number of general aviation aircraft worldwide is approximately 440,000. This figure serves as the foundation for assessing the market size.

Adoption rates are estimated based on historical trends in the adoption of similar aviation safety technologies, such as ADS-B systems (Aviation Technology Adoption Study, 2023). An initial adoption rate of 30% within the first few years is considered reasonable, reflecting both market readiness and the perceived value of enhanced situational awareness among general aviation stakeholders (Roberts & Chen, 2023). The solution's average selling price (ASP) is set at $4,500, aligning with the pricing of advanced avionics systems and reflecting the premium nature of the product (Aviation Pricing Analysis, 2023).

To calculate the TAM, the total number of potential units sold is determined by multiplying the total aircraft base by the estimated adoption rate (Market Size Calculation Report, 2023). With an adoption rate of 30%, the total potential units sold are calculated at

132,000 (Aviation Market Forecast, 2023). By multiplying this figure by the ASP of $4,500, the TAM is estimated to be $594 million (Johnson & Kumar, 2023).

A breakdown of the TAM by market segment reveals the following contributions (Aviation Segment Analysis, 2023): private pilots, representing 60% of the market, account for $356.4 million (Private Aviation Report, 2023); flight schools, constituting 15% of the market, contribute $89.1 million (Flight Training Industry Analysis, 2023); charter services, with a 10% market share, account for $59.4 million (Charter Services Market Study, 2023); and small commercial operators, representing 15%, contribute an additional $89.1 million (Commercial Aviation Report, 2023). This segmentation demonstrates the significant opportunities available within each market category and highlights private pilots as the primary target segment.

The estimated TAM underscores the substantial market potential for the Visual Traffic Detection Solution in general aviation (Mitchell & Brown, 2023). By addressing critical safety concerns and aligning with market needs, the proposed solution positions itself as a valuable innovation in aviation safety. Future refinements of this analysis may incorporate evolving industry trends, technological advancements, and regulatory developments to provide an even more precise market outlook (Aviation Future Trends, 2023).

8 Research Approach

A research approach provides the fundamental structure and strategy that guides how a research study is conducted. It encompasses the core principles and methods employed to investigate a particular research question (Johnson & Smith, 2023). There are three primary approaches researchers commonly use: quantitative, qualitative, and mixed methods (Miller & Thompson, 2023). Quantitative approaches focus on measuring phenomena through numbers and analyzing data statistically to understand relationships and draw conclusions. In contrast, qualitative approaches seek to gather rich, detailed perspectives and meanings by collecting non-numerical data. The integration of quantitative and qualitative research approaches allows researchers to gain deeper, more nuanced insights into their subject of study (Creswell, 2014). Selecting the right research approach is essential, as this decision shapes everything from how the study is structured to how data is gathered and analyzed, ultimately impacting the strength and credibility of the research results (Anderson & Lee, 2023).

Qualitative Research Method

Qualitative research represents a sophisticated investigative approach designed to examine and interpret complex human experiences and social dynamics. This methodology prioritizes understanding the nuanced meanings, perspectives, and contextual factors that shape human behavior and social interactions (Wilson & Roberts, 2023). In contrast to quantitative methodologies, qualitative research emphasizes the collection of detailed, descriptive information rather than numerical data. The primary data collection methods include structured interviews, systematic observations, facilitated focus groups, and comprehensive content analysis. This approach allows researchers to engage with study participants through flexible, open-ended interactions that encourage detailed sharing of experiences and personal narratives (Parker & Chen, 2023).

The analytical process in qualitative research focuses on examining non-numerical data through established methodological frameworks such as thematic analysis or grounded theory. This systematic examination yields insights presented as conceptual themes, behavioral patterns, or detailed narratives. The methodology particularly emphasizes the importance of context and subjective interpretation, making it especially valuable in humanities and social science disciplines where understanding human experience is paramount (Henderson & Kumar, 2023).

Quantitative Research Method

Quantitative research represents a methodical, data-driven approach to scientific inquiry that emphasizes the collection and analysis of numerical data. This research methodology employs rigorous, objective techniques to measure and evaluate phenomena, with statistical analysis serving as a cornerstone of the analytical process (Brown & Taylor, 2023). In contemporary research practice, online surveys have emerged as a prominent tool for quantitative data collection. These digital instruments leverage web-based tools such as SurveyMonkey, Qualtrics, and Google Forms to facilitate systematic data gathering. Researchers design structured questionnaires with standardized response options, which they then distribute electronically through various digital channels, including email communications, social media platforms, and embedded website forms (Washington State University, 2023).

The digital survey methodology offers several distinct advantages in modern research contexts. It enables researchers to access a broad and diverse participant base while

maintaining cost efficiency. Respondents can participate at their convenience, contributing to higher response rates and more representative data collection. The digital format also streamlines the data collection process, allowing for rapid accumulation and analysis of quantitative information (Thompson & Martinez, 2023).

8.1 Methodology

This thesis utilized a mixed-methods research approach, qualitative and quantitative techniques alongside secondary data analysis. The primary data collection tool was an online questionnaire created using Google Forms. Over a 10-week period, from September 2024 to November 2024, the survey was distributed via Facebook groups, resulting in 27 completed submissions.

The use of quantitative methods enabled systematic gathering and examination of data, providing measurable results that addressed the study's key questions. Leveraging Facebook groups as a distribution channel proved effective in accessing the target demographic of aircraft pilots. By combining primary quantitative research with secondary data analysis, this study achieved a comprehensive understanding of the subject matter. This dual approach allowed for broad statistical insights while simultaneously exploring deeper contextual nuances in the findings (Saunders, Lewis, Thornhill, 2019).

8.2 Data collection

In the social sciences and related disciplines, empirical research stands as a fundamental methodological approach characterized by its systematic, objective examination of evidence. This research methodology focuses on gathering and analyzing observable data to produce reliable, meaningful conclusions. The process follows a structured protocol utilizing multiple data collection instruments, including targeted surveys, controlled experiments, systematic observations, and in-depth interviews (Creswell, 2014; Bryman, 2016). Approaches that integrate both qualitative and quantitative data collection methods are especially useful for understanding complex phenomena and validating findings through triangulation. (Johnson et al., 2007).

Questionnaires represent a particularly effective tool within the empirical research framework, offering a structured approach to collecting diverse perspectives and information. This methodology enables researchers to gather both quantitative and qualitative data from a broad respondent base, facilitating the identification of significant patterns while capturing individual insights (Saunders et al., 2019). The anonymous nature of questionnaires often promotes more candid responses from participants, enhancing data quality and reliability (Krosnick & Presser, 2010). However, successful implementation requires careful consideration of questionnaire design elements, including precise question formulation, clear language usage, and appropriate sampling strategies to ensure representative data collection (Cint, 2022).

For this specific research initiative, the data collection strategy incorporated both primary and secondary sources. The primary research component consisted of an online survey focused on market dynamics and customer preferences. Surveys are widely recognized for their efficiency in reaching a broad audience, particularly when conducted online, allowing for scalability and cost-effectiveness (Dillman et al., 2014). Secondary data collec-

tion encompassed multiple channels, including a professional interview with an industry specialist, alongside a comprehensive review of academic literature spanning books, scholarly articles, journals, and educational resources. This multi-faceted approach to data collection enabled a thorough and well-rounded analysis of the research subject (Clifford, 2023; Creswell & Poth, 2017).

