DEVELOPMENT AND EVALUATION OF AN ELECTRONIC LOGBOOK SYSTEM FOR LIGHT AIRCRAFT OPERATIONS

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Abstract. This paper presents the development and implementation of an electronic logbook system tailored for light category aircraft. The aim of the project was to replace traditional paper-based recordkeeping with a digital solution that enhances operational efficiency, safety and compliance with aviation documentation requirements. The proposed system allows pilots and aircraft operators to manage flight hours, maintenance tasks, fuel consumption and document validity in a unified, web-based platform. Built using accessible web technologies (HTML, PHP, MySQL), the system offers a cost-effective and user-friendly alternative suitable for flying schools and small aircraft owners. The article discusses the benefits, technical structure, and limitations of the solution, supported by user testing. The results confirm that even small-scale operators can effectively adopt digital tools that align with modern aviation standards and support the ongoing process of digital transformation in general aviation.

Keywords: electronic logbook, general aviation, light aircraft, maintenance records, digitalisation, airworthiness

1. INTRODUCTION

Digital transformation is a key driver in increasing the efficiency and safety of operations in the aviation industry. With increasing demands on flight data accuracy, maintenance traceability, and operational transparency, the need for a reliable and comprehensive system for recording and managing aviation-related information is essential. Traditionally, aircraft flight and maintenance records have been kept in paper form. However, this method is often prone to errors, physical damage, data loss, and limited accessibility. The introduction of electronic logbooks (eTechLog) represents a significant step forward in this area. These digital tools allow pilots, aircraft operators, and maintenance personnel to manage, access, and store records more effectively. Real-time data input, automatic notifications, maintenance planning support, and cost analytics contribute to the safety and operational sustainability of general aviation and training operations [1]. The light aircraft segment, often operated by aero clubs, flying schools or private owners, lacks cost-effective digital solutions that meet their specific needs. Existing commercial solutions are often designed for large aircraft operators and are expensive or overly complex for small entities [2]. This article introduces the development and implementation of an electronic logbook for light category aircraft. The solution aims to provide an affordable and technically accessible system, designed in HTML, PHP, and MySQL, enabling users to manage flight, maintenance, and operational cost data efficiently [3]. The goal of the work is to create a functional prototype of an electronic logbook suitable for real operation, which contributes to increased digital integration, simplification of administrative activities, and supports decision-making in aircraft operation management.

2. METHODOLOGY OF SOLVING RESEARCH PROBLEM

The research team followed standard principles of applied software engineering and aviation operational analysis. Based on literature review, regulatory documents, observation, and consultations with instructors and aircraft operators, a web-based solution was developed that allows for effective recording and management of flight and maintenance data for aircraft operated in the light category [3].

The object of the research is a digital system used to manage aircraft operation records. The system was developed using basic web programming languages and deployed in a test environment for practical evaluation. During the development, multiple iterations were carried out, reflecting feedback from aviation personnel.

The following tools and technologies were used:

- HTML for structuring the user interface,
- PHP for server-side operations and logic,
- MySQL for data management and storage.

Additional libraries such as Tailwind CSS and JavaScript were used to improve visual clarity and responsiveness of the system [3]. For the purpose of analysis and evaluation, the system was tested with sample flight data and service intervals. The practical benefits were assessed by simulating real-life scenarios relevant to aircraft operators. The system was evaluated for compatibility, security, clarity, and response times on multiple devices. Feedback from real users – especially from the pilot community – was incorporated into final modifications [3].

In order to support the objectives of this work, the following working hypotheses were formulated and verified through the development and testing of the system:

- H1: The implementation of a digital logbook system will reduce the time required to enter, store and retrieve aircraft operational and maintenance records compared to traditional paper-based methods.
- H2: A basic electronic system developed using standard web technologies (HTML, PHP, MySQL) is sufficient to meet the documentation and monitoring needs of light aircraft operators in accordance with applicable aviation standards.
- H3: Users with basic digital literacy will be able to operate the proposed system without the need for specialised IT training or external technical support.