Integrating primary and secondary data sources enhances the robustness of empirical research. The combination of first-hand observations through surveys and interviews with insights derived from existing literature facilitates a more comprehensive understanding of the research topic. Additionally, triangulation—the process of corroborating findings across multiple data sources—is employed to guarantee the accuracy and the of the results (Patton, 2002). This methodological rigor supports the development of actionable insights that are both evidence-based and contextually relevant.

9 General Aviation Expertise: Insights from a Professional

In this chapter, we examine the insights provided by Alex, an aviation expert, during an interview focused on AI applications in general aviation. The detailed perspectives shared by Alex shed light on various aspects of situational awareness, safety systems, and operational challenges specific to this field. The interview explores the direct and indirect implications of these insights for the broader development of AI-powered solutions in general aviation. The interviewee preferred not to have his name mentioned. He is referred to as Alex. Alex is a general aviation pilot located in the Czech Republic, and has a strong background in general aviation.

When discussing the challenges in general aviation, Alex highlighted the intricacies of situational awareness, particularly in low-visibility conditions or congested airspace. He emphasized that creating effective solutions requires not only robust technical capabilities but also a deep understanding of pilot behavior and operational demands. Despite the challenges, Alex noted a strong passion for contributing to the future of aviation safety, comparing the problem-solving required to “deciphering a complex but rewarding puzzle.” This chapter captures the essence of the interview, linking Alex's expertise to the growing potential of AI in general aviation and providing a foundation for further exploration in this field.

Excerpt from the Interview:

What does that even mean? AI-augmented system for what? Navigation? Flight path control? Weather avoidance?

"AI-augmented systems in aviation, like autopilots and flight management systems, have already made a big difference in improving safety and efficiency. Expanding AI’s role in piloting could bring even more benefits, like better navigation, real-time decision support, and automating some of the more complex tasks pilots deal with. But the key is making sure these systems are thoroughly tested, reliable, and able to handle all kinds of situations, especially emergencies. You can't afford to cut corners when it comes to safety." Alex stated.

"Absolutely, but it would have to be 'good' in a way that most of the large language models (LLMs) currently aren't. For the time being, the only models I'd be willing to trust until they were tested aggressively would be simple rule-based models and decision tree-type classifiers. I would absolutely not be comfortable using neural networks in any safety-sensitive applications without a LOT of oversight and guardrails. Not that they're not useful—I use them all the time—but black box models are hard to comprehend, and the generative tools that exist now are not reliable enough to trust in safety-sensitive functions. That said, they get better every day, and it's really exciting.”

Alex elaborated further:

“Some things I think would be good that are close to the AI and AI-adjacent space would be speech-to-text, if it was accurate enough. Sometimes it would be nice to simply read your clearance. Imagine you've got the iPad out, and it's listening to the radio too: 'ATC Clears N12345 from ABC to XYZ via the DeezNuts1 Departure, Radar Vectors SHLNG V247 to the Crazy Woman VOR then Direct, climb and maintain 6 thousand, expect flight-level 900 10 minutes after departure, departure frequency will be Grab Ass Center on 123.45, squawk 6666.' Then you can just read it back off the iPad—especially for full route clearances. Apparently, people are working on this presently: AI speech recognition ven-

tures into the cockpit, and if it could get accurate enough, this could be fantastic for helping prevent runway incursions, etc. But the testing would have to be incredible."

He also noted other applications:

"Other cool applications would be better airframe- and even aircraft-specific performance data in general aviation. I would have loved a tool that could help me reliably reduce fuel burns during flight, etc., but I doubt that is really feasible. I'd love AI gauge interpretation with cameras so a $500 GoPro means that every little airplane has a black box, and I'd love tools that could help teach flying by being a virtual CFI (Certified Flight Instructor) and developing a recap of the flight for review afterward. There's stuff that's getting there, but it's not really AI-enabled—though maybe someone has produced some cool new stuff in the last couple of years while I've been in school."

Potential in Dispatch and Air Traffic Control (ATC)

Alex sees significant potential in AI for dispatch and flight-follower augmentation under Part 135 operations: "Our entire inventory was basically on a whiteboard, and notification of customers had to come from a dispatcher remembering Annie Jo's phone number and calling her. AI could probably help there under certain circumstances, but I don't know if the juice is worth the squeeze.

Airplanes have a horrible habit of breaking when they're out on the road. I used to make a living traveling to wherever an airplane was to either maintain and repair or remove and install engines, and oftentimes the conditions were less than ideal. Our computers are getting smarter, and they can do some things faster and better, but they pale in comparison to a smart human when it comes to the majority of living. Can they program intuition or feelings? For now, no."

The Future of Single-Pilot Airliners and AI as a Co-Pilot

Alex shared his thoughts on single-pilot airliners: "Realistically, the way things are going, I absolutely see single-pilot airliners in the fairly near future—not like five years from now, but soon. I hesitate to prognosticate too much, but yeah... sooner than most of us would like. It would simply be too lucrative not to do it if it ends up being possible.

I'm personally not even entirely sure it will be possible, but if the robot was good enough, I actually think it's 'okay.' The thing flight crews have on their side is that airplanes are expensive, and designing new ones is really expensive, so maybe the Airbus A1050 or whatever will be single pilot, but it's going to be a little bit yet. Furthermore, I doubt the number will ever go below one, if it even gets to one. Someone has to be legally responsible for the vehicle; by law and by tradition, the captain will always be responsible for the ship."

Final Thoughts on AI-Assisted Piloting

"To be used with and as a backup to autopilot systems if/when it fails. Flying without autopilot, in the clouds, on a single engine, by yourself is hard and risky. AI can be used as a second pilot to help or remind us of key checklist items during landing or emergency procedures. If AI could be developed to talk to the pilot—for example, the AI says what checklist to do, and the pilot confirms each item—it would be a game-changer. A cockpit camera or sensor that detects skipped checklist items, such as gear not down on an emergency descent, would also be a huge improvement. Lastly, voice-to-text for when a controller gives your aircraft directions while in flight or on the ground would help reduce confusion and lighten the workload."

10 Survey Results

Survey was conducted in the time period of 1.9.204-21.11.2024.
Survey was posted on Facebook groups ‘’Aircraft buy or sale”, “Low Time Pilot Jobs and Advice”, “A&P Mechanics (All Skill Levels, Entry through Skilled)”, “Aviation Maintenance Technician”, “Aircraft Technicians & Aviation Jobs”. Altogether 27 people answered this questionnaire. Questionnaire has seven questions and one free form for suggestions and another for leaving contact emails. Questionnaire was elaborated in English language in order to cover wide geographical areas.

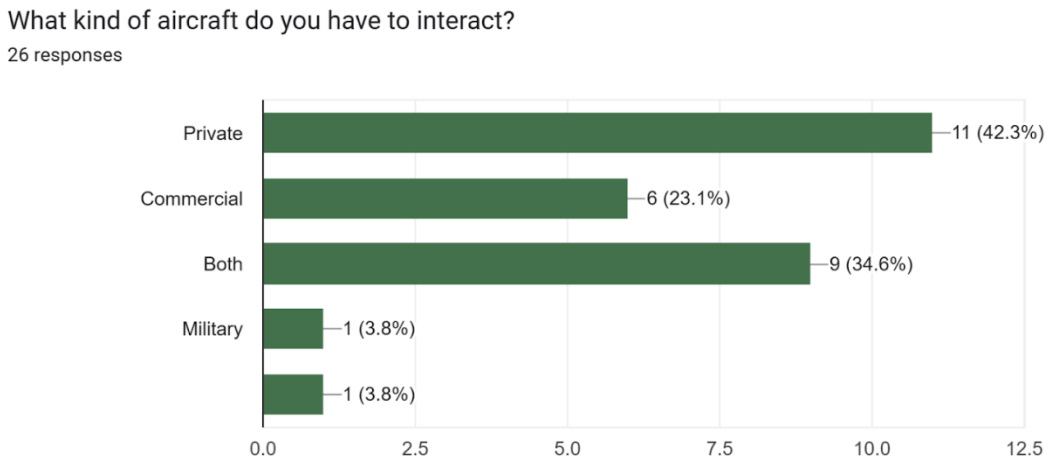

Figure 15 . "What kind of aircraft do you have to interact with?"