These hypotheses were tested through iterative software development and validation by selected users from a flight training environment. Their positive feedback and error-free interaction with the system confirmed the validity of the assumptions, especially in terms of usability and functionality.

3. RESULTS

The development and implementation of electronic logbooks in general aviation is part of the broader trend of digital transformation in the aviation industry. Digital tools, including electronic flight logs (eTechLog), maintenance planning software and aircraft document management systems, are already well-established in commercial air transport, but their application in the field of light aircraft operation remains limited [1]. Digitalisation in this context does not only refer to the transition from analog to digital data entry, but also involves the automation of workflows, better integration with airworthiness monitoring systems, and increased responsiveness to operational needs in real-time environments.

3.1. Electronic logbooks in aviation

An electronic logbook is a digital alternative to traditional paper-based logs, used to record flight hours, maintenance events, fuel consumption, aircraft documents, and other operational data. These systems are accessible via web or mobile platforms and often include features such as data backup, real-time synchronisation, and automatic notifications for inspections, expirations, or service intervals [2].

Many eLogbook systems also integrate with maintenance tracking or CAMO platforms, enabling seamless task scheduling and centralised oversight of aircraft status.

Benefits reported in multiple aviation sectors include reduced workload for administrative personnel, elimination of redundant paperwork, and improved visibility into historical performance trends. Moreover, the digital format facilitates quicker audits by aviation authorities and improved transparency for aircraft owners or fleet managers [6]. Integration with cloud storage allows secure long-term archiving, while simultaneously enabling real-time sharing of operational status with technicians or remote service providers. The use of electronic logbooks improves the transparency of records, minimises human error, and enables better long-term tracking of airworthiness status and operating costs. Additionally, the ability to generate statistical reports and export documents contributes to the overall efficiency of aviation management and compliance with EASA regulations [3].
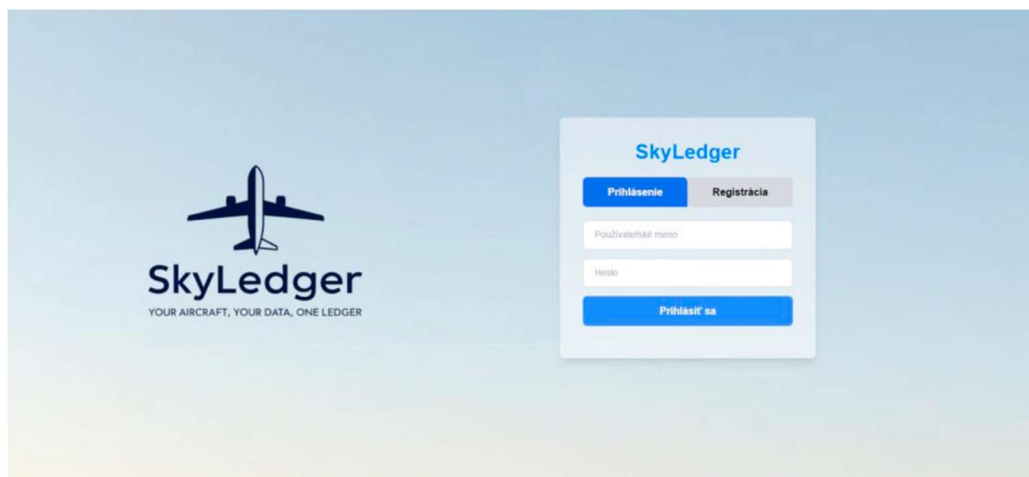

Figure 1 - Login interface of the SkyLedger system

Figure 1 shows a sample login form interface from the developed SkyLedger system, which represents the first point of access for users to view and manage operational records securely.