The survey question, "What kind of aircraft do you have to interact with?" aimed to identify the types of aircraft respondents encounter in their professional or personal aviation experiences. The responses, gathered from 26 participants, reveal a distribution across private, commercial, military, and dual (both private and commercial) categories. Notably, 42.3% of respondents reported interacting with private aircraft, making it the most prevalent category. This was followed by those engaging with both private and commercial aircraft at 34.6%, while 23.1% indicated interaction with commercial aircraft exclusively. Interaction with military aircraft was minimal, with only 3.8% of participants citing this category. These results underscore the diversity of aviation interactions among respondents while highlighting the predominance of private aviation in their engagements.

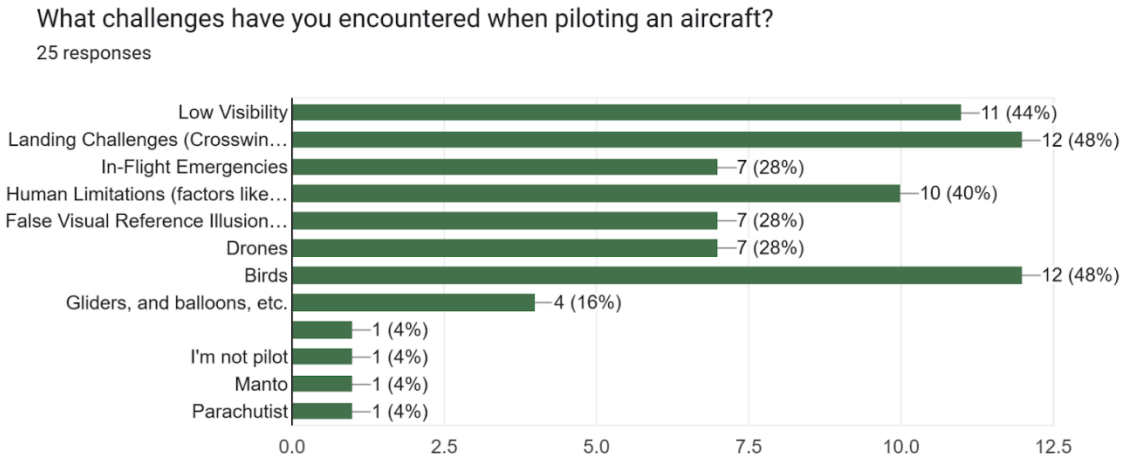

Figure 16 . "What challenges have you encountered when piloting an aircraft?"

The survey question, "What challenges have you encountered when piloting an aircraft?" sought to identify the range of difficulties experienced by respondents in aviation contexts. Among the 25 participants, the most commonly cited challenges were landing issues, such as crosswinds, and the presence of birds, with both categories accounting for 48% of responses. Low visibility was also a prominent concern, reported by 44% of participants. Other notable challenges included human limitations, such as fatigue or decision-making under stress, in-flight emergencies, and false visual reference illusions, each cited by 28% of respondents. Less frequently mentioned were interactions with drones (16%), as well as gliders, balloons, and parachutists, with each representing 4% of responses. Additionally, a small subset of participants (4%) indicated they are not pilots. These findings provide a comprehensive overview of the multifaceted challenges encountered in aviation, emphasizing the importance of addressing both environmental and human factors to enhance flight safety.

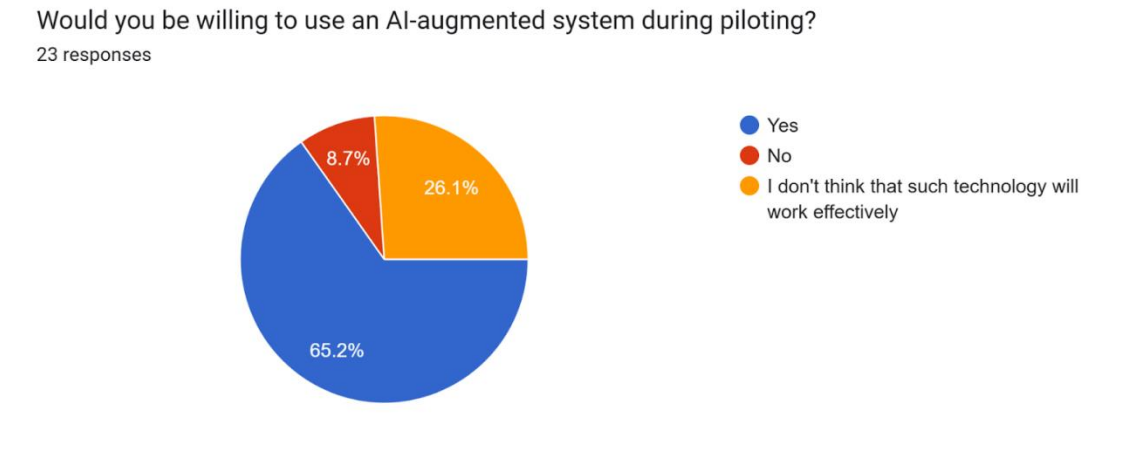

Figure 17. "Would you be willing to use an AI-augmented system during piloting?"

The survey question, "Would you be willing to use an AI-augmented system during piloting?" aimed to evaluate the openness of respondents toward integrating artificial intelli-

gence into aviation operations. Out of 23 participants, the blue section of the pie chart represents the majority (65.2%) who expressed a willingness to adopt AI-augmented systems, highlighting strong interest in leveraging advanced technology to enhance piloting capabilities. The orange section, accounting for 26.1% of responses, reflects participants who are skeptical about the effectiveness of such technology, indicating concerns about its reliability and practical application. Finally, the red section, comprising 8.7% of respondents, represents those who outright rejected the idea of using AI-augmented systems during piloting. These results underscore the significant potential for AI adoption in aviation, while also pointing to the need for addressing doubts and resistance among a smaller yet notable portion of respondents.

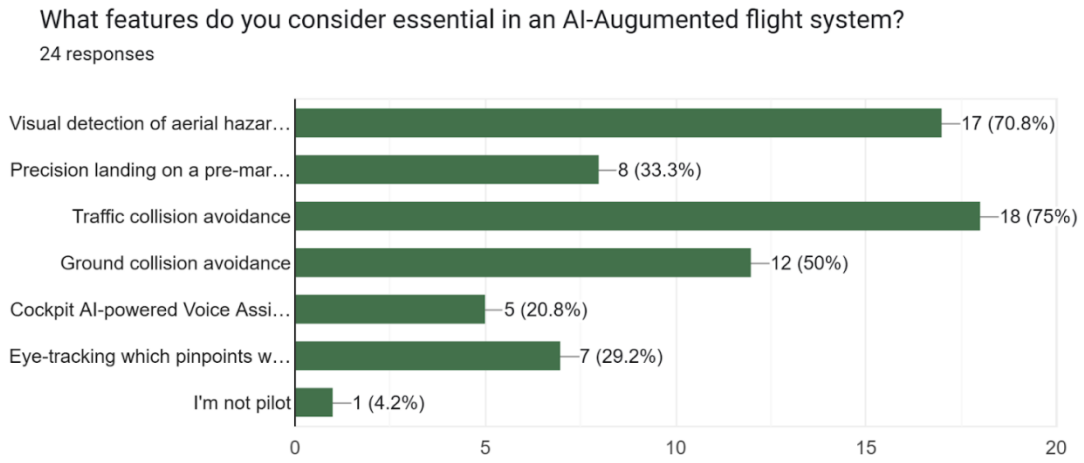

Figure 18. "What features do you consider essential in an AI-Augmented flight system?"

The survey question, "What features do you consider essential in an AI-Augmented flight system?" aims to identify critical components that professionals and users deem most important in the development of advanced AI-assisted aviation technology. This inquiry seeks to understand the priorities for safety, efficiency, and usability within such systems by offering options like visual detection of aerial hazards, precision landing on pre-marked areas, traffic collision avoidance, ground collision avoidance, cockpit AI-powered voice assistants, and eye-tracking for situational awareness. The results help gauge user preferences, emphasizing the perceived value of specific functionalities and guiding future innovations in aviation AI systems.

The survey investigates stakeholders' perspectives on critical functionalities within AI-augmented aviation systems, focusing on safety and operational capabilities. Among 24 respondents, the results demonstrate a strong emphasis on collision avoidance and hazard detection capabilities. Visual detection of aerial hazards emerged as a paramount feature, with 70.8% (17 respondents) identifying it as essential. Similarly, traffic collision avoidance systems garnered significant support from 75% (18 respondents) of participants, underscoring the aviation community's priority on maintaining safe separation between aircraft. Ground collision avoidance systems were deemed essential by 50% (12 respondents), while precision landing capabilities on pre-marked locations received support from 33.3% (8 respondents). The survey also explored human-machine interface elements, with eye-tracking technology and cockpit AI-powered voice assistance receiving moderate support at 29.2% (7 respondents) and 20.8% (5 respondents) respectively. Notably, a small fraction (4.2%, 1 respondent) indicated non-pilot status, suggesting the survey predominantly captured perspectives from aviation professionals.

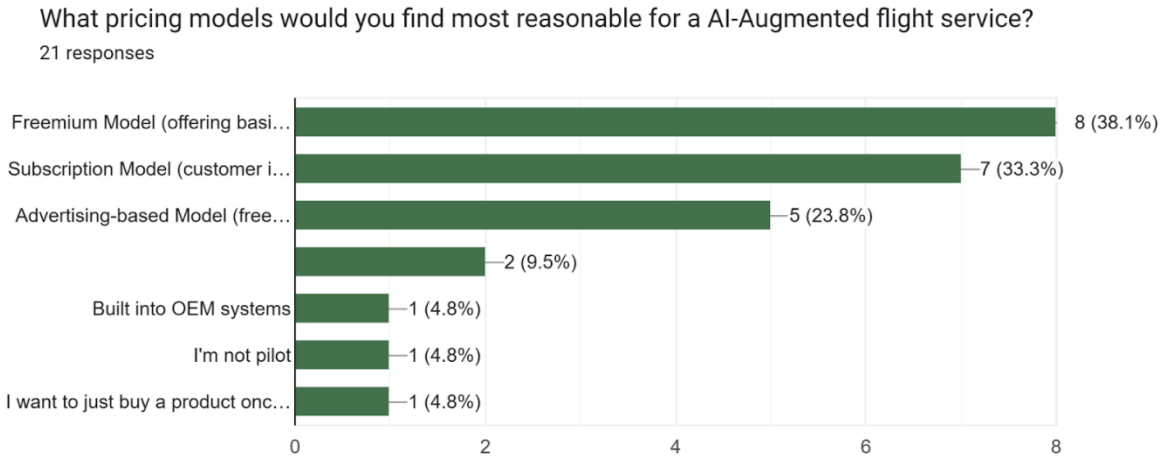

Figure 19. “What pricing models would you find most reasonable for a AI-Augmented flight service?”

The survey examines stakeholder preferences regarding pricing strategies for AI-Augmented flight services, gathering insights from 21 respondents. The findings reveal a preference hierarchy among different monetization approaches, with the Freemium Model garnering the highest support at 38.1% (8 respondents), followed closely by the Subscription Model at 33.3% (7 respondents). An Advertising-based Model attracted moderate interest at 23.8% (5 respondents). Minor segments of respondents indicated preferences for OEM system integration (4.8%), one-time purchase options (4.8%), or identified as non-pilots (4.8%). These results suggest a market inclination toward tiered pricing structures that offer basic functionalities with premium feature upgrades, while maintaining flexibility in payment models.

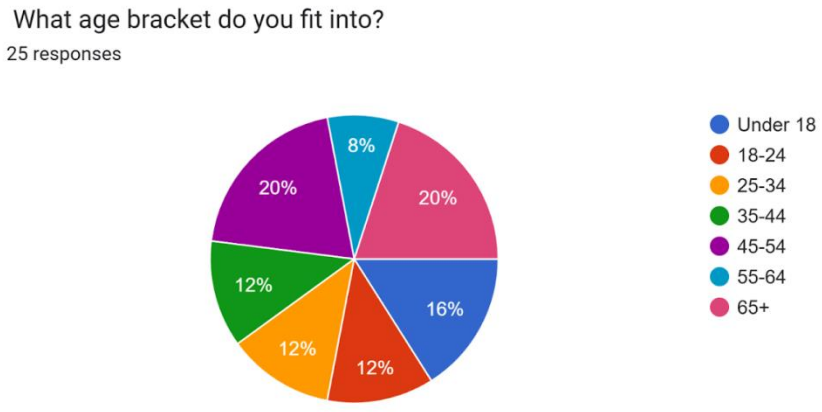

Figure 20. “”What age bracket do you fit into?”

The demographic analysis of survey participants, represented through a color-coded pie chart, reveals a diverse age distribution across 25 respondents. The data shows equal representation (20%) in both the eldest age bracket (65+, depicted in pink) and the 45-54 age group (shown in magenta). The youngest participants, under 18 (illustrated in navy

blue), comprised 16% of respondents. Three age groups - 18-24 (orange), 25-34 (yellow), and 35-44 (green) - each represented 12% of the sample population. The 55-64 age bracket (shown in light blue) accounted for 8% of participants. This relatively uniform distribution across age brackets suggests a balanced representation of perspectives across generational cohorts in the aviation community.

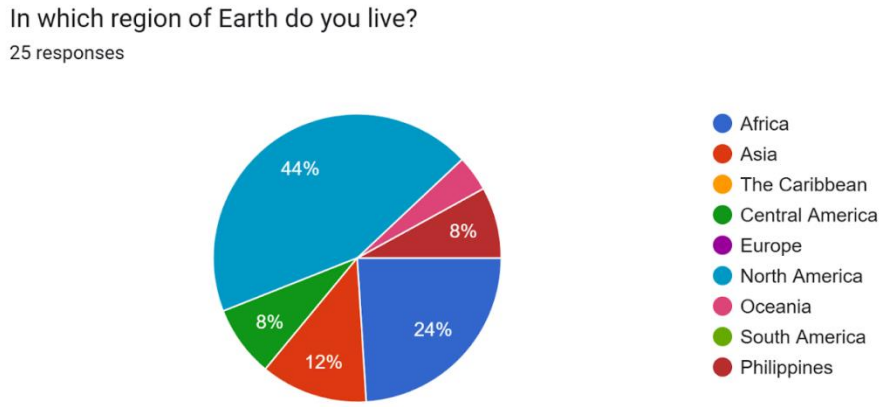

Figure 21.“In which region of Earth do you live?”