3.2. Regulatory framework and record-keeping

Under EASA regulations, every aircraft operator is obliged to maintain accurate, up-to-date, and traceable records related to airworthiness, maintenance tasks, and technical inspections. According to Part-M and Part-CAO, aircraft owners or operators must ensure that:

- all airworthiness tasks are completed in accordance with an approved maintenance program,
- records of component usage, flight time, and performed inspections are kept for a minimum specified duration,
- release to service statements and airworthiness review certificates (ARC) are up to date and properly filed [4].

Beyond EASA's baseline requirements, national authorities in some countries have begun to offer guidance or recognition to operators using electronic solutions, provided they include features such as audit trails, user authentication, and protection against unauthorised changes. Acceptable Means of Compliance (AMC) guidance documents describe technical safeguards and process conditions for digital record-keeping tools [5]. Electronic systems that comply with these requirements must ensure secure data handling, versioning, integrity of records, and access control. The European Union Aviation

Safety Agency (EASA) does not mandate the use of electronic systems but allows their implementation provided they meet legal and operational criteria [5].

Figure 2 - Document management interface – certificate validity tracking

As illustrated in Figure 2, a dedicated module of the SkyLedger platform manages document records and automatically monitors expiration dates, helping to ensure ongoing compliance.

3.3. Market status and limitations

While various digital MRO and CAMO platforms exist (such as RAMCO, AMOS, or CAMP), they are primarily designed for large aircraft operators and business aviation. Their cost and complexity make them less suitable for private operators or small flying clubs operating ultralight or light sport aircraft (LSA). In these sectors, users either rely on paper logs or attempt to adapt generic solutions like spreadsheets or commercial mobile apps [6].

Furthermore, many of the existing enterprise-grade systems require IT support teams for setup, integration, and maintenance, making them impractical for small operators with limited resources. There is also a usability gap, as complex systems are often not optimised for touchscreen use in cockpit conditions, nor are they localised for regional needs, currencies, or documentation formats. There is a growing need for affordable, lightweight, and customisable solutions that address the specifics of light aircraft operations, including:

- simple user interface adapted to non-technical users,
- basic but complete functionality (flight log, maintenance record, document upload),
- low operating costs,
- availability on mobile and desktop devices.

Some community-driven or open-source initiatives have attempted to fill this gap, but they often suffer from poor support, lack of documentation, or outdated design. SkyLedger, by contrast, is developed specifically to serve general aviation needs, and incorporates user feedback to improve clarity, workflow structure, and alert logic.

Figure 3 - SkyLedger dashboard – cost breakdown

Figure 4 - SkyLedger dashboard –statistical overview

As shown in Figure 3,4, the cost tracking dashboard presents a graphical overview of fuel and maintenance expenses, giving operators a comprehensive view of financial data per flight hour. In line with trends described by ICAO [6] and GAMA [8], the demand for digitally supported operational tools continues to increase. Furthermore, European Commission guidelines [7] emphasize the role of lightweight and modular digital platforms in improving regulatory compliance and operational sustainability, particularly in the general aviation sector.

Figure 3 - Example of automated email notification sent by SkyLedger system

One of the practical features already implemented in the SkyLedger system is the automated email notification module (see Figure 5). This function sends alerts to registered users regarding upcoming document expirations, scheduled maintenance intervals, and important deadlines. Notifications are configured based on flight hour thresholds or calendar dates and are automatically dispatched to ensure timely compliance. This reduces the risk of overlooked inspections and contributes to maintaining continuous airworthiness. Recent industry reports suggest that the next wave of innovation will come from AI-enhanced data analytics and automated service scheduling, based on predictive modelling of component wear and failure patterns [8]. Although such features are beyond the scope of SkyLedger's

current version, the foundation laid by implementing structured digital logging is essential to adopting these future capabilities. The SkyLedger project aims to fill this gap by offering an open, modular and cost-effective solution developed with commonly available technologies and focused on the needs of general aviation stakeholders [2].