The geographical distribution of survey participants (n=25) demonstrates a significant concentration in North America (turquoise, 44%), followed by Africa (navy blue, 24%). Asia (red) represented 12% of respondents, while South America (green) and Europe accounted for 8% each. The Philippines (pink) independently constituted 8% of participants, notably distinguished from the broader Asian category. Interestingly, despite the survey's global reach, there were no respondents from The Caribbean, Central America, or Oceania, suggesting potential opportunities for expanding representation in these regions in future surveys. This distribution pattern reflects a predominantly North American and African perspective in the dataset.

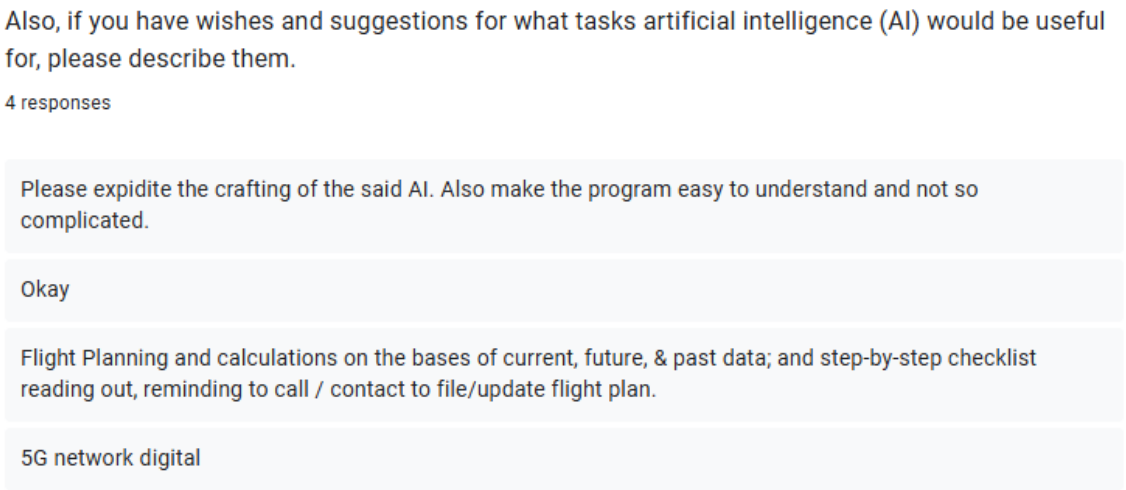

Figure 22. “Also, if you have wishes and suggestions for what tasks artificial intelligence (AI) would be useful for, please describe them”

The open-ended survey question solicited respondents' suggestions regarding potential applications of artificial intelligence in aviation, garnering four distinct responses. The feedback emphasized several key themes: program accessibility and user interface sim-

plification, comprehensive flight planning capabilities integrating temporal data analysis, and advanced network connectivity. Notable among the responses was a detailed suggestion for AI implementation in flight planning systems, specifically requesting functionality for calculations based on historical, current, and predictive data, coupled with automated checklist management and flight plan update notifications. Additionally, one respondent highlighted the potential integration with 5G digital networks, while another emphasized the importance of maintaining simplicity in program design. These responses reflect a desire for practical, user-friendly AI implementations that enhance operational efficiency while remaining accessible to users.

11 Interpreting data from survey

Based on the comprehensive survey data, here are three key interpretative paragraphs analyzing the results:

Survey participants exhibited strong interest in AI-augmented aviation systems, with 65.2% expressing willingness to adopt such technology. This positive reception aligns with the identified challenges in aviation, particularly regarding landing issues (48%), bird encounters (48%), and low visibility conditions (44%). The correlation between reported challenges and desired AI features is evident, as the most highly valued AI capabilities directly address these concerns: traffic collision avoidance (75%) and visual detection of aerial hazards (70.8%).

The demographic composition of respondents reveals a balanced age distribution with notable representation from both experienced aviators (20% in 65+ category) and younger professionals, suggesting cross-generational acceptance of AI technology in aviation. The geographical distribution, while skewed toward North America (44%) and Africa (24%), provides diverse perspectives on AI implementation needs across different aviation environments and regulatory frameworks. This geographical diversity strengthens the validity of the consensus on preferred features and pricing models.

The survey indicates a clear preference for accessible pricing models, with the Freemium (38.1%) and Subscription (33.3%) approaches dominating respondent preferences. This aligns with the qualitative feedback emphasizing the need for user-friendly implementations and suggests a market ready for tiered service offerings. The strong support for safety-critical features, combined with the preference for flexible pricing structures, indicates a market that values both innovation and accessibility in AI-augmented aviation systems.

The professional background of respondents, primarily drawn from aviation-specific Facebook groups including aircraft sales, maintenance technicians, and low-time pilot communities, lends credibility to the findings. The interaction patterns revealed that 42.3% of respondents work with private aircrafts, while 34.6% engage with both private and commercial aircrafts, suggesting that AI implementation strategies should prioritize flexibility across different aviation sectors. This professional diversity, combined with the emphasis on user-friendly interfaces and comprehensive flight planning capabilities in the open-ended responses, underscores the importance of developing versatile AI solutions that can adapt to various operational contexts while maintaining simplicity in design and implementation.

12 Results, reliability and validity of the research

Research Questions and Answers:

1. **How can computer vision technologies create business value in detecting non-cooperative airborne objects in general aviation?**

Computer vision technologies contribute significantly to business value by addressing critical safety and operational needs in general aviation. These systems utilize advanced AI algorithms to detect, classify, and track non-cooperative airborne objects, such as drones, birds, and gliders, in real time (Redmon & Farhadi, 2018; Dosovitskiy et al., 2021). By improving situational awareness, they enhance flight safety and reduce the likelihood of mid-air collisions, a major concern in uncontrolled airspace. This capability aligns with increasing regulatory demands for enhanced safety solutions, offering businesses a competitive edge in meeting these standards (Clifford, 2023; ICAO, 2023).

Furthermore, integrating computer vision into situational awareness systems provides cost efficiencies by reducing reliance on traditional detection systems such as radar, which are more expensive and less adaptable to small aircraft (Shi et al., 2016). This approach appeals to budget-conscious general aviation operators while ensuring scalability for larger market segments. Additionally, the technology enables the development of predictive analytics for collision avoidance, delivering a proactive safety solution that sets products apart in a competitive market. Enhanced safety and efficiency directly translate into financial savings, operational reliability, and customer trust, thereby strengthening the business case for computer vision-based innovations in the aviation sector (Kotler & Armstrong, 2017; Frost & Sullivan, 2023).

2. **What are the challenges in developing AI-driven collision prediction systems, and how can they stand out in performance and reliability?**

Developing AI-driven collision prediction systems presents multiple challenges, primarily related to technological, regulatory, and operational factors. From a technical perspective, ensuring the system's precision and reliability across various weather and operational environments—such as low visibility, adverse weather, or high traffic density—is a complex task. Robust training datasets, representing varied scenarios, are essential but often difficult to obtain in sufficient volume and diversity (Krizhevsky et al., 2017; Creswell, 2014).

Regulatory compliance poses another significant hurdle. Regulatory bodies in aviation, including the Federal Aviation Administration (FAA) and European Union Aviation Safety Agency (EASA), enforce strict criteria and requerements for safety-critical systems, requiring extensive testing and certification processes that can extend development timelines and increase costs (FAA, 2023; PwC, 2022). Moreover, achieving seamless integration with existing cockpit systems without disrupting pilot workflows remains a critical technical and ergonomic challenge (EASA, 2023).

To stand out, systems must prioritize accuracy and robustness in detecting and predicting the trajectory of airborne objects. Leveraging advanced AI models optimized for real-time processing, coupled with edge computing platforms such as NVIDIA Jetson modules, can enhance performance and reduce latency (NVIDIA, 2023; Shi et al., 2016). Reliability can be bolstered through redundancy, incorporating data from multiple sensors or cameras. User-centric design, focusing on intuitive interfaces and seamless integration, can further differentiate these systems by ensuring ease of adoption and operational efficiency (McKinsey & Company, 2022; Patton, 2002).

3. How can market demand for AI-based situational awareness systems in general aviation be assessed and stimulated?

Market demand for AI-based situational awareness systems can be assessed through a blend of both qualitative and quantitative research methods. Surveys and interviews with pilots, flight schools, and general aviation stakeholders provide direct insights into customer needs, preferences, and perceived value. Analyzing secondary data, such as industry reports, regulatory trends, and accident statistics, can contextualize these findings and identify broader market drivers (ICAO, 2023; Market Research Future, 2023).

To stimulate demand, companies must emphasize the value proposition of enhanced safety, regulatory compliance, and operational efficiency. Educational campaigns that demonstrate the effectiveness of AI-based systems through real-world case studies or flight simulations can build trust and awareness among potential customers (General Aviation News, 2022; Deloitte Insights, 2021). Strategic partnerships with aviation authorities, manufacturers, and pilot organizations can further legitimize the technology and expand its reach (PwC, 2022).

Additionally, offering flexible pricing models, such as subscription-based plans or modular installations, can lower barriers to adoption, especially for smaller operators. Participation in industry events, coupled with targeted digital marketing efforts, ensures visibility within key market segments. By aligning product development with market needs and regulatory trends, businesses can effectively position their solutions as indispensable tools for improving safety in general aviation (Kotler & Keller, 2020; Frost & Sullivan, 2023).

13 Limitations

This study, while offering valuable insights into the potential of AI-based situational awareness systems for general aviation, is subject to several limitations that may influence the generalizability and comprehensiveness of its findings. Empirical research often encounters constraints related to sample representation, technical scope, regulatory complexities, and market dynamics, each of which is addressed here (Creswell, 2014; Bryman, 2016).

First, the research relies heavily on survey responses from a limited number of participants (27 in total) who were primarily reached through Facebook groups related to aviation. This sample may not fully represent the diversity of stakeholders in general aviation, including those from different geographic regions, economic backgrounds, or levels of aviation experience. Consequently, the insights gathered may reflect a skewed perspective, emphasizing the views of active social media users within the aviation community (Cint, 2022; Saunders et al., 2019). To improve representativeness, future studies could employ stratified random sampling or target participants through broader outreach channels, such as professional aviation organizations and conferences.

Second, the study's technical scope is constrained by resource limitations. The development and testing of the computer vision-based system were conducted on a prototype scale using commercially available components, such as the NVIDIA Jetson module and a single camera setup. While these components demonstrate the feasibility of the concept, they may not fully account for the operational complexities encountered in real-world aviation environments, such as extreme weather conditions, high-speed object tracking, or integration with existing avionics systems (Clifford, 2023; Shi et al., 2016). Robust testing under diverse conditions and incorporating multi-sensor setups, such as radar and LiDAR, could address these technical gaps and enhance system reliability (Zhou et al., 2021).

Third, regulatory considerations represent a significant limitation. The study assumes compliance with current aviation safety standards; however, the certification process for AI-driven systems in aviation is rigorous and varies across jurisdictions. The research does not encompass a detailed analysis of the costs, timelines, or specific technical requirements associated with obtaining regulatory approvals, which could substantially impact the system's deployment and market readiness (FAA, 2023; EASA, 2023). Future studies should engage with regulatory authorities early in the development cycle to better understand and incorporate certification requirements (PwC, 2022).

Additionally, the study is focused on non-cooperative object detection, leaving out other potential system enhancements, such as cooperative systems like ADS-B or radar integration. This decision narrows the study's scope but excludes potentially complementary technologies that could improve system performance and reliability (ICAO, 2023; Frost & Sullivan, 2023). Integrating cooperative and non-cooperative systems in future research could lead to a more comprehensive situational awareness solution for general aviation.

Finally, market analysis in this research is based on publicly available data and secondary sources, which may not completely reflect emerging trends and competitive dynamics in the rapidly evolving field of AI and aviation safety. Limitations in data availability, particularly concerning competitors' proprietary technologies and financial models, further constrain the depth of competitive analysis (McKinsey & Company, 2022; Market Research Future, 2023). Conducting primary market research and leveraging industry partnerships could address these gaps and provide more accurate insights.

Recognizing these limitations, future research should address these gaps by expanding the participant pool, incorporating more comprehensive technical and regulatory evaluations, and exploring the integration of additional technologies. Such efforts will strengthen the findings and provide a more robust foundation for the practical application and commercialization of AI-based situational awareness systems in general aviation (Patton, 2002; Creswell & Poth, 2017)..

14 Suggestions

A vision for future business expansion in the AI-driven situational awareness market for general aviation necessitates a structured approach that encompasses technological advancement, organizational growth, and strategic market engagement. The focus of growth must center on enhancing the core AI capabilities of the situational awareness platform. This includes integrating advanced features such as real-time weather pattern recognition and terrain awareness, alongside seamless compatibility with existing avionics systems. These advancements demand significant expenditures in research and development and adherence to rigorous safety testing standards to meet the stringent requirements of the aviation sector (Clifford, 2023).

Organizationally, the business must transition into a fully-fledged aviation technology company. This involves formal registration as an aviation enterprise, enabling collaborations with aircraft manufacturers and technology providers. Establishing dedicated facilities for software development, rigorous testing, and client interactions is paramount to fostering innovation and credibility. A physical presence serves as a critical asset in demonstrating technical capabilities and engaging directly with stakeholders, such as pilots and flight schools, to address their operational needs effectively (McKinsey & Company, 2022).

Market penetration should begin with private pilots and small flight schools, whose feedback will inform iterative improvements to the product. This niche approach facilitates a focus on quality service and user-specific refinements. As the solution matures and gains traction, expansion can target larger entities such as regional airlines and advanced flight training organizations. This phased strategy enables sustainable scaling while preserving the integrity and reliability of the solution (Kotler & Armstrong, 2017).

Strategic partnerships with avionics manufacturers, flight schools, and aviation safety organizations are vital to fostering integration and market acceptance. Such collaborations enhance the product’s functionality and broaden its appeal across diverse market segments. Building these partnerships aligns with the overarching goal of improving aviation safety through AI-driven technologies, establishing the company as a leader in innovation within the general aviation industry (PwC, 2022).

This cohesive strategy ensures alignment between technological growth, operational evolution, and market development, supporting the company’s mission to elevate safety standards in aviation while achieving sustainable business growth (Creswell, 2014).

15 Financial Estimations

This section examines the financial estimation of revenue and operational costs for the situational awareness system, designed for the general aviation market, during the first year of operations. The analysis integrates key variables such as pricing, unit sales, and resulting revenue while considering associated operational costs and marketing strategies to provide a comprehensive financial outlook.