4. DISCUSSION

The developed electronic logbook system (SkyLedger) presents a practical digital solution for aircraft operators in the light category. During the evaluation process, several advantages and limitations were identified, which are relevant when considering the broader implementation of such systems in general aviation. One of the key benefits observed was the simplification of flight and maintenance record-keeping. The system allows pilots to enter and review flight hours, fuel usage, maintenance events, and document validity in a unified interface. The availability of data in a centralised web environment improves accessibility and reduces the time required for administrative tasks. This aspect was particularly valued by flying instructors who operate multiple aircraft across different bases [1]. Automatic notifications and document monitoring proved to be an effective feature, helping users avoid the expiration of important airworthiness certificates or maintenance intervals. The system calculates service times based on flight hour accumulation and alerts the operator when thresholds are approaching, thus enhancing operational safety [2]. Compared to commercial MRO and CAMO platforms, which often involve licensing fees and technical complexity, the solution is financially accessible. The total annual cost of domain and hosting does not exceed 20 EUR, making it suitable for flying clubs and private aircraft owners with limited budgets. Moreover, the use of open technologies (HTML, PHP, MySQL) ensures long-term sustainability and independence from proprietary vendors [2] Although EASA does not prescribe the mandatory use of digital systems, it requires operators to ensure that records are accurate, verifiable and retrievable. The proposed system was designed to align with these expectations by including secure login procedures, role-based access, and structured data storage [3]. However, legal validation of digital records and integration with national aviation authorities remain open issues. For full regulatory acceptance, a certification process or approval as an "acceptable means of compliance" may be required in the future [4].

Despite its strengths, the system is not without limitations. One of the main concerns is the need for continuous internet access, which may not always be available at remote airfields. Offline functionality and data synchronisation mechanisms would enhance robustness in such cases. Another limitation is data input dependency on the user. The quality and accuracy of the logbook still depend on pilots or technicians correctly entering the data. Automated data capture (e.g. from onboard instruments) or integration with ADS-B systems could further improve reliability and reduce human error [5]. Test users highlighted the intuitive interface and clarity of the dashboard as positive elements. Flight schools appreciated the possibility of tracking total aircraft hours and calculating costs per flight hour. Some users suggested adding a mobile app version or offline-capable progressive web app (PWA) to improve flexibility. The integration of graphical overviews (e.g. cost breakdowns, flight time per aircraft) received favourable reactions and contributed to a better understanding of long-term operating trends [2].

5. CONCLUSION

The implementation of an electronic logbook system for light category aircraft represents a relevant and practical step in the ongoing digital transformation of aviation. While commercial and business aviation sectors have long adopted electronic maintenance record systems, general aviation still heavily relies on traditional, paper-based methods. The solution developed in this project demonstrates that modern digital tools can be effectively introduced even in low-budget, small-scale operations, such as flying schools or private aircraft ownership. The system offers several key advantages such as simplified

access to flight and maintenance records, automatic monitoring of document expiration and service intervals, cost tracking per flight hour, and the ability to generate graphical overviews of operational data. These features contribute not only to increased safety and organisational efficiency but also provide the. operator with a clearer picture of aircraft utilisation and costs, which is crucial for planning and optimisation.

Based on the development process and user validation, the three working hypotheses stated in the methodology were confirmed:

- **H1** was confirmed through observed reductions in time spent managing operational records and improvements in data accessibility.
- **H2** was supported by the successful use of standard web technologies to meet documentation needs without reliance on proprietary platforms.
- **H3** was validated by the ability of non-technical users (e.g., flight instructors, aircraft owners) to operate the system without IT support or additional training.

Despite some technical limitations, such as internet dependency and manual data entry, the benefits observed during testing indicate that the system is highly usable and fills a gap in the digital solutions market for general aviation. Its open technological foundation offers flexibility for future development, including mobile access, offline functionality, or integration with other aviation software platforms. In conclusion, the proposed electronic logbook provides a low-cost, effective, and user-friendly alternative to traditional logbooks. Its continued improvement, informed by user feedback and aligned with airworthiness regulations, may serve as a model for broader adoption across general aviation operations.

6. LITERATURE LIST

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