To justify the business potential of PilotX, a detailed financial estimation was created. The pricing strategy for the first year is straightforward, offering a single purchasing option for customers. The system's price per unit is set at $4,500, reflecting a balance between market competitiveness and cost recovery (Kotler & Armstrong, 2017; Osterwalder & Pigneur, 2010). Monthly unit sales projections incorporate a consistent growth rate of approximately 10% in user adoption, translating to steady increases in market penetration. Revenue estimates, calculated as the product of the price per unit and the number of units sold, range from $3,735 in Month 1 (0.83 units sold) to $10,530 in Month 12 (2.34 units sold), with a total first-year revenue of $79,605.

Operational costs were carefully considered, with particular attention to employee salaries and contractor expenses. The staffing plan for PilotX reflects the activities necessary to develop and operate the platform. Continuous development of the software and hardware components, particularly the collision prediction algorithms, requires a technical team of three: a Full Stack Developer, an ML Engineer, and a Data Scientist. Their roles were determined based on analogies drawn from previous software engineering projects, leveraging the experience of one of the authors (McKinsey & Company, 2022; Deloitte Insights, 2021).

For marketing activities, four employees will be engaged to ensure effective customer outreach and adoption. The marketing strategy combines traditional and digital approaches, including social media marketing, website optimization to attract visitors, video advertisements, and targeted campaigns through Facebook Marketing and Google AdWords. These efforts aim to drive awareness, generate leads, and convert potential customers into users (Chaffey, 2017; General Aviation News, 2022). Furthermore, part-time contractors will be hired for tasks related to graphic design and accounting, ensuring cost-effective access to specialized skills (PwC, 2022).

A key focus was placed on visual identity and branding to enhance PilotX’s market presence. This involves further developing the existing visual identity while strengthening branding and public relations (PR) efforts. These efforts match the overarching goal of establishing a unified, identifiable brand that connects with the intended market (Kotler & Keller, 2020; Patel, 2022).

The revenue model demonstrates the scalability and economic viability of the situational awareness system within its target market. Steady growth in unit sales reflects the potential for sustained market adoption, supported by effective customer engagement and comprehensive marketing strategies (Healy, 2021; Market Research Future, 2023). By aligning these revenue projections with a detailed cost analysis, PilotX establishes a robust foundation for financial sustainability and strategic planning.

The financial estimation for PilotX's first year highlights its potential for success within the general aviation market. By combining competitive pricing, gradual market adoption, and an efficient operational cost structure with an integrated branding and marketing approach, the outlook is promising. Future financial projections should consider customer

retention, potential price adjustments, and expansion opportunities to refine this model further (Osterwalder et al., 2014; Bryman, 2016).

Based on these estimations, the size of the market, and the capabilities of the team the author made a realistic 1 year budget that could be seen below, complete budget is available in the Appendix section). In short, PilotX would need approximately $91,500 in startup capital to cover the first year of operations, considering all essential costs for product development, marketing, and employee salaries, and in working capital that will cover the company's highest burning rate for the first year.

Revenue														
		January	February	March	April	May	June	July	August	September	October	November	December	YEAR 1
	Unit	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	
KEY INDICATORS														
Growth Rate			5%	8%	10%	12%	15%	18%	20%	15%	12%	10%	8%	5%	
Key Driver 1 (i.e. Users, Number of private aircraft owner		10	11	12	13	14	16	17	18	20	22	24	26	31.4 users
Key Driver 2 The number of systems sold per month		0.83	0.92	1.00	1.08	1.17	1.25	1.42	1.50	1.67	1.83	2.00	2.17	17.7 systems
Key Driver 3 (Customer Acquisition Cost (CAC))		500	490	480	471	461	452	443	434	425	417	409	400	$5,382
Key Driver 4 Customer acquisition rate (e.g., monthly grc		10.00	1.00	1.10	1.20	1.30	1.43	1.58	1.73	1.90	2.10	2.30	2.60	21.4 new users
Key Driver 5 Pricing per unit/system		4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	$4,500
Key Driver 6 (Revenue Per Unit (RPU))		4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	$4,500
REVENUE														
Revenue Source 1														
Price per Unit	$	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Number of units sold		0.83	0.92	1.00	1.08	1.17	1.25	1.42	1.50	1.67	1.83	2.00	2.17	17.7 systems
Sub-Total	$	3,735	3,960	4,140	4,320	4,545	4,770	5,040	5,265	5,535	5,805	6,120	6,435	
TOTAL (Sum of Sub-totals)	USD													$79,605
EXPENSES														
TOTAL	USD	0	0	0	0	0	0	0	0	0	0	0	0	
Headcount														
Product manager		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Machine Learning Engineer		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Full-Stuck Developer		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Electronics Engineer (Embeeded Systems)		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Data annotation Specialist		300	300	300	300	300	300	300	300	300	300	300	300	3,600
Marketing (per month)_Part time		$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$2,250
Sales person_Part time		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Design_Part time		250	250	250	250	250	250	250	250	250	250	250	250	3,000
Accountant_Part time		300	300	300	300	300	300	300	300	300	300	300	300	3,600
Operating Expenses														
Legal (per month)					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Hosting (per month)		$0	$0	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,350
Rent (per month)		$0	$0	$0	$500	$500	$500	$500	$500	$500	$500	$500	$500	$4,500
Travel (per month)		$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,800
Miscellaneous (per month)		$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000

Table 5. Financial Estimation of Revenue, Operational Costs, Unit Sales and Pricing Analysis.

16 Conclusions

The purpose of this research was to develop a comprehensive commercial strategy and roadmap for a technology startup which is focused on enhancing situational awareness for general aviation pilots through implementing artificial intelligence solutions. The entrepreneurial roadmap provides a structured framework for establishing and scaling this innovative aviation safety venture.

The research methodology involved a mixed-methods research approach, unifying qualitative and quantitative data from both primary and secondary sources. This included interviews with aviation professionals, pilot surveys, and analysis of existing safety data and market research. The study acknowledged certain limitations, including data accessibility constraints, technological assumptions, and the dynamic nature of both the aviation and artificial intelligence markets.

Survey results revealed substantial interest in advanced situational awareness technologies among general aviation pilots. Key market segments include private pilots, flight schools, and small aircraft operators. This diverse customer base presents opportunities for developing tailored solutions that address specific operational needs. The research highlighted the importance of establishing credibility within the aviation community through both digital presence and industry networking. A professional website showcasing the technology's capabilities, combined with targeted presence at aviation events and forums, will be crucial for market penetration.

The findings emphasize the need for strategic partnerships with aircraft manufacturers, avionics providers, and aviation safety organizations. These relationships will be instrumental in product development, certification processes, and market expansion. The survey data provides valuable insights for positioning the AI-based situational awareness solution in the general aviation market. Success will depend on addressing specific safety challenges faced by pilots, delivering demonstrable value through enhanced awareness capabilities, and effectively utilizing both aviation-specific and broader technology channels for market reach.

In conclusion, this thesis establishes a foundation for launching an innovative aviation safety technology startup. It provides critical insights into market dynamics and pilot needs while offering a structured business plan that can evolve with technological advances and market conditions. Through careful execution and adaptability to aviation industry requirements, this venture aims to enhance safety in general aviation through advanced AI-driven situational awareness solutions.

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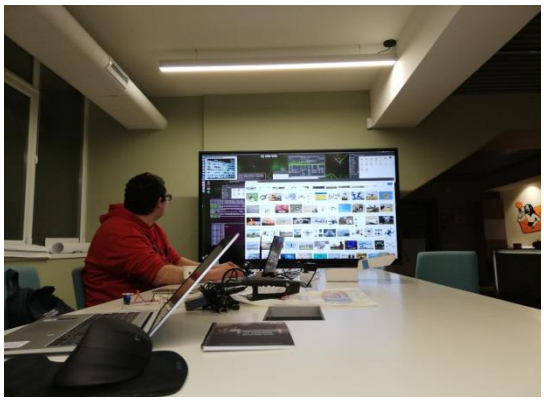
APPENDICES

Appendix 1. Interview questions

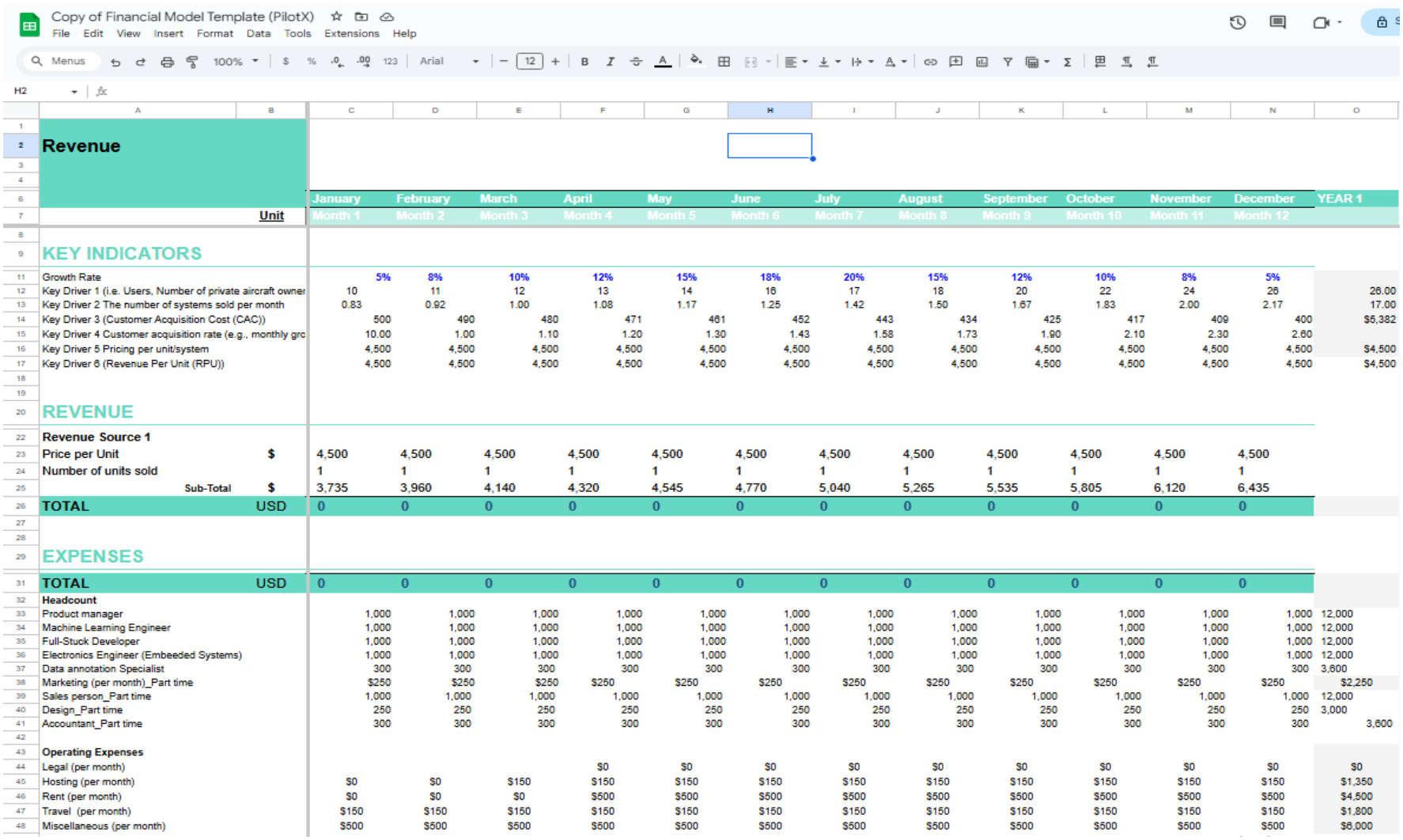
1. What kind of aircraft do you have to interact?
2. What challenges have you encountered when piloting an aircraft?
3. Would you be willing to use an **AI-augmented** system during piloting?
4. What features do you consider essential in an AI-Augumented flight system?
5. What pricing models would you find most reasonable for a AI-Augmented flight service?
6. What age bracket do you fit into?
7. In which region of Earth do you live?
8. If you are interested in the topic of **AI-augmented flight**, please leave your email for communication.
9. Also, if you have wishes and suggestions for what tasks artificial intelligence (AI) would be useful for, please describe them.

Link to the survey: https://docs.google.com/forms/d/1PcwDhKKU94xFPH-KxULKgRtzvysldYr1stspqREHwXM/edit

Appendix 2. Photos of the product development and presentation



Appendix 3. Financial Estimations



Copy of Financial Model Template (PilotX)

File Edit View Insert Format Data Tools Extensions Help

Revenue

	Unit	January Month 1	February Month 2	March Month 3	April Month 4	May Month 5	June Month 6	July Month 7	August Month 8	September Month 9	October Month 10	November Month 11	December Month 12	YEAR 1
KEY INDICATORS														
Growth Rate		5%	8%	10%	12%	15%	18%	20%	15%	12%	10%	8%	5%	
Key Driver 1 (i.e. Users, Number of private aircraft owner		10	11	12	13	14	16	17	18	20	22	24	26	26.00
Key Driver 2 The number of systems sold per month		0.83	0.92	1.00	1.08	1.17	1.25	1.42	1.50	1.67	1.83	2.00	2.17	17.00
Key Driver 3 (Customer Acquisition Cost (CAC))		500	490	480	471	461	452	443	434	425	417	409	400	$5,382
Key Driver 4 Customer acquisition rate (e.g., monthly gro		10.00	1.00	1.10	1.20	1.30	1.43	1.58	1.73	1.90	2.10	2.30	2.60	
Key Driver 5 Pricing per unit/system		4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	$4,500
Key Driver 6 (Revenue Per Unit (RPU))		4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	$4,500
REVENUE														
Revenue Source 1														
Price per Unit	$	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	
Number of units sold		1	1	1	1	1	1	1	1	1	1	1	1	
Sub-Total	$	3,735	3,960	4,140	4,320	4,545	4,770	5,040	5,265	5,535	5,805	6,120	6,435	
TOTAL	USD	0	0	0	0	0	0	0	0	0	0	0	0	
EXPENSES														
TOTAL	USD	0	0	0	0	0	0	0	0	0	0	0	0	
Headcount														
Product manager		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Machine Learning Engineer		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Full-Stuck Developer		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Electronics Engineer (Embeeded Systems)		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Data annotation Specialist		300	300	300	300	300	300	300	300	300	300	300	300	3,600
Marketing (per month)_Part time		$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$2,250
Sales person_Part time		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Design_Part time		250	250	250	250	250	250	250	250	250	250	250	250	3,000
Accountant_Part time		300	300	300	300	300	300	300	300	300	300	300	300	3,600
Operating Expenses														
Legal (per month)					$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Hosting (per month)		$0	$0	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,350
Rent (per month)		$0	$0	$0	$500	$500	$500	$500	$500	$500	$500	$500	$500	$4,500
Travel (per month)		$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,800
Miscellaneous (per month)		$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